MISSOURI SHAMROCK

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WELCOME ISSUE

October 1953

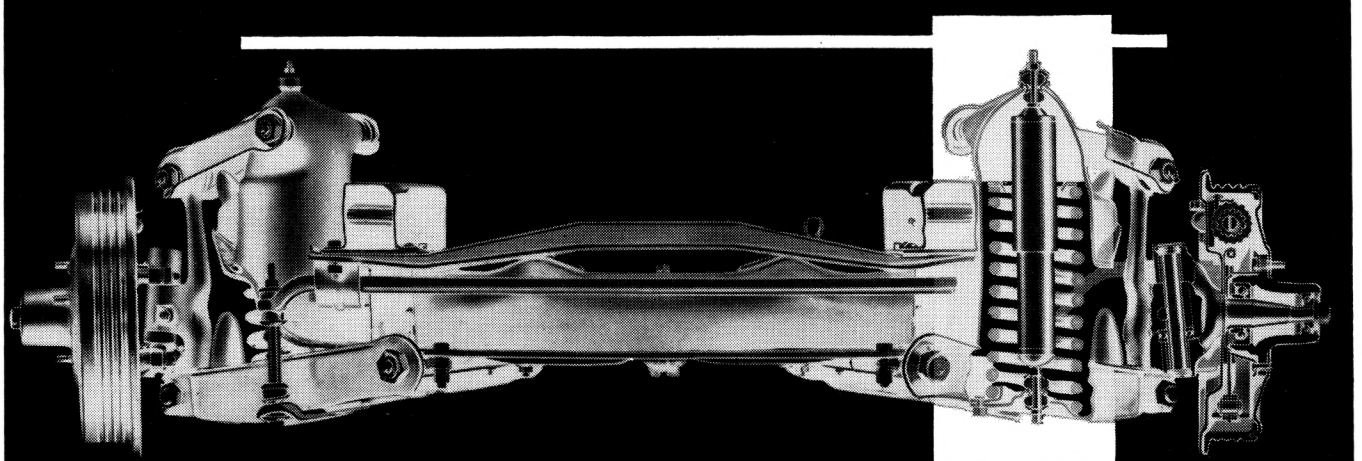
25c

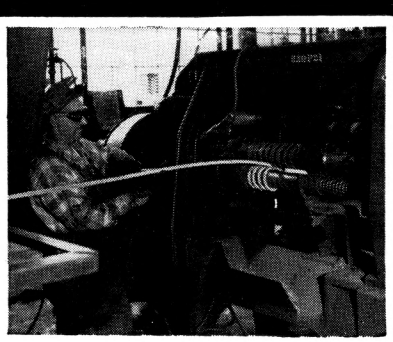
Features:

The Dean Speaks
Words From Willy
The Bluestem Lake
Meramec Power Plant

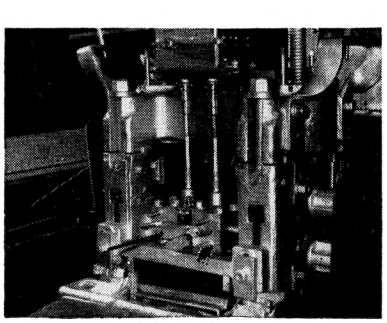
We gambled on the future

and the auto industry cashed in





● Here, at Muehlhausen Spring Division of Standard Steel Spring Co., precision-rolled U·S·S CARILLOY Spring Rounds are coiled without centerless grinding. CARILLOY Rounds have minimum decarburization, and they cost less to use.



● At the Gary Works of United States Steel, this precision mill rolls CARILLOY Coil Spring Rounds with extreme accuracy. Tolerances are half of standard: .004″ on the diameter, instead of the usual .008″, and only .006″ out of round, compared to .012″ on ordinary rolled bars.

IN the early days of the development of coil springs for front suspensions of automobiles, the only steel that was available was an ordinary hot-rolled bar from which as much as .035″ of metal per side had to be removed by grinding to insure freedom from harmful seams, pits, and decarburization. This cost money, was wasteful and time consuming.

We at United States Steel felt there was a better way of doing this, so we put our best engineers on the problem.

Using a mill especially equipped for the purpose, they devised an ingenious method of producing hot-rolled bars to eliminate harmful defects and most of the grinding expense. Rolled by this method to half the standard tolerances, with half or less the amount of decarburization, these CARILLOY Precision Rolled Coil Spring Rounds can be used "as furnished" or with only a small amount of centerless grinding.

This exclusive development has paid off in two ways. It has paid off for the automobile manufacturer in that his costs are reduced and spring performance is of the highest order. And it has paid off for us because these CARILLOY Precision Rolled Coil Spring Rounds are now used in over half of the coil springs in new automobiles.

Here's just one more example of the better steel products being developed by United States Steel's vast research program. To keep pace with the ever-increasing demand for special steel, United States Steel is always looking for young men with exceptional ability and training in metallurgy, engineering and related fields. For more information, write United States Steel Corporation, Room 2816-C, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS

3-1817

UNITED STATES STEEL

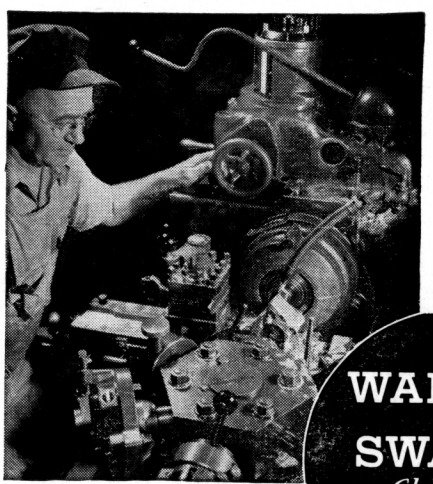
You can't vote yourself security

THE GERMANS TRIED IT and lost their nation —the Russians pretended to try it and made themselves slaves.

You'll notice that security is always offered in return for your vote—"just a vote of confidence, so I can get for you what you want." So the worker votes for a union boss he never saw, the businessman votes for a subsidy or cost-plus government contract.

And for every inch they advance toward security, they retreat a mile toward regulation that is next to servitude.

But there *is* a way to enjoy security in America (and only in America, by the way). That is, to make yourself something the world must have—a skillful farmer, a productive worker, a sound businessman. In this country it is true that the more value you add to the world and the more you add to the world's goods, the more you will be paid in return. *That* is security with self-respect —the only kind of security Americans want.

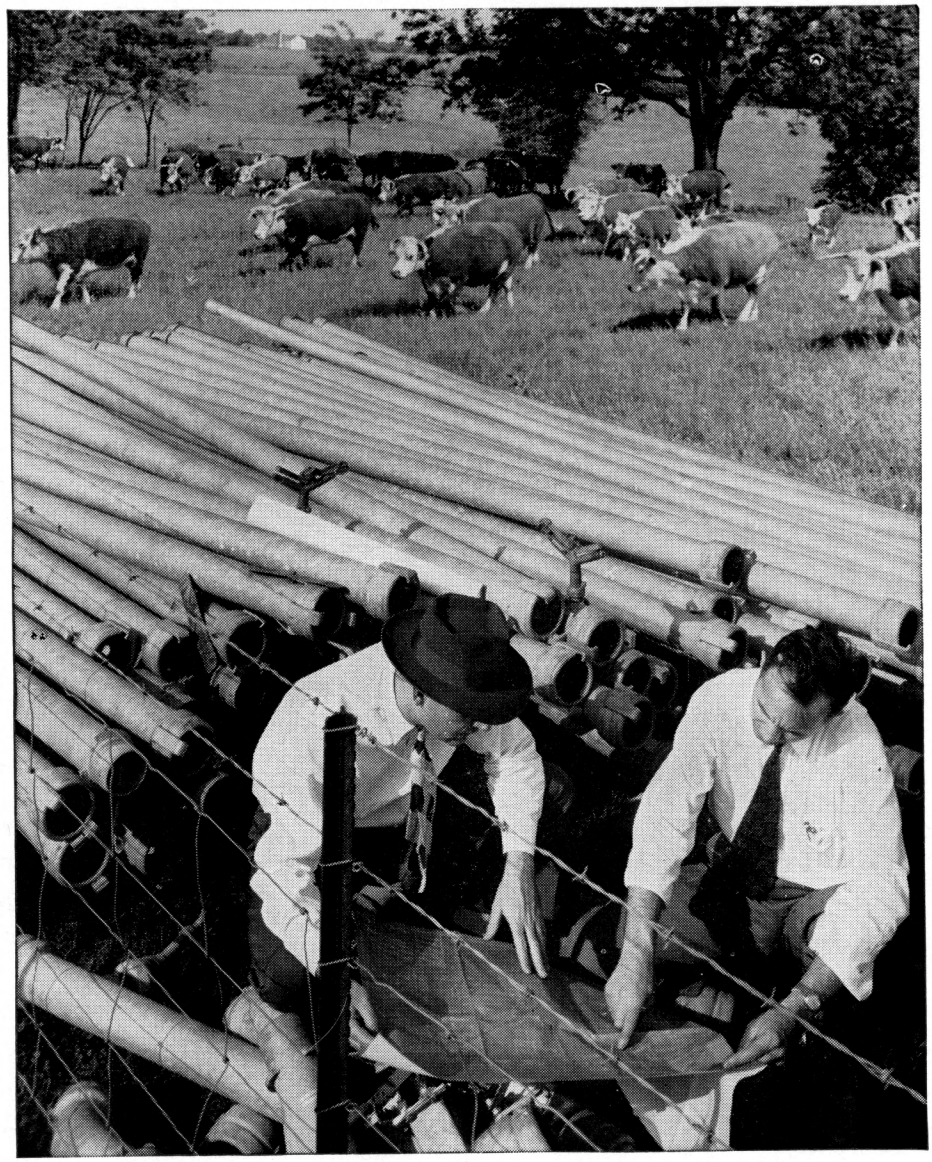


There are employment opportunities at Warner & Swasey for young men of ability and character who believe as firmly in the principles of Americanism as they do in the principles of sound engineering. Write Charles Ufford.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

Two agricultural scientists, from a large state university, check the blue print for irrigation pipe on Republic's experimental farm.



HERE THE CATTLE ARE GUINEA PIGS

If you're going into industry, one of your most difficult tasks faces you in the next few months. You'll have to distinguish between progressive companies and stand-stills. One way is to consider the pioneering each is doing.

How much does this company you might join plan its future?

How much does it care about society in general?

The cattle in the picture, for instance, are at Republic's experimental farm. They are part of a study to determine how much extra grass, hence extra meat, can be produced by irrigation. The purpose of the experiment is to prove the benefit of converting worn-out crop land to profitable grazing area.

The economic reasons for Republic's experiment are that animals must be fenced and Republic makes steel farm fence; also that irrigation requires pipe and Republic makes steel irrigation pipe. But beyond this immediate commercial aspect, Republic's experimental farm has a goal reaching far into the future.

Republic Steel's policy is based on a deep realization that no economic or social section of a nation can long progress at the expense of others. Progress must be mutual and industry has a responsibility to *do for* its customers as well as to *sell to* them. This, we believe, is an enlightened approach to economics which will promote the continuing welfare of all.

We hope such research programs, of which our farm experiments are only one example, will catalog Republic in your mind as a progressive, forward-thinking company.

REPUBLIC STEEL

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REPUBLIC STEEL

WORLD'S WIDEST RANGE OF STEELS AND STEEL PRODUCTS

NEEDED--- A NEW APPROACH!



HE HAD ONE

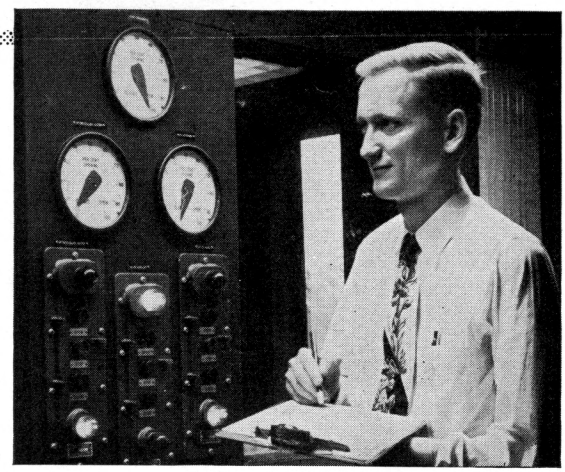
We're looking for young engineers—engineers with new ideas—engineers who can visualize the practicality of today's research and evolve from it the aircraft of tomorrow.

It is this type of thinking that has enabled the McDonnell engineering team to design and develop such hallmarks of aviation as the "Phantom", first twin-jet carrier based fighter plane, and the now famous "Banshee" series of Navy jet fighters.

Today, McDonnell engineers are engaged in a variety of projects concerning airplanes, helicopters and guided missiles. We are always interested in new talent—*young men with a new approach.*

If you're looking for our type of engineering —we're looking for you. Check your Placement Office for dates when the McDonnell representative will visit your school— or write to:

TECHNICAL PLACEMENT SUPERVISOR
BOX 516, ST. LOUIS 3, MISSOURI



JACK R. SNYDER
Design Engineer—Helicopter Engineering Division
S. B. A. E. PURDUE UNIVERSITY '46

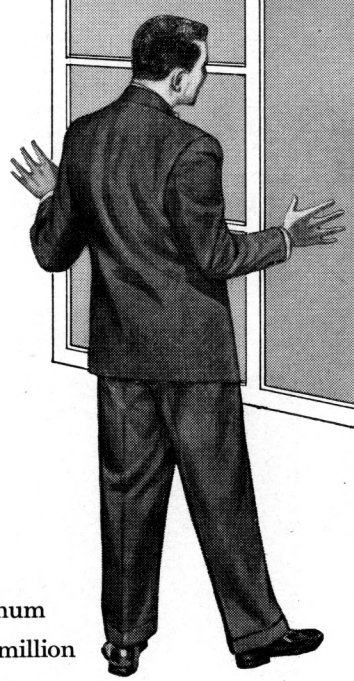
As a Group Leader in our Helicopter Design Department, Jack has made significant contributions toward M. A. C. helicopter development projects. Most noteworthy has been his work concerning the adoption of hydraulic power controls to helicopters and convertiplanes.

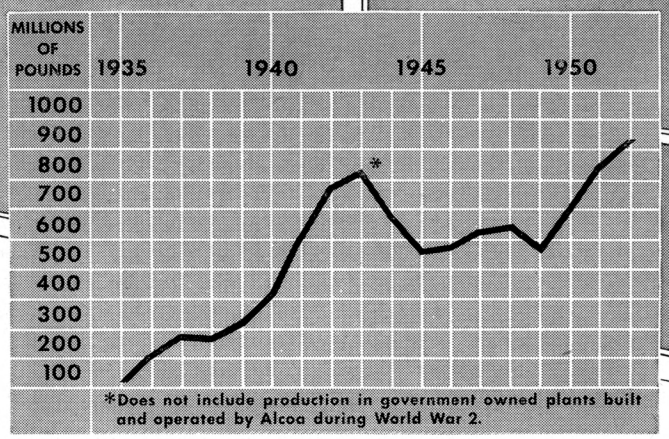
Jack joined the McDonnell engineering team soon after his graduation from Purdue in 1946. He is shown above inspecting one of the control panels in our recently completed Helicopter Laboratory. We need more young engineers like Jack Snyder—*engineers with a new approach.*

BUILD YOUR FUTURE WITH A COMPANY . . . . YOUNG IN YEARS, YOUNG IN SPIRIT AND IDEAS

McDONNELL Aircraft Corporation
Manufacturers of AIRPLANES AND HELICOPTERS * ST. LOUIS 3, MO.

Can you see your future through this Window?





This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1952. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director. ALUMINUM COMPANY OF AMERICA, Pittsburgh, Penna.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

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COVER

Back from summer jobs and vacations, these Engineers return to the Engine Building and its feeling of fellowship in the profession.

—Photo by Dave Aldag

MISSOURI SHAMROCK

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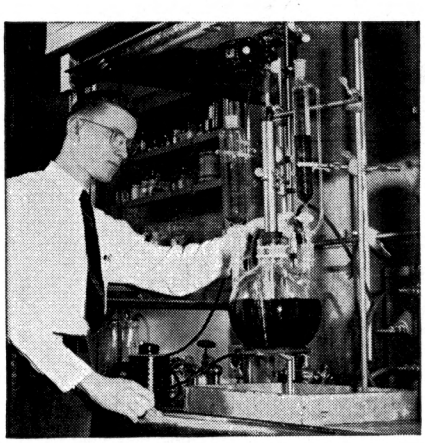
THE DU PONT DIGEST

Research

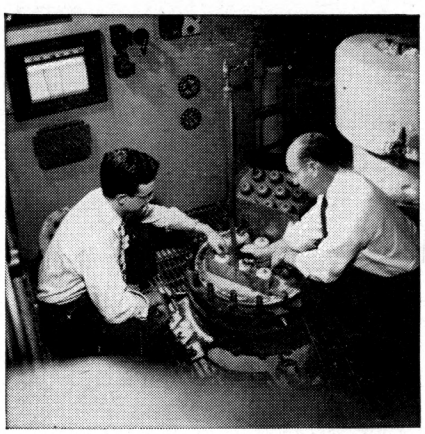
provides broad opportunities for chemists, physicists and engineers cooperating on many problems.

For one thing, much Du Pont research is fundamental, aimed at advancing scientific knowledge regardless of specific commercial objectives. However, such research often suggests new products . . . each with its own challenging technical problems which must be solved before commercial production can begin. Solving these problems offers another great field of work for teams of engineers and scientists.

"Teflon" tetrafluoroethylene resin is an example of this well integrated teamwork.



Howard E. Holmquist, *Ph.D. in Org. Chem., Univ. of Minn. '51, is shown at work on a problem in synthetic organic chemistry.*

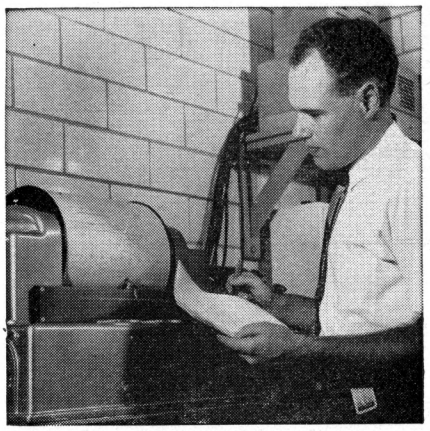


Doing chemical *engineering research on a plate in a distillation tower are: C. M. Gamel, Jr., S.M.Ch.E., M.I.T. '48; and J. B. Jones, M.S.Ch.E., Univ. of Mich. '46.*

During research on refrigerants, the polymer was discovered and work was begun to make it useful. The new plastic had a remarkable combination of properties; temperature resistance beyond the range of any previous plastic, excellent electrical characteristics, and the highest degree of chemical inertness of any commercial plastic.

In fact, "Teflon" was almost too unusual. Although it melts, it is too viscous to flow like other plastics. It does not dissolve—even in aqua regia. There was no method for molding it or for making it into thin coatings.

The problem of molding was solved with the help of techniques used in powder metallurgy. "Teflon" is now molded by cold pressing, followed by sintering or "fusing" at about 360°C.



Research workers *have available modern apparatus, such as the infrared spectrometer being used here by Vaughan C. Chambers, Ph.D. Org. Chem., M.I.T. '50.*

For coatings, previous research suggested dispersions—minute particles suspended in a liquid. After much study, a team of technical men learned how to suspend particles of "Teflon" about 1/125,000 of an inch in diameter. Then a commercial scale process was devised. This development made possible thin coatings of "Teflon" and also a process for extruding the material.

Meanwhile, another group discovered how to successfully formulate the new plastic into "Teflon" tetrafluoroethylene resin finishes and wire enamels.

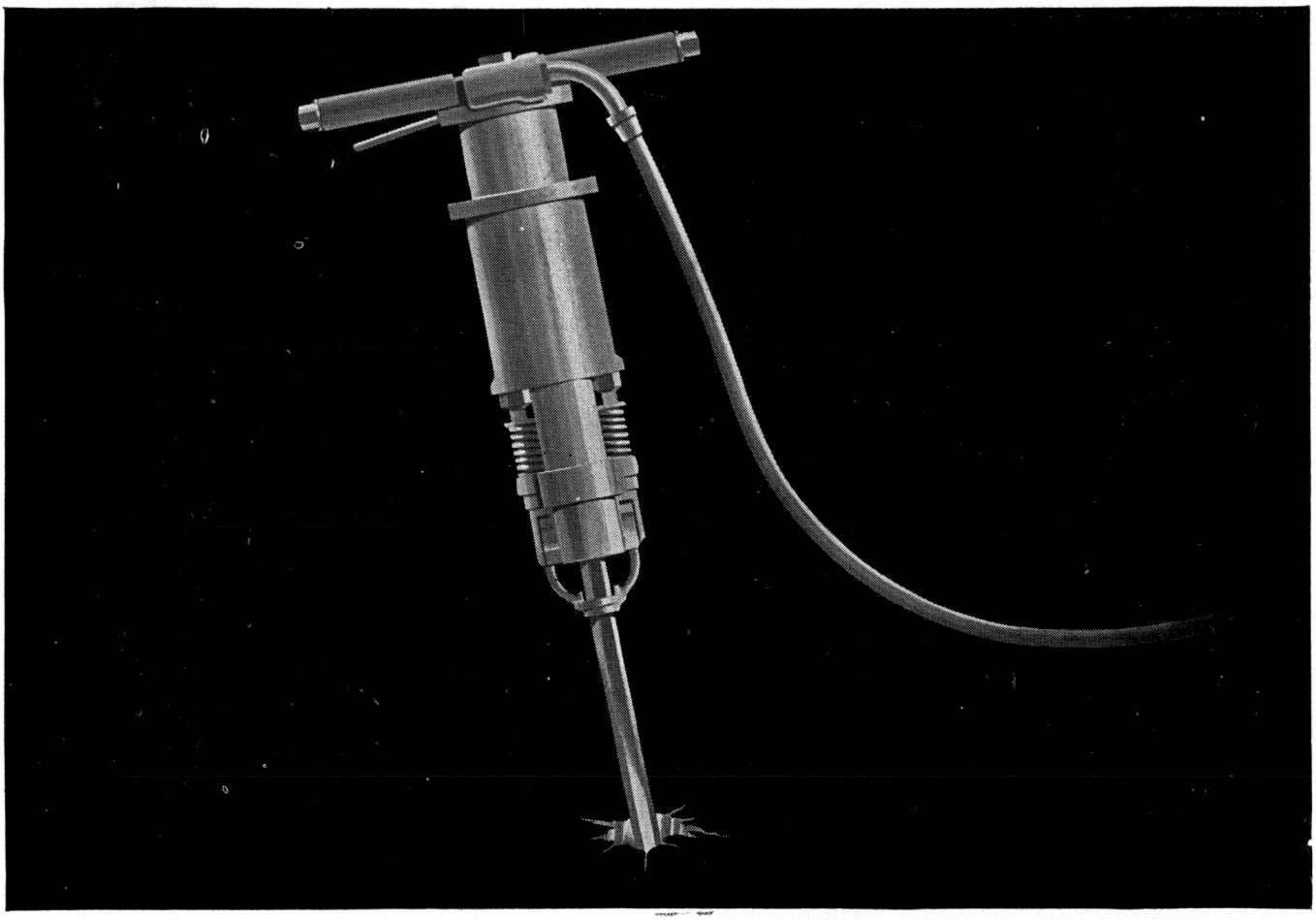
The development of "Teflon" illustrates the close teamwork that is the basis of research at Du Pont. But this teamwork doesn't end with research. Bringing the product to commercial reality requires development and design work by chemists and both chemical and mechanical engineers. Next month's Digest will feature information on the opportunities Du Pont offers men interested in this phase of making "better things for better living . . . through chemistry."

ASK FOR "Chemical Engineers at Du Pont." New illustrated booklet describes initial assignments, training and paths of promotion. Just send post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware. Also available: Du Pont and the College Graduate and Mechanical Engineers at Du Pont.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Watch "Cavalcade of America," on Television



AIR MUSCLE...

Properly compressed and coupled to this drilling tool, air packs a rock-busting wallop. How different from the days when men slung sledges, and even cracking pavement was a slow, tortuous task . . . as were many other manual jobs in industry.

MIND OVER MUSCLE...

When men of science learned how to put a cyclone in a cylinder, pneumatic tools and compressed air became salient servants in saving men's muscles and industry's time.

In its more than two hundred applications compressed air cleans, sprays, operates machines for hoisting, hauling, hammering, drilling, cutting, grinding, blowing, pumping. Applied in free or enclosed action this versatile, conveniently-conveyable power agent may be found at work in mines and mills, on highways and skyways, on and under the water, in production and processing.

AMERICA WORKS LIKE THAT...

Uniquely so. For here, every art, every science, every branch of engineering work together for the good of all. And the power behind their progress is America's all-seeing, all-hearing and reporting Inter-Communications System.

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- Design of component parts such as coils, loudspeakers, capacitors.
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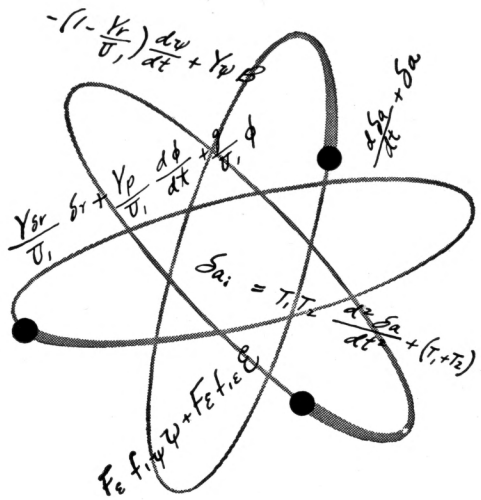
Future of Automatic Controls brings new opportunities for engineers and scientists at Honeywell



As science advances, and as our country continues to develop its industrial might, the business of automatic control gets bigger and increasingly important.

For the prime force behind the 20th century revolution has been and will continue to be *automatic control.*

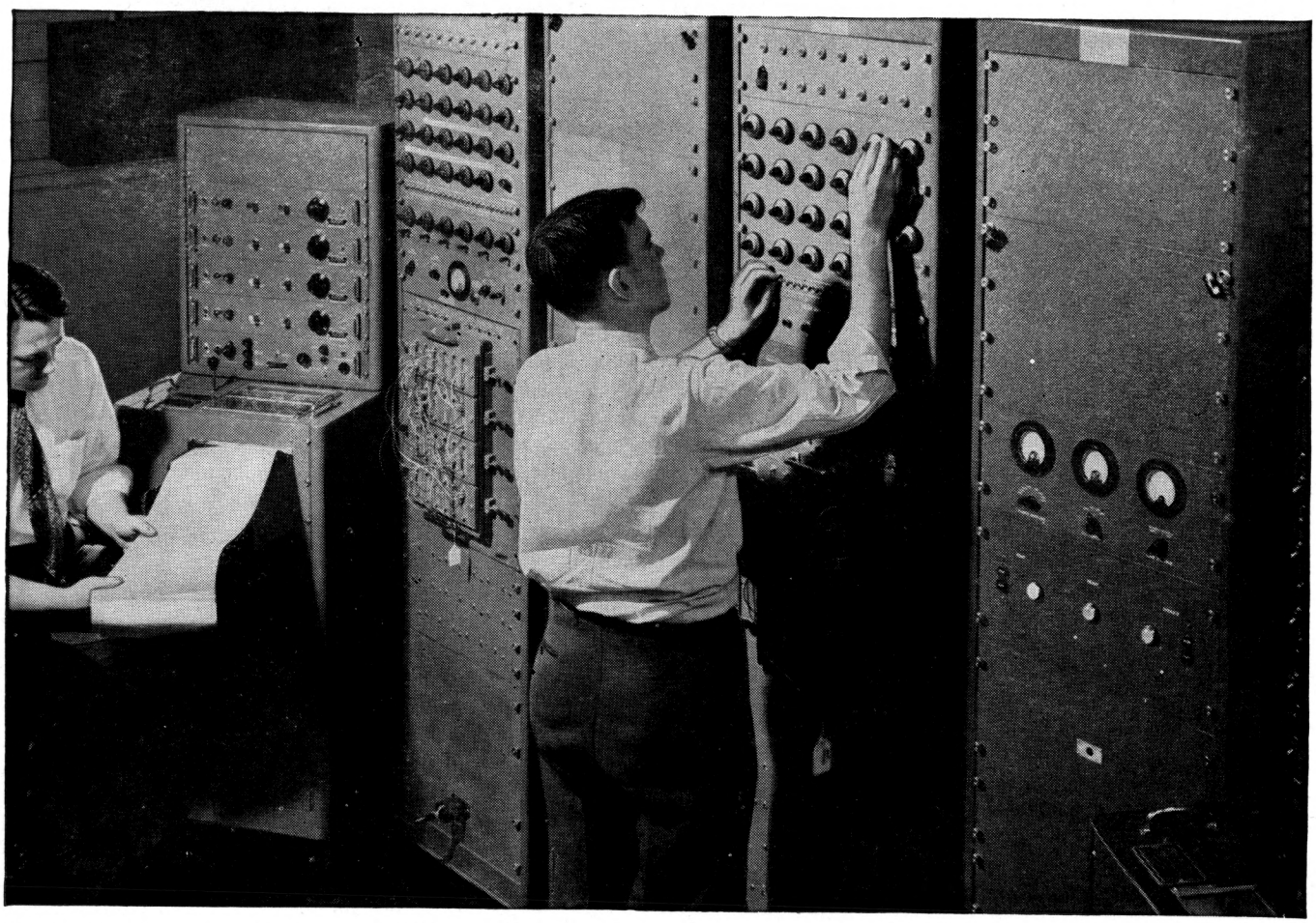
So at Honeywell, leader in this field for over 60 years, it of course means a bigger, more exciting, more challenging job ahead—all of which adds up to greater opportunities for engineers and scientists.

And that's why we're always looking for men with ideas and ambition to grow with us.

Here at Honeywell one out of ten employees is engaged in research and engineering activities.

Shown below is part of our Aeronautical Division's analog computing equipment, which helps our research engineers to develop and simulate flight tests on automatic controls for aircraft. It's typical of work being done by all of the company's eight divisions in plants across the country.

So if you're an engineer or scientist and like to use your imagination freely in such fields as electronics, hydraulics, mechanics, chemistry, physics, and a wide variety of others, be sure to send in the coupon below.



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MINNEAPOLIS **Honeywell**

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Gentlemen: Please send me your booklet, "Emphasis on Research" which tells more about engineering opportunities at Honeywell.

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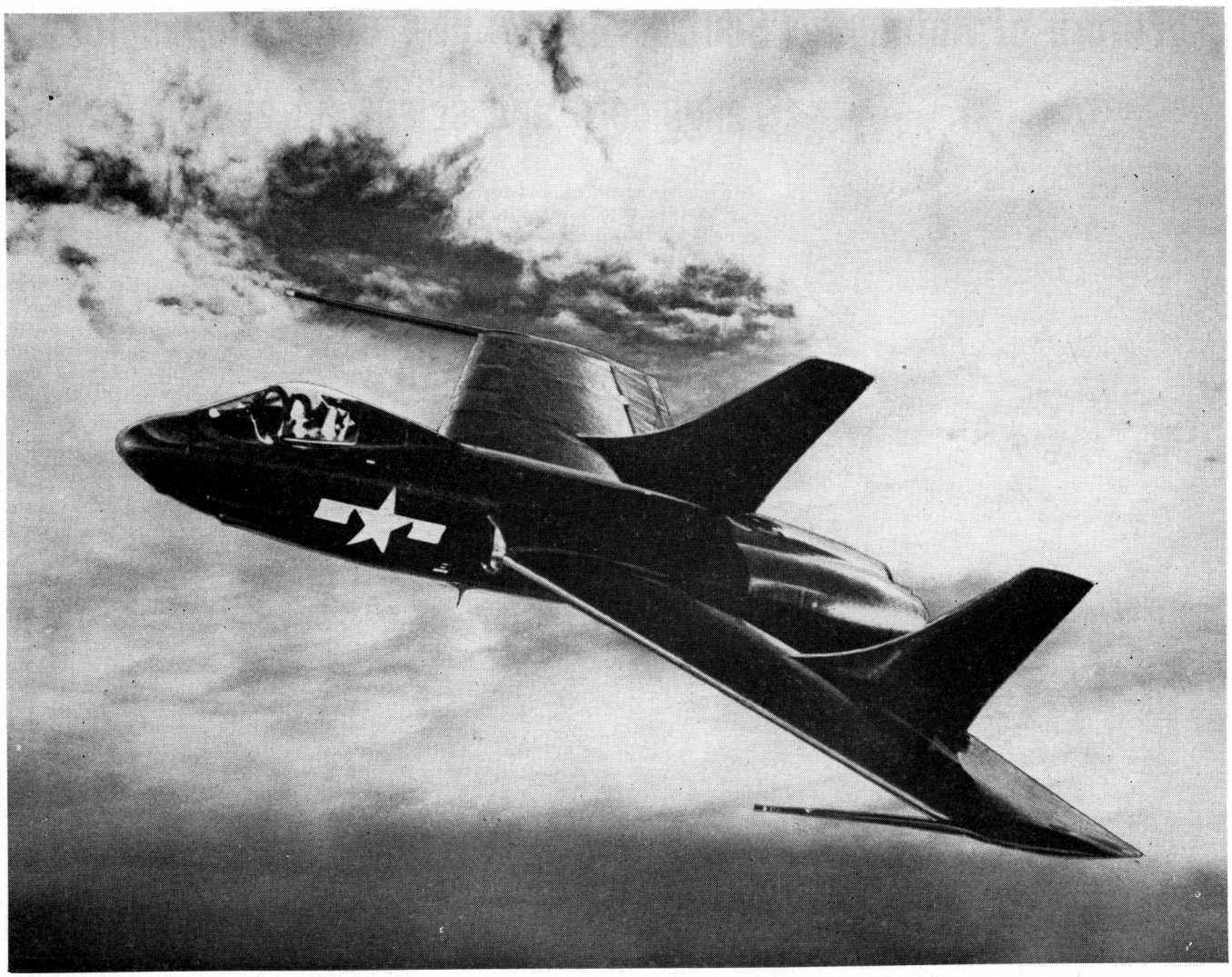


CHANCE-VOUGHT CUTLASS —*Westinghouse*

Thrusts developed by the engines in this ship far exceed the expectations of jet design before WW II. The use of new metals and their alloys has been a significant factor in weight and power design.

Welcome . . .

As we start a new year at the University, we welcome the new students in Engineering School. You new students have chosen a career that is just becoming a profession, and the place to cement this profession is right here in the University. No house is satisfactory unless the foundation is solid, and the engineering foundation is here. If you become lackadaisical, lose your ingenuity, and become a handbook engineer, the profession suffers by it. If you fail to make social and business contacts here, with experience for the future in mind, the profession suffers. Engineering, as a profession, isn't the anti-social, turn-the-crank idea. It is the idea of constructive thought with the well-being of all people in mind. Setting this foundation entails working in three things: Engine Club, your professional society and above all, your studies. Should any more be said?

D.B.A.

the DEAN SPEAKS

By Dean H. O. Croft

On behalf of the faculty, it is a very great pleasure to welcome all new students to the College of Engineering, as well as to greet again those who are returning to resume their studies. We of the faculty hope that all have had a healthful and fruitful vacation and are now ready to concentrate on the class and laboratory work being undertaken.

We wish to congratulate the new students for their having chosen engineering as a profession. Certainly no other career can offer greater personal satisfaction or a greater sense of accomplishment. Few other professions present more opportunities for accepting great responsibilities in the destines of great enterprises, thus affecting the welfare of the nation.

The study of engineering demands continued concentration and effort. The curricula consists of a hard core of basic science and mathematics followed by courses of engineering theory and design, with laboratory work at appropriate intervals. In addition, each curricula which is accredited by the Engineers' Council for Professional Development (all curricula in the college are officially accredited) must include the study of the Humanistic and Social Studies to the extent of approximately twenty per cent of the program taken. The schedule followed has been determined over a long period of years at many Colleges of Engineering, including Missouri, as being that best adopted for a four year course. The inclusion of the Social and Humanistic Studies is essential as engineers must know the fundamentals in written and spoken English, history, economics, etc., if they expect to assume leadership in a civilization as complex as ours.

The program of study for engineering is not easy. It will demand a major share of your time because not only do you as an engineering student, enroll for more courses per semester than the average student in other fields, but also many of the courses contain very difficult subject matter. Therefore, it is well to make the best possible start by making an hourly plan of study and following your study plan conscientiously. Your high school study habits, if any, will not suffice for University work and you will find that you will have to study during some of your free hours in the daytime and almost every night if you are to keep up with your class. It is best at the start to "over study" rather than "to take it easy" as much of the basic knowledge is introduced during the first month and your educational progress may falter without the self-confidence that comes from knowing that you know the basic facts.

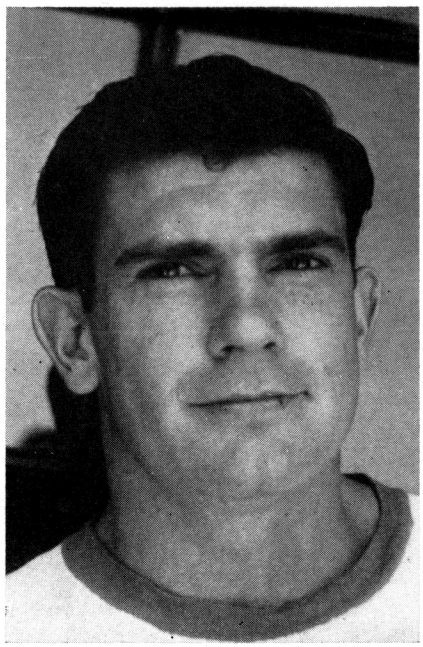
We of the faculty expect you to succeed in reaching your goal. In fact we are here to help you succeed but it is not easy for any of us—nor would you want it to be easy. The alumni of this college number many famous engineers in all parts of the world and you will wish to join this group, but to be qualified to do so will demand your best efforts and the hard work of your instructors. We do not expect you to be a drudge and study all of your spare time, but we do hope you will use your spare time effectively for your education so that none of your time may be wasted.

By using your time "effectively" we mean using it for self-education, by reading books and magazines which are not "required" reading, but which you will find enjoyable; we mean going to the plays and concerts and lectures which are produced in this University community; but above all we mean taking an active part in the college activities, such as the Engineers' Club.

The Engineers' Club (an incorporated group) is under the direct control of the student body of the college and organizes meetings, dances, shows, and all of the main events for "Engineers' Week" held during the week in March including Saint Patricks' Day. This very magazine, "The Shamrock," is edited and managed exclusively by engineering students for engineering students and alumni under the control of the Engineers' Club. This organization and its many activities provide a splendid laboratory in Human Relations. Take advantage of the opportunity and ask the officers

(*Continued on Page* 38)

WORDS from WILLY



Bill Ellis, President of Engine Club

By Bill Ellis

The fact that St. Pat was an engineer was discovered on this campus 51 years ago. The celebration started as a simple affair with the engineering students at the University of Missouri declaring a holiday in hence of St. Patrick. The first celebration was merely a skip day.

Since this first episode, St. Pat traditions have grown and spread to other colleges throughout the country. It is with pride that we note that other schools look to Missouri U. as the founder and leader of the various functions during St. Pat's Week.



The original blarney stone.

St. Pat's celebration lasts one full week starting with the engineers attending Burrall Class in Stephens Auditorium. This is followed in various order with a mid-night show, Hamburg show which is actually sort of a stag show, a serenade, column guards, barbecue, queen contest, beard growing contest, parade, campus stunt, Knighting ceremony, laboratory exhibits by each professional society, the Green Tea, and alumni banquet. These events are climaxed on Saturday night with a St. Pat's Ball.

ST PAT'S BOARD

The committee directly in charge of St. Pat's Week is called St. Pat's Board. This board is headed by Gene Anderson, chairman; John Schnakenberg, secretary. Two members from each class, freshman, sophomore, junior, and senior, serve on the St. Pat's Board. Petitions will be passed out during a regular Engineers' Club meeting sometime before the Christmas vacation. The class representatives to serve on St. Pat's Board are chosen from these petitions by the Executive Council.

EXEC. COUNCIL

The Executive Council is composed of Dave Aldag, editor of the Shamrock; Bill Ellis, President of the Engineer's Club; Ken Walton, vice-president; Jim Southerland, secretary; Bob McCloud, treasurer; Ron Graham, business manager; Gene Goodman, chairman of membership committee; Henn Liiv, alumni representative; Tom Carter, chairman of attendance and discipline committee and Gene Anderson and John Schnakenberg, who were mentioned above.

Other functions of your organization include, of course, meetings. Club meetings are held the first Wednesday of each month. At the end of each business meeting there is a program. The program has variety in form of speakers, movies, sorority skits, etc. Another function of the Engineer's Club is the fall dance. This year it will be held sometime in November.

I have tried to give a run-down of your organization. Its success will depend upon you . . . through your desires, your ability, your ideas, and your work . . . we can live up to our glorious traditions.

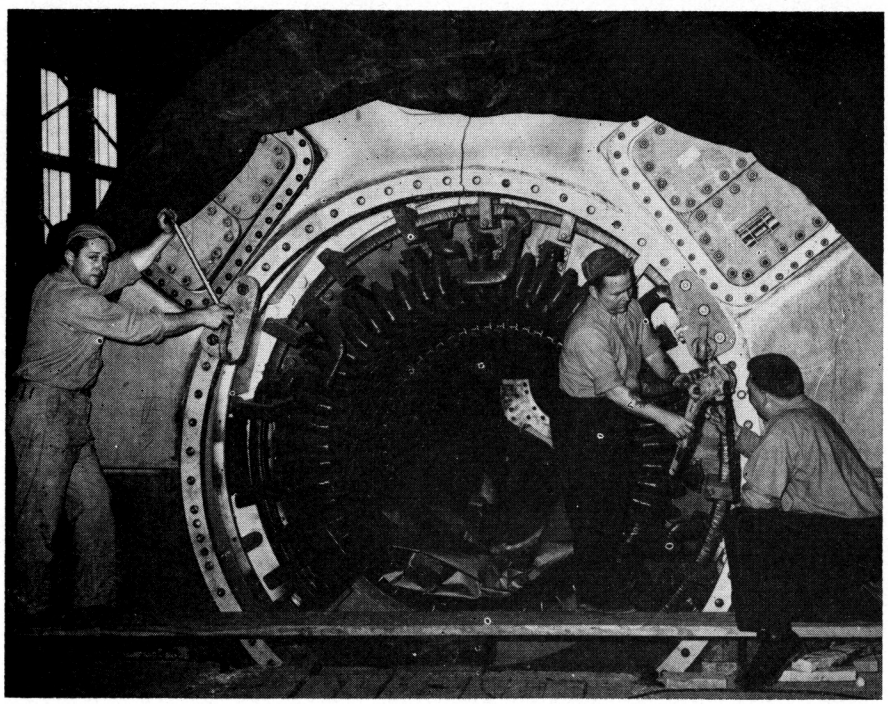
MERAMEC POWER PLANT

By Dave Aldag

About thirteen miles south of St. Louis there is located one of the newest and biggest steam power plants in this area. This "kilowatt factory," as it is called, is part of the planned expansion of generating plants who must meet the increasing demand for electricity. Lengthy economic studies of fixed costs versus operating cost were undertaken in the design of the plant.

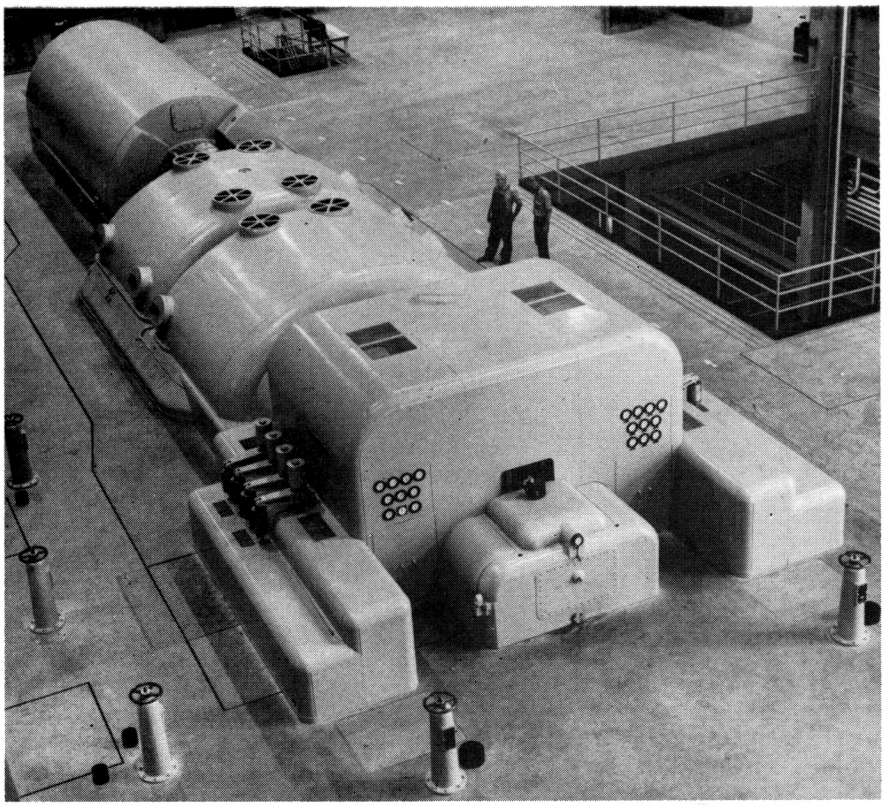
CONSTRUCTION

In the construction of the building, the design was very functional. Instead of bricks and tile, concrete and steel were used on the floors and walls. Corrugated steel with an asphaltum coating was used because it was about one-third the cost of brick walls. It was thought that boilers should be enclosed; but the Meramec boiler except for the firing section, is (outdoors.) Other plants go even farther than this. Everything is outside except for the control panels. It was also thought that the floor around the turbines and control panels should be made of clay tile. In newer plants, this has been discarded for the concrete floor, which is by far the cheaper. There are no architectural frills involved in the Meramec Plant. In the past, plants had been located such that the centerline of the condenser was at the same level as the mean river level, from which the cooling water was drawn. This entailed the cost of constructing retaining walls, and waterproof foundation walls. In the Meramec Plant, a new idea in circulating water systems allowed the condenser to be set above the mean river level. This relieved the cost of water retention construction. Stacks and precipitators have been placed right on the ground, instead of on the roof, saving cost in structural steel and foundation work for such heavy equipment. The cost of construction was cut to a minimum without sacrificing any operating expense, and the elimination of such luxuries as tile floors and brick walls gave the nickname to the plant, "kilowatt factory," for that is just what it is.



The stator of this generator is being readied for the foundation setting.
—Photo Courtesy of Union Electric

The plant at present is designed for two generating units. There is one boiler, turbine, and generator for each unit. The first unit is now in operation and the second unit is expected to be on the line sometime next May. Each generator has a nameplate capacity of 110,000 kilowatts, and they are expected to generate 125,000 kilowatts continuously. However, the first unit has carried a 140,000 kilowatt load many times. When one figures these capacities in kilowatts, it may seem easier to consider how many 100-watt bulbs would be lit by this generator. On a 140,000 kilowatt load, the generator can light 1,400,000. light bulbs; enough to supply everyone in St. Louis and the county with a



Enough power to light 1,400,000 light bulbs is vested in this turbine-generator.
—Photo Courtesy Union Electric

light for 24 hours a day.

STEAM TURBINE

The turbine is set up in three sections and the steam goes into the high pressure section at a temperature of 950° Fahrenheit, and a pressure of 1250 P.S.I. There are seven extraction points on the turbine which draw steam from the turbine to heat water that is going into the boiler.

After the steam goes through 17 stages, the end of the first section, part of it is tapped off to return to the boiler for reheat, and the rest is directed to the first heater. Steam from the reheat in the boiler is sent into the second section of the turbine. About midway through the second section, part of the steam is directed to the third section of the turbine, while the rest is directed either to the third heater or the second part of the second section. At the end of the second section, the remaining steam is sent to the condenser. Steam taken from the middle of the second section is sent into the middle of the third section and directed toward both ends of the turbine. It is just like putting two low pressure turbines back to back and using a common intake manifold for both.

At progressive stages, steam is extracted to go to the three remaining heaters. These direct contact heaters are unique in that the pressure difference between them is not made up by mechanical pumps; but they are stacked on top of each other so the water leg is enough to prevent blowback in the heaters.

The heaters, all seven, heat condensate which comes from a lower pressure and temperature heater. Some of these are tubular, and some are direct contact type heaters, according to the design need. From the highest pressure heater the water is directed into the economizer in the boiler.

BOILER

The boiler, now commonly called a steam generator, is a massive piece of structure in itself. It stands approximately 12 stories high, and is about 50 feet deep and 25 feet wide. The flue gas is directed upward from the firing chamber, across the superheater and reheat tubes, and down through the economizer and air preheater. The only part of the boiler that is inside the building is the lower part of the firing chamber. The boiler burns about 50 tons of pulverized coal every hour, and the heat released from the combustion of the coal turns 925,000 pounds of water into steam at the high pressure and temperatures mentioned before. Whereas steam used to be generated by forcing hot flue gas over water tubes, this boiler generates steam by

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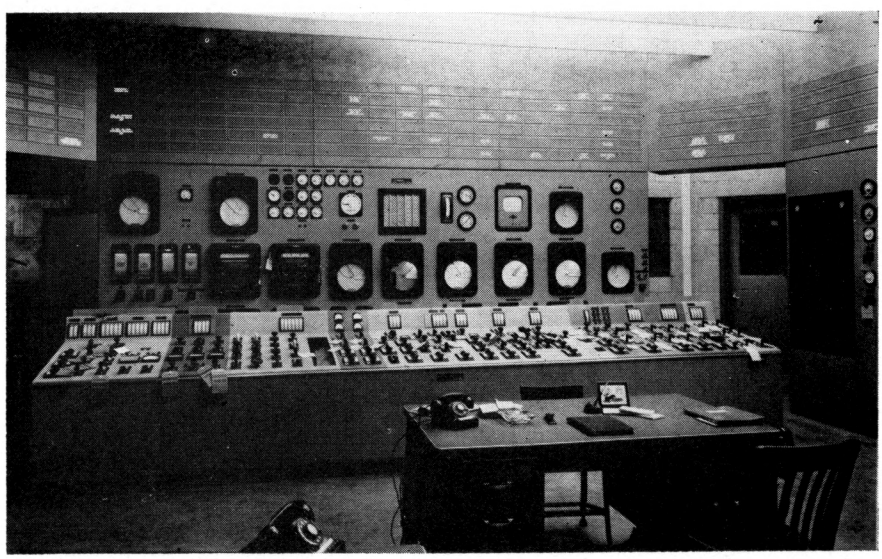

All major turbine, boiler and auxiliary controls are handled, with the help of recording instruments on the wall, from this control bench.
—Photo Courtesy Union Electric

THE LOSS of OUR KEYSTONE



Dr. Arthur M. Greene, one of the faculty members, who refused to recognize the edict of the Engineering students.

With regret we quote a news article from the September 4 issue of the New York Times.

Dean Greene was the well known figure of the Engineering School back in 1903, for he was the gentlemen that removed more than half the engineers from school on the first St. Pat's Day celebration. He later reinstated the students he had so effectively kicked out; for his increasing support of the idea that St. Patrick was an Engineer and his glorious reinstatement of the "rowdy" students, he was dubbed by St. Patrick Knight of St. Patrick Summa Cum Laude.

Dean Greene had promised to be with us for the Fiftieth Anniversary of the St. Pat's Celebrations, which was held last year; but due to an illness, he was unable to attend.

The item below, taken from the New York Times, serves to give his full career; part of which this very colorful man served with us. May it be said that we shall never forget one of the first, most active men of the first St. Pat's Celebration, Dr. Arthur M. Greene, Jr.

PRINCETON, N. J., Sept. 3—Dr. Arthur M. Greene, Jr., Dean Emeritus of Princeton University's School of Engineering, died yesterday afternoon at the age of 81. Death was attributed to a heart attack suffered while he was swimming at Madison, Conn.

One of the country's best known figures in the field of mechanical engineering, Dean Greene came to Princeton from Rensselaer Polytechnic Institute in 1922 to organize the School of Engineering as an educational unit. By the time he retired from the faculty in 1940 the school's enrollment had more than quadrupled, jumping from eighty-four to almost 400 in eighteen years.

Dr. Greene began Princeton's undergraduate programs in chemical geological and mechanical engineering. He retained civil engineering, first introduced at Princeton in 1875, and organized graduate programs of study in four branches of engineering.

Princeton's traditional emphasis on liberal arts courses as integral parts of an engineering curriculum was epitomized by Dean Greene's insistence that "the imagination of the engineer should be equal to that of the novelist, the artist, the poet or the preacher, for in many respects the work of all these creators is the same in the development of the complete whole."

Taught After 80th Birthday

A year ago Dean Greene, remembered by hundreds of Princeton alumni as a "most inspirational teacher," achieved an ambition by teaching after his eightieth birthday—a goal he had set for himself as a high school student. He had continued to teach a graduate course in engineering economics after he retired.

A native of Philadelphia, Dean Greene received a B. S. degree from the University of Pittsburgh in 1893 and an M.E. from the same institution the next year. He was made an honorary Doctor of Science by Pennsylvania in 1917, an honorary Doctor of Engineering by R. P. I. in 1922 and an honorary Doctor of Laws by the University of Missouri in 1940.

He started his teaching career at Drexel Institute in Philadelphia, and from 1895 until 1902 taught mechanical engineering at the University of Pennsylvania. For the next five years he served as Professor of Mechanical Engineering at the University of Missouri and in 1906-07 was junior dean of Missouri's School of Engineering. He was professor of Mechanical Engineering at R. P. I. from 1907 until he joined the Princeton faculty in 1922.

An honorary member and a past vice president of the American Society of Mechanical Engineers, Dr. Greene was also past president of the Society for the Promotion of Engineering Education and the Society of Engineers of Eastern New York. He was active in a number of scholarly and professional societies, was a fellow of the Advancement of Science, a member of the Franklin Institute of Philadelphia, the Newcomer Society

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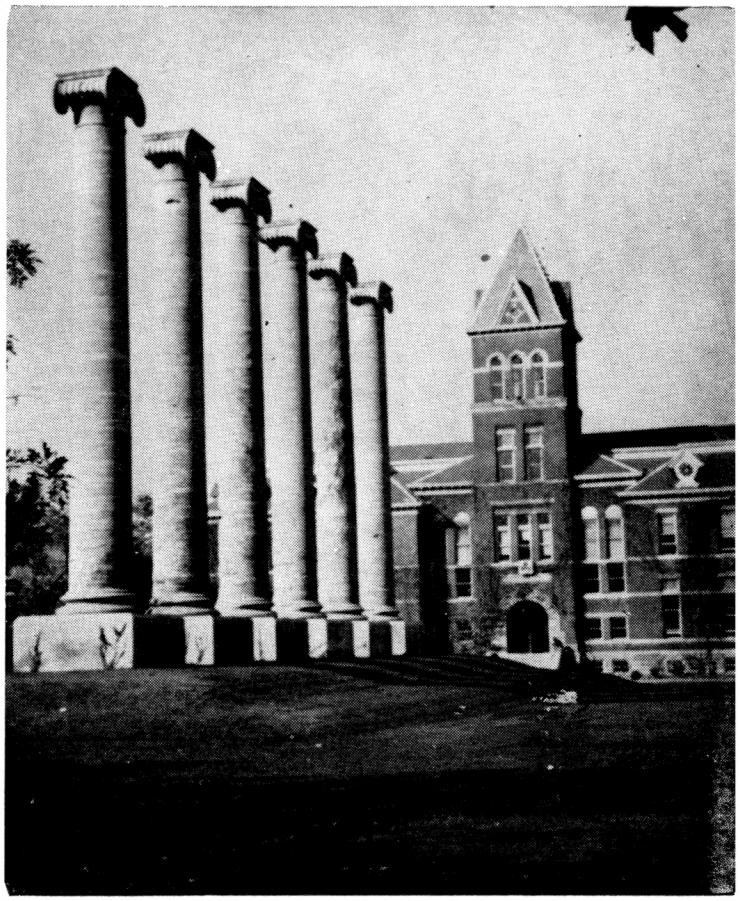
MIZZOU MEMOS



By Don Brooker

FRANK N. BARKER, C.E. '23, has resigned (July, 1953) as Illinois chief highway engineer after 30 years with the highway department to become assistant chief engineer of the Atchison, Topeka and Santa Fe Railroad with offices in Chicago.

WILLIAM E. MEIER has moved from Kansas City to Phoenix, Arizona where he is employed by the Goodyear Aircraft Corporation.

MAX C. SONS, C.E. '35, has been appointed chief petroleum engineer of the Carter Oil Company at Tulsa, Oklahoma. The company is a subsidiary of Standard Oil Company of New Jersey.

RICHARD C. CUNNINGHAM, '36, received the highest honor award of Westinghouse, the Westinghouse Order of Merit. He received the award for "his careful guidance of the development of the control system for the first submarine atomic power plant; for his skillful coordination of design, erection and test operation at widely scattered locations, and for his leadership in the engineering design of nuclear power plants. He is manager of the power plant department, Atomic Power Division.

ROY HARRINGTON, Ag. Eng., '50, sends in a nifty report on how he and Dorose Zink of Ames, Iowa pursued each other with object matrimony (his words are "to select and win the mutual love and understanding of a lifelong partner with common interests and values"). They completed the assignment on September 6, this year. Roy is a project engineer in the Product Development department of Deere and Company, Moline, Illinois.

CONRAD DUNN, E.E. '50, is a fire inspector for Factory Mutual Engineering Division in St. Louis. He recently completed a year and a half in uniform in radar school duties.

MR. GLADWYN V. LAGO, Assistant Professor of Electrical Engineering at the University of Missouri has received an RCA Predoctoral Fellowship in Electronics as administered by the National Research Council for the school year 1953-54. These fellowships are supported by the Radio Corporation of America, the selection

(*Continued on Page* 26)

THE BLUESTEM LAKE

By Virgil Cummins

It became apparent to the City of El Dorado, Kansas, in 1948 that it was soon going to be facing a water shortage. The present lake was not only supplying a growing city, but also the Skelly Oil Company and the El Dorado Refining Company.

With Skelly talking expansion and water already short, the city employed Black and Veatch Consulting Engineers of Kansas City to make surveys to find out where a lake could be built and estimate the cost of such a lake.

STUDY AND TESTS

The next four years were spent in studying water sheds, testing the amounts of water used, and estimating the cost of a new dam of adequate size for future years. By the end of 1952 concrete plans had been made for the lake.

The lake will cover 870 acres and hold 3½ billion gallons of water. It will have a drainage area of 42 square miles and will require approximately 16½ inches of rain run-off to fill it. The dam will cost around $1,500,000 of which Skelly Oil Company will pay $1,000,000.00; El Dorado Oil Company, $333,000.00, payable in water premiums during the next 14.7 years. This will leave $167,000.00 to be payed by the city from the water department surplus. This means that water rates for the oil companies will double, while the city rates will increase only about 30 per cent.

CONSTRUCTION

On the 4th of June, construction of the dam began under the supervision of the resident engineer, Charles H. Sauceman. The contractor began by clearing away all trees and underbrush on the dam site.

The first work on the dam proper consisted of the excavation of 35,700 cubic yards of stripping. At this time 10,000 cubic yards of topsoil also was excavated and stock-piled for later use as a seeding bed on the down stream side of the dam. From the cut-off trench, 60,000 cubic yards of selected impervious material (clay) was excavated and later placed in the embankment core. The final excavation from the cut-off trench was 4,800 cubic yards of solid rock which was placed in the embankment as was the pervious blanket.

The H. Riley and Florence rock formations were cavernous in places and required pressure grouting to seal off such caverns. The pressure grouting was accomplished by drilling holes 20 to 30 feet deep in the bottom of the cut-off trench, cementing in a short pipe to which connections were made, and pumping a cementing material into the hole until a specified pressure was reached. (If an excessive amount of grout was pumped into a hole, other holes were drilled nearby and pressure grouted until the cavern filled.)

With the trench sealed off, selected impervious material was compacted into it to make the fill. This material came from borrow pits and other sources. The larger borrow pits were located downstream from the dam, but some smaller pits were up

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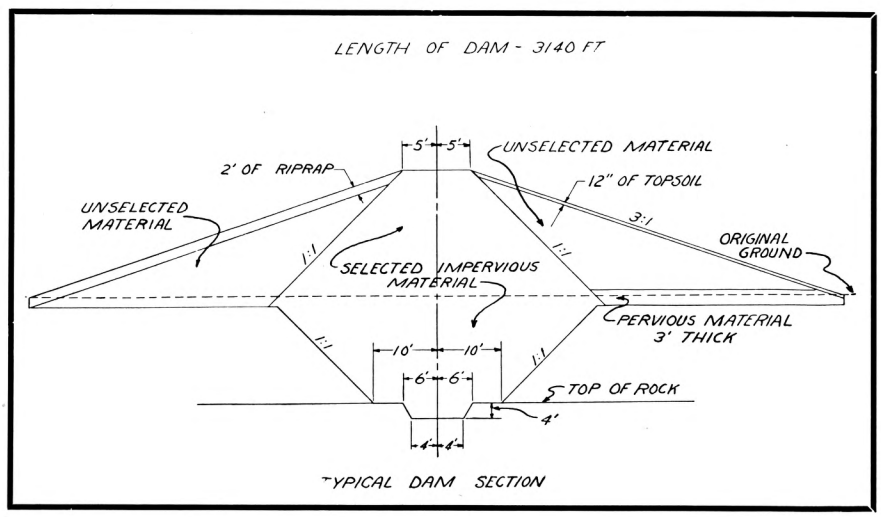
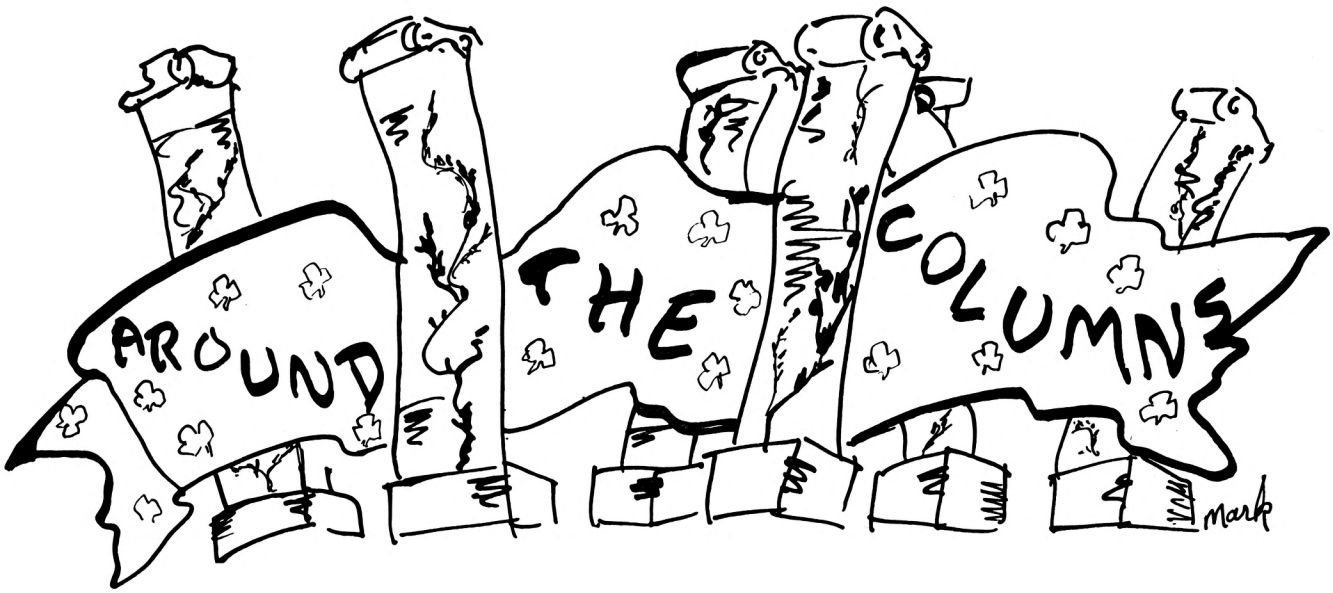


This section of the dam shows the various materials used and where they are placed.



with Slipstick Sam, B.S. '99

School Days! School Days! dear old golden rule days. Readin' and writin' and 'rithmetic, taught to the tune of an old Slip Stick!

♣

Welcome all of you new engineering students. Just one little word of advice—Keep up on all assignments and home work as failure to do this has sent several away from the dear old engineering classrooms. This engineering is all and more than what it has been talked up to be. You will enjoy your work after completing four years in engineering and then look back on the years spent here as happy ones. It is nice to have all of you upper-class men back in the ranks. Ole Sam suggests that each of us set an example (didn't mention what kind) for all the new students.



♣

You readers who have been following Slip Stick Sam will no doubt remember how much trouble we had keeping Rex Whitton, Jr., in Route Surveying class the past year. It seems he always had some unfinished business by the old steps of the famed Jesse Hall. That seems to have become a permanent and everlasting agreement now for wedding bells rang for Rex and Doris on August 1, 1953. We wish you both a continued success and happiness. Congratulations, Rex! Doris finally trapped you.

♣

Dale Henry whom you will all remember as Farad is still hanging on to his bulb snatching job in Lexington, Missouri. Ole Sam understands that his six months old son Doug will soon be taking over as he has now learned to pull himself up. Better watch him Farad or he will soon be taking your position. Oh, well, anyone could handle that.

♣

Robert L. Duss (better known as Nails has boned into the Engineer-in-training program with the Missouri State Highway Department and is now located at Forsyth, Missouri, where a new bridge is under construction over the new Bull Shoals Lake. Believe it or not he is enjoying his job very much and needless to say would not trade it to go back to all of those fall classes. However, just one small item I forgot to mention, he is soon to become a proud daddy again and with his three year old son Robbie plus the responsibilities of raising a family in this generation he feels extremely fortunate to have a job again.



Ole Sam is happy to report that Rex Whitton, Jr., is to be stationed in San Francisco for about four months where his ship will be in dry dock and following that assignment he will

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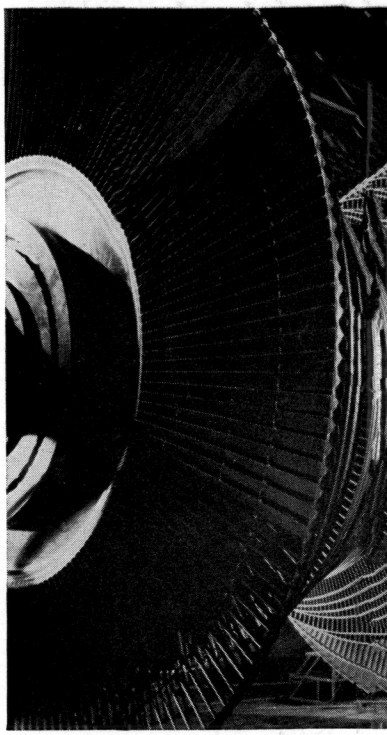
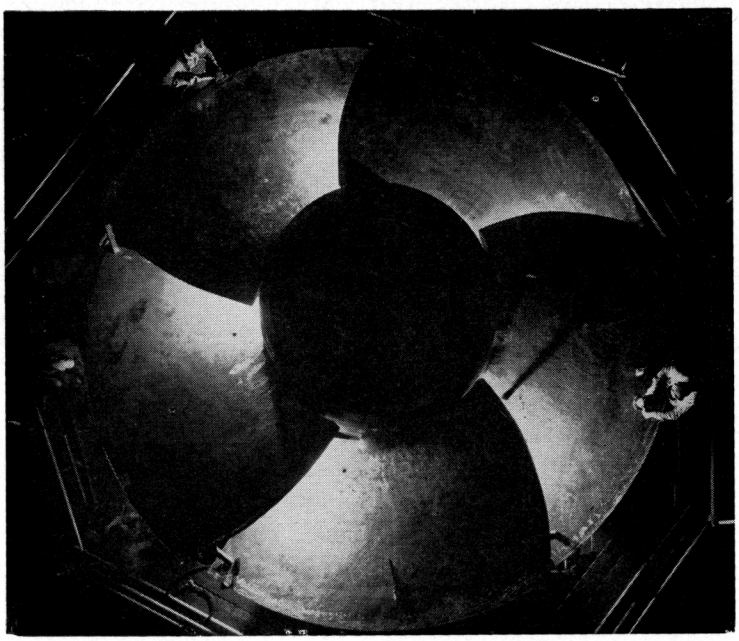
KWIK PIC



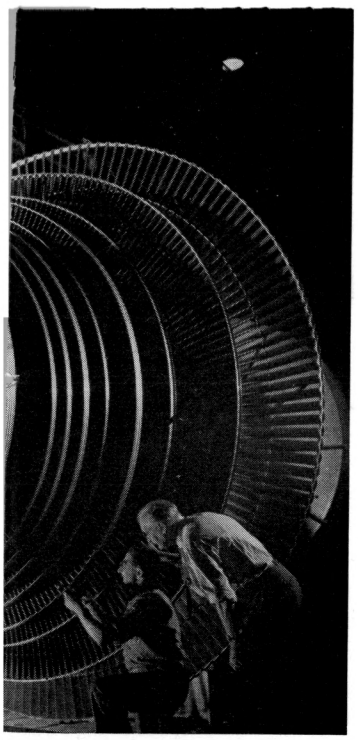
Low-pressure spindle for a 120 steam turbine said to be one of t structed in the United States. Longe is 40 inches.



This 24½-ft. diameter, 200,000-lb. Kaplan propeller type water-wheel runner, the largest of its kind in the U.S., resembles a giant flower in bloom.

—Allis Chalmers

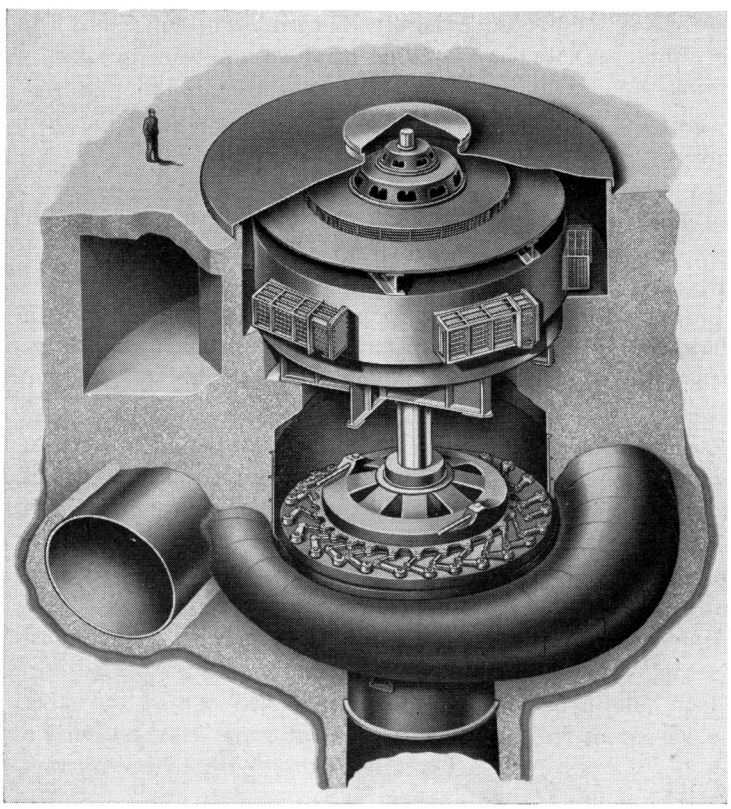
SINGLE SHOTS OF ENGINEERI



·000-kw, cross-compound reheat
ıe largest of its kind ever con-
at blade of this 178,500-lb. spindle

—*Allis Chalmers*

; OF ITEMS
IG INTEREST



Artist's drawing of largest electric motor and reversible pump-turbine ever built. As a turbine it will have a maximum rating of 120,000-hp. As a motor, it is rated 102,000-hp, 106 rpm, and as a generator, 70,000 kva, 13,800 volts. When motor driven, the unit will have a pumping capacity of 3.3 billion gallons of water per day. The equipment will be the heart of a pump-storage project at TVA's Hiwassee Dam in North Carolina. Scheduled completion date is 1955.

—*Allis Chalmers*

BULLARNEY



By Gray

A truck driver, hauling clay for a fill, backed his truck too far over the dump grade. The weight of the load being dumped lifted the front end of the truck several feet off the ground.

"Now, what are you going to do?" an associate asked.

The driver eased out of the cab and said, "I think I'll grease it—I'll never get a better chance."

♣

"Why do you call your boy friend Pilgrim?"

"Because every time he calls he makes a little progress."

♣

A shovel operator sitting at the bar was surprised to see a kangaroo enter the establishment and approach the bar. Taking his place next to the shovel operator the kangaroo ordered a bourbon.

"How much?" the kangaroo asked the bartender as the drink was set before him.

"Two bucks," answered the bartender.

The kangaroo reached in his pouch, withdrew his wallet and laid two bills on the bar. Then, downing the drink, the kangaroo turned to leave.

The shovel operator, watching bug-eyed, turned and said, "Pardon me, but I'm around here quite a bit and I never saw any kangaroos in here before."

"I'm not surprised," answered the kangaroo, "when they charge two bucks a drink."

♣

A man met a woman singer at a recital. Her lovely voice affected him so strongly that he entirely overlooked her undeniably plain face. In fact, her vocal ability continued to charm him so that he finally asked her to marry him. The lady accepted gladly and the wedding took place.

The following morning the groom woke first. He raised himself on his elbow and gazed at the face of his sleeping bride. What he saw in the candor of the sun's early rays, made him cry out: "Wake up, for heaven's sake, wake up and sing."

♣

A man named Joe Hogsbristle appeared in court to have his name legally changed. The judge nodded, "What name do you want to take?"

"Frank Hogbristle. I'm sick and tired of hearing people say, 'Hi Joe, whattya know'."

♣

Operator: "Did you hear about Bill's new job?"

Contractor: "No, what's he doing?"

Operator: "He's working in a bloomer factory pulling down fifty-two hundred a year."

♣

One of our present troubles seems to be that too many adults, and not enough children, believe in Santa Claus.

♣

The chorus girl swept into the dressing room with a mink coat draped casually over her arm.

"Dearie," asked one of the other girls, "how did you ever get such a gorgeous mink? Why, I've been struggling for years to get one."

"Honey," replied the other, "you mustn't struggle . . . ever."

♣

It is reported that a Communist Party worker, having a particularly tough time finding recruits in America, submitted the following report to his superior:

"It is becoming increasingly difficult to reach the downtrodden masses in America. In the spring they're forever polishing their cars; in the summer they take vacations; in the fall they go to the world series and football games. And in the winter you can't get them away from their television sets. Please give me suggestions on how to let them know how oppressed they are."

♣

The doctor gave his 80-year-old patient a very curious look.

"I've been practicing for two decades, and I'm darned if I ever heard of such a complaint as yours. What do you mean, your virility's too high?"

"It's all up in my head," replied the old man, sighing gently.

♣

"This model has a top speed of 130 miles an hour, and she'll stop on a dime."

"What happens after that?"

"A little putty knife comes out and scrapes you off the windshield."

♣

Girl: "Where did you learn to kiss like that."

Tractor Operator: "Siphoning gas."

♣

With all those feminine falsies, a guy never knows what he's up against.

♣

A woman shopper picked out six apples and handed them to the grocery clerk. "That'll be 65 cents," he said.

She handed him a dollar and started to walk out.

"Wait a minute, you forgot your change."

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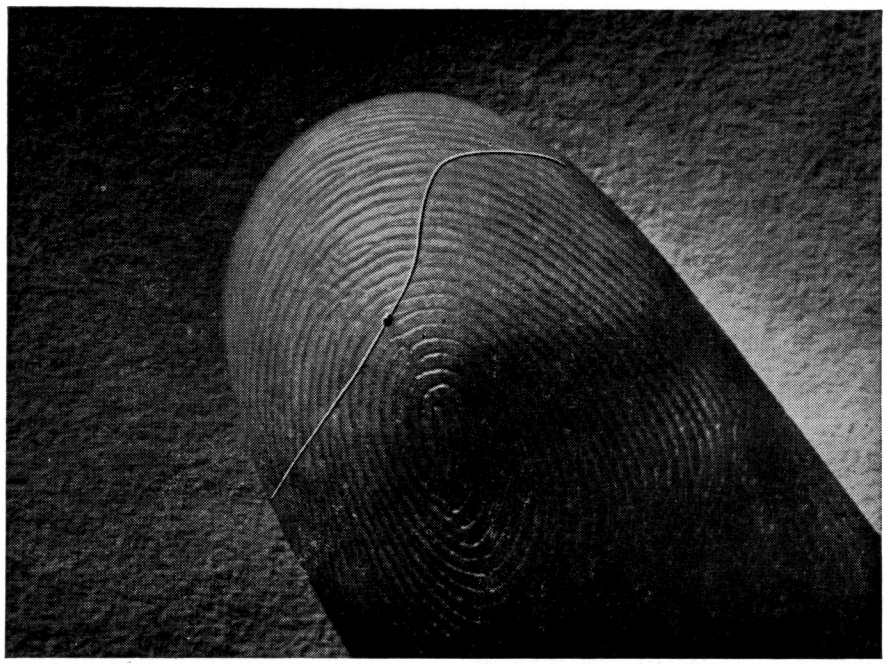
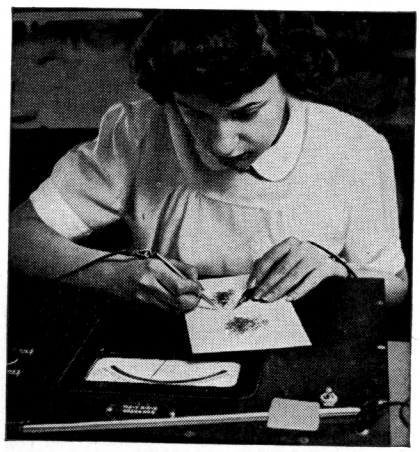
It took 100 years of engineering



See that tiny speck of oxide on a hair-like wire? It's called a thermistor, and it's the first practical *thermally* sensitive resistor. It's so sensitive it will measure temperature variations within one-millionth of a degree. As a circuit element and control device, this small, stable and rugged unit has a place in a variety of electrical circuits.

Although the thermistor is the smallest and, in appearance, one of the simplest devices made by Western Electric—manufacturing unit of the Bell Telephone System—it was more than 100 years in the making.

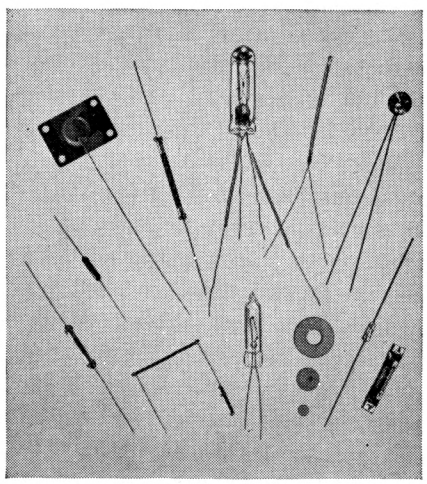
Back in the 19th Century—some time before Western Electric was founded in 1869—Michael Faraday studied a curious thermally sensitive resistor material similar to that used in 20th Century thermistors. As Faraday and others after him discovered, the trouble with making effective use of this material was that different units made by what seemed to be the same process, showed large variations in their behavior. The problem of how to control the amount of impurities present in the material was finally solved a few years ago by our research team mates at Bell Telephone Laboratories.



At Western Electric's Allentown (Pa.) Plant hundreds of minute thermistor components are electrically tested and sorted every day. The basic component, an oxide, has a large negative temperature coefficient of resistivity.

Once beyond the laboratory stage, Western Electric's engineers tackled the job of *mass-producing* the hard-to-handle oxides. After many trials they got a pilot line in operation—then a full scale production line through which compressed powders of thermistor material could be sintered into a strong, compact and homogenous mass. Today reliable thermistors are being made in many shapes and sizes—small beads, rods, discs, washers—to meet varying circuit and design problems. To make this possible, Western Electric engineers had to find new ways to apply a slurry of oxides on wire; new ways to extrude and mold oxide mixtures.

At every turn, the thermistor has presented fresh challenges to our engineers. Engineering is like that at Western Electric—where technical men of varied skills pool their knowledge in a constant search for new and better ways to do things.



The thermistor takes many forms depending on the resistance and power-handling capacity needed in a particular circuit.

WANT TO KNOW MORE?

Send the coupon below for a copy of the 16-page technical monograph entitled, "Thermistors as Components Open Product Design Horizons."

WESTERN ELECTRIC COMPANY
COLLEGE RELATIONS DEPARTMENT
195 BROADWAY, NEW YORK 7, N. Y.

I'd like more information about

☐ Thermistors and their application
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School _____ **Class** _____

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

NEWSTUFF

By Henn Liiv

Over the summer many new items made appearance on the industrial market. Ol' SHAMROCK heard the news about the following:

While TIME magazine recently brought notice to the fifth birthday of the germanium transistor, quoting certain skepticisms about its present usefulness, General Electric is enthusiastic about its junction-welded germanium transistors. TIME quotes Philco's Director of Research, Donald G. Fink, who explains the defects of transistors; moisture corrosion, tiny wires breaking away for no apparent reason, and sudden unexplained defects in the carefully processed germanium itself. Fink recommends encapsulation. —General Electric presents new evacuated, hermetically-sealed units of all-welded construction. This type of construction eliminates aging effects due to trapped moisture and solder flux fumes. It also allows power ratings up to three times of those of any previous transistors. The units have been demonstrated to operate under water at temperatures up to 100 degrees centigrade, and they are claimed to have an essentially infinite life. The new units will soon be mass produced at the rate of several million yearly.

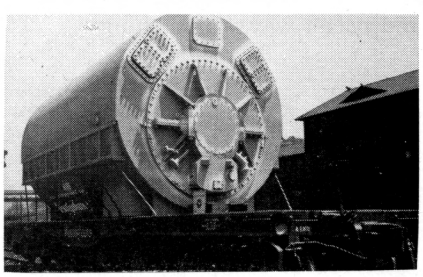
Westinghouse has a new method for testing vibrations in generator frames. A plastic model of the frame is first made, to which a varied range of vibration frequencies is applied by an electromagnetic driver—not unlike the driving element of a radio loud speaker. The vibrations are recorded with the aid of a crystal phonograph pick-up. The method may be used to investigate vibratory effects on any large complex machinery, where it is impossible to get information by mathematical computation.

Seems that General Electric has too much spare time. They present an extensive study on fireflies: using intricate laboratory apparatus, they determined that the average light output of all Cleveland fireflies measured only 6-thousandth of a lumen . . . 137,000 average lightning bugs, all flashing simultaneously, give out as much light as a 60-watt inside-frosted electric bulb.

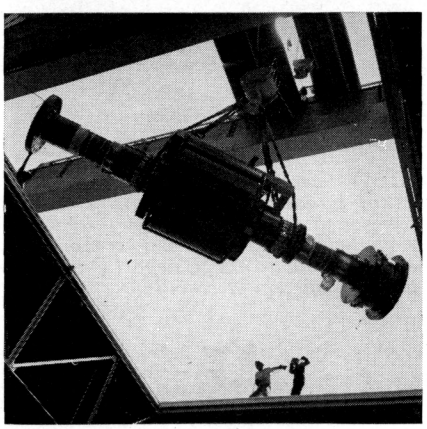
Transportation of extra-heavy electrical equipment has long been a problem. The solution has been found now in a specially-designed railroad flat car. Thrall Manufacturing Company, who builds this car for Westinghouse, claims that most of the extremely heavy generator units can now be shipped completely assembled, which results in great time savings at both the shipping center and at the destination. The flat car is about the same length as an average box car, and is equipped with extra heavy journals so that it can easily carry all but the very largest generators as completely assembled units. Instead of the usual eight wheels on two trucks, the car has 16 wheels on four trucks. It weighs about 106,000 pounds.

The most powerful electric motor ever built — 83,000-horsepower — has been installed at Arnold Engineering Development Center, Tullahoma, Tenn. The motor is part of a 216,-000-hp electric drive for transonic and supersonic wind tunnels, which will be available for research to the Air Force, Army and Navy, and to all parties—in government, industry, and science—interested in aircraft development. The

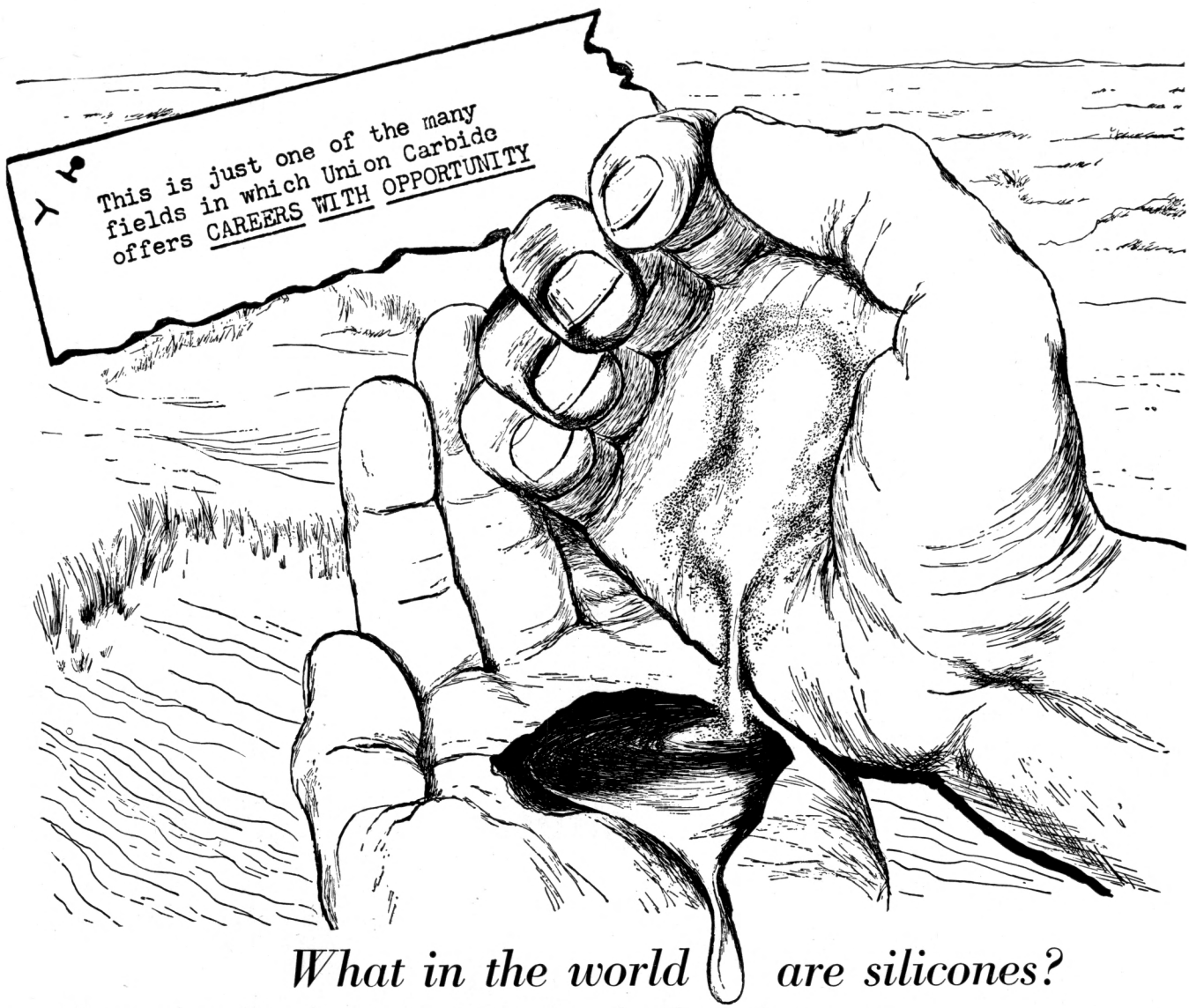
(*Continued on Page* 38)



Sixteen wheels on this heavy duty flat car are enough to carry all but the largest generators.
—Westinghouse



The stator of an 83,000 horsepower motor is being lowered into place.
—Westinghouse



What in the world are silicones?

These astounding chemicals—born of sand and oil—hate water, laugh at heat and cold, and are doing remarkable things for you and industry

SILICONES are the fabulous offspring of an unusual chemical marriage between sand and oil. Sand, the basic material for glass, gives silicones some of the best features of glass. Oil, source of many plastics, gives silicones some of the special qualities that have made plastics so useful to all of us.

WIPE ON . . . WIPE OFF—Silicones are the secret of the new, long-lasting automobile and furniture polishes that you simply wipe on and wipe off. Another silicone forms a water-tight bond between tough glass fibers and plastics that go into radar domes for airplanes, boat hulls, even washing machine parts.

WHEN APPLIED TO MASONRY WALLS, silicones are at their amazing best. A one-way street for water, they keep rainwater from penetrating, yet let inside moisture out!

THEY LAUGH AT HEAT AND COLD—Heat-resistant silicone insulation protects electric motors at high temperatures. Yet silicone insulation on jet plane wiring remains flexible, even in the brutal cold of the stratosphere. And silicone oils and greases withstand both arctic cold and tropic heat!

SILICONES AND THE FUTURE—Even the scientists don't know all the answers about silicones. But they do know there is an exciting future ahead for them. The people of Union Carbide, who pioneered in many of the special silicones now used by industry, are helping to bring that future closer to all of us.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Ask for booklet G-2.*

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HOW TO DESIGN FOR LOWER STRUCTURAL COSTS

WITH today's accent on cost, there is a promising future for the designer who can simplify structural designs to save steel and construction manhours. Such savings are being realized every day by the use of arc welding instead of riveting in the construction of all types of industrial plants, multi-story buildings and bridges. By eliminating rivets and taking advantage of rigid framing and continuous beam construction, welded designs help to offset the rising costs in labor and materials.

Shown below is a typical example of how full structural continuity achieved through arc welding effected savings of $22,000 in the construction of an 87,000 square foot process warehouse. Arc welding actually has saved 1.68 pounds of steel per square foot. At $0.15 per pound for fabricated steel, the saving amounts to $22,000 over the cost of steel alone had riveted design been used.

In spite of the rapid progress made in the construction field by the welding industry, new developments are taking place every day which are of prime importance to the structural engineering graduate. Latest information on welded structural designs is available in handbooks and bulletins simply by writing to The Lincoln Electric Company, Cleveland 17, Ohio.

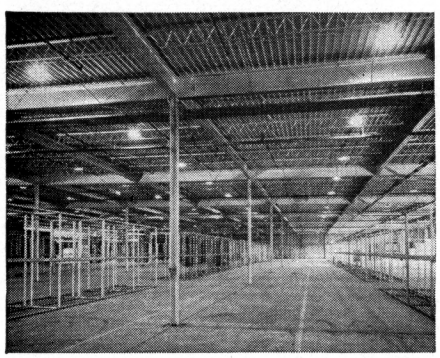

Fig. 1. Process warehouse *for the Hale-Halsell Grocery Co., Tulsa, Oklahoma. Size 250' x 350' with 16' clear height. Contractor: Tulsa Rig and Reel and Manufacturing Co. Consulting Engineer: David R. Graham & Associates, Tulsa, Oklahoma.*

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 17, OHIO
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

MIZZOU MEMOS

(Continued from Page 17)

of the Fellows being made by the National Research Council of the National Academy of Sciences of Washington, D.C. The purpose of the Fellowships is to promote research activities in the general field of electronics and to give special graduate training to persons working in that field. A limited number of these Fellowships are available each year and the Fellowships are open to any citizen of the United States. Mr. Lago will spend the year as an RCA Fellow at Purdue University, doing research work in the general field of Feedback Control Devices.

BULLARNEY

(Continued from Page 22)

"That's all right," she said sweetly. "I stepped on a grape on the way in."

♣

The fellow and girl charged around a corner and bumped smack into each other. They stepped back, apologized, and started up again. But they both dodged in the same direction, and bumped once more. Again they started up, bumped, and apologized. This time the fellow stepped back, raised his hat and gallantly remarked, "Just once more, cutie, then I really have to go."

♣

"I sure feel rotten today. Couldn't sleep a wink last night."

"Well, why didn't you pull the shade down?"

"Because I couldn't reach across the street."



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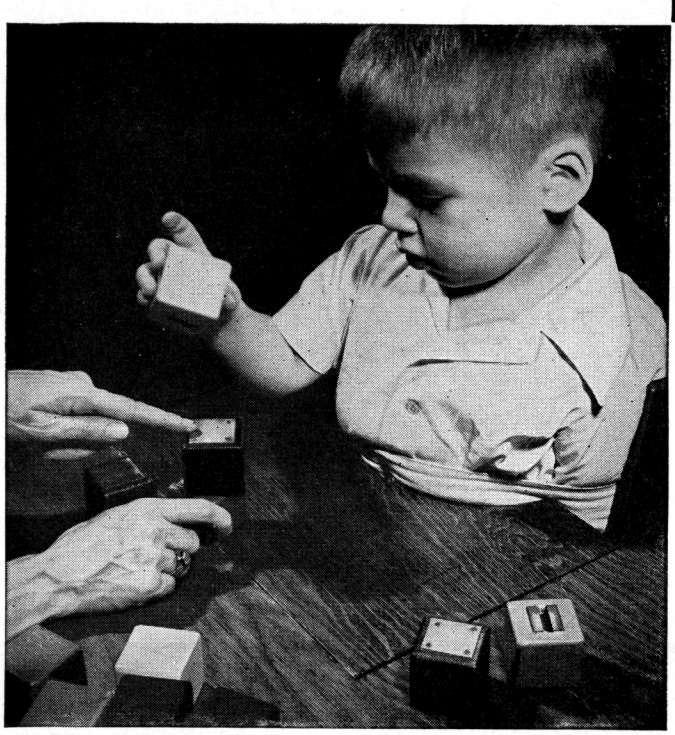
What's Happening at CRUCIBLE

about Alnico Permanent Magnets

You will find Crucible Alnico Permanent Magnets in products ranging all the way from cuff links to magnatrons. Here are just a few unusual applications in which these magnets were used to simplify or improve a product.

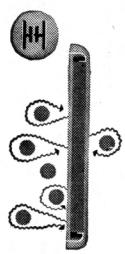
This is Warren, age 4, a cerebral palsied youngster, using magnetic toys in therapy-play.



Magnetic Toys Cerebral palsied youngsters at the Children's Rehabilitation Institute, Cockeysville, Maryland, are unable to play with normal toys. Their lack of muscular coordination and control, causes ordinary blocks or toys to slip through their grasp and fall to the floor. Crucible helped overcome this problem by imbedding small permanent magnets in the toys. By using these magnet-equipped toys on metal topped tables, the children are able to control them much more easily.

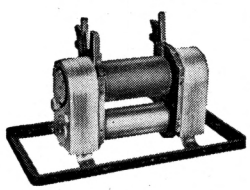
The Children's Rehabilitation Institute has pioneered techniques to help these handicapped children gain maximum muscular control and coordination. Experience at the Institute has shown that the use of magnetized toys helps develop coordination in hand and arm use, and in grasping and releasing.

Cuff Links One manufacturer of cuff links had a happy idea. He replaced the stem with a magnet assembly designed by Crucible magnet engineers. The tiny, powerful aspirin-sized magnets used, gave the finished product a holding force at the pole plate as high as 80 ounces troy.



Enlarged cross section view of one cuff link.

Telescriber-Recorder In one application, for this instrument that transmits written messages over wire, two permanent magnets were being used to match the electromagnetic fields. Assembly time and unit costs were high. Crucible magnet specialists designed one permanent Alnico magnet to replace the two. Magnet costs were cut 50% . . . and efficiency of the unit was increased.



Top bar Crucible Alnico; lower bar (replacing former 2nd magnet) provides return path.

Engineering Service Available

Perhaps your magnet problems are entirely different from these. Whatever they may be, our staff of magnet and electronic engineers will be glad to tackle them, and to work with you in meeting your magnet requirements. Don't hesitate to call us when you have an application for permanent magnets.

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96 Years
of Banking

MEMBER F.D.I.C.

DEAN GREENE

(*Continued from Page* 16)

of Great Britain, the Engineering Foundation and the American Engineering Council.

Active in Civic Affairs

Dean Greene was a prolific writer on technical subjects. He was the author of "Elements of Heating and Ventilation," "Elements of Power Generation," and "Elements of Hydraulic Power Generation."

Commissioner of the New Jersey Board of Professional Engineers and Land Surveyors from 1941 through 1946, Dean Greene was deeply interested in civic affairs. He was a former president of the Borough of Princeton's Board of Education and for many years a senior member and officer of the board of trustees of the Princeton Hospital.

At his retirement from the University, he was a consultant with fifteen organizations, including the Prudential Insurance and Hydraulic Press Manufacturing Companies and Governmental advisory agencies at both the Federal and State levels.

During World War II Dr. Greene was a special consultant to the War Production Board, the Office of Inter-American Affairs and the Army's Second Service Command.

His wife, the former Mary Elizabeth Lewis, who was also a distinguished educator, died early in 1949.

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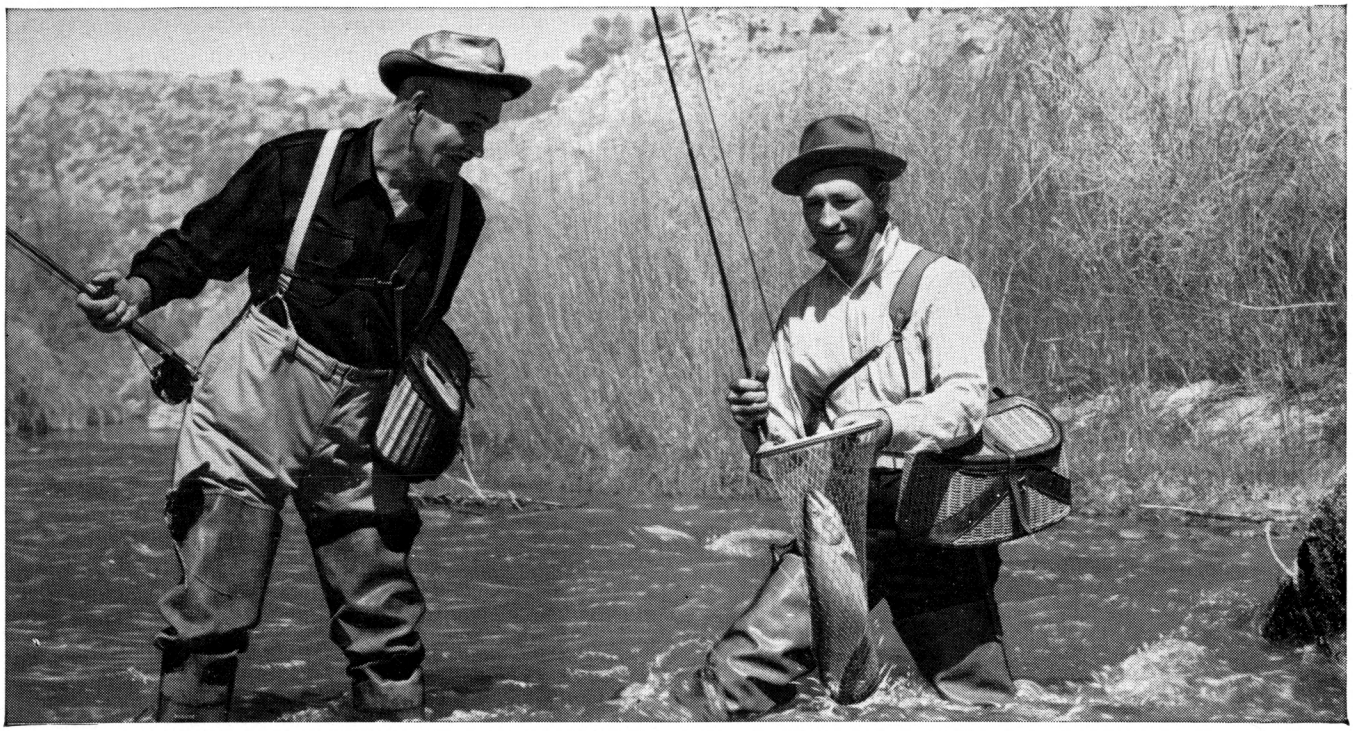

THE BEST YEARS of his life are not all past for Tom Toman (left) of Casper, Wyoming. Tom retired over five years ago after 26 years with Standard Oil. He's here shown fishing on the North Platte River, with his son, Rudy, now one of our employees at Casper. Every month Tom receives retirement income provided through his and the company's contributions to Standard Oil's retirement plan while he was working.

TESTED WAYS TO BETTER LIVING

BETTER LIVING can begin with your job. The fact that 19,900 employees of Standard Oil and its subsidiary companies have been with us for more than 10 years is evidence of that.

What do all these people find in their jobs that keeps them happy?

Steady work at good pay comes first to mind. But in addition to being assured of better-than-average earnings with a growing and progressive company, Standard Oilers can work with the company toward security for themselves and their families. Employee benefits have been steadily improved since the company's first retirement checks were mailed to Standard Oilers in 1903. Our present retirement plan, in which more than 90% of our eligible employees participate, is part of one of the broadest employee benefit programs in any industry.

These benefits help guard against financial stress in case of accident—on or off the job—or sickness, and bring such things as hospitalization, regular savings, and stock ownership more easily within reach.

Every job here is important in some way to every other job, too—so that all our 51,000 employees, pulling together, help make Standard Oil an even better place to work.

Finally, when you know that your efforts are important to your community and to your country, you can feel you not only make a good living, but you're living well.

Standard Oil Company

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DADDY'S PROUD—and relieved. Melvin Long of our Champaign, Illinois, bulk plant paid a large part of the expenses of daughter Patricia Ann's arrival through Standard Oil's contributory Group Hospital Expense and Surgical Operation Insurance Plan, which covers employees and their immediate families.



IT'S NO FUN TO BE SICK—but Lydia Wagener and her visitor, Sophie Szkarlat, both of our Detroit office, know she is protected under Standard's Sickness and Disability Benefits Plan, and its Occupational Illness and Injury Plan. Employees receive substantial payments in emergencies caused by sickness or injury either on or off the job.



SAVINGS PAY OFF double at Standard Oil. Catherine Lynch and Elizabeth Faller help issue bonus stock certificates. Under our Savings and Stock Bonus Plan, 29,410 employees have bought U. S. Savings Bonds and received, in turn, shares of company stock at no cost to become stockholder-owners of Standard Oil.

MERAMEC PLANT

(*Continued from Page* 15)

radiation of heat from the flue gasses.

The first section of the boiler is constructed of tubes set side by side in all four walls. Pulverized coal is blown into this section with four nozzles in each corner of the boiler. Temperatures in this section are around 2100 degrees Fahrenheit. This heat is transferred by radiation to the comparatively cool water walls, and the water reaches saturation temperature and boils. This steam is collected in the main drum and sent to the superheating tubes. Here, the steam is heated by convection and radiation to even higher temperatures and sent to the turbine.

The flue gases then pass over the reheat tubes and increase the temperature of the steam taken from the first section of the turbine. The reheater section has an automatic spray device that sprays water into the reheat steam drum. Surprisingly enough, this extra steam that is forced into the second section of the turbine makes the output of the generator increase by two or three thousand kilowatts.

At still a very high temperature, the flue gas enters the economizer section. The water from the heaters is heated in this section and sent to the water walls where the temperature is raised to the saturation point.

After the flue gases pass through the preheater section, where both primary and secondary air are heated to about 150 degrees Fahrenheit, it enters the precipitator.

Studies made on the boiler during the past summer fix the efficiency, at operating loads, around 89%. These studies were made by evaluating the losses in the boiler. At high loads, the water walls have a tendency to slag, and it is felt that more excess air will alleviate this condition.

From tests made this summer, the precipitator was found to remove better than 97% of the solids in the flue gas. These solids are removed by two very large electrostatic cells. Wires and plates are charged alternately with high voltages. Such a charge attracts the particles, and removes them from the flue gas. Periodically the wires and plates are rapped with electric solenoid connected to the plates and the dust falls into a hopper. This dust and the ashes from the first and second section of the boiler are sluiced with water into a large lake. Although there is very much of this ash thrown away every day, no use has been found for the material so all of it can be utilized. It can be the basic material for under blocks; and since it contains trace elements, it may be used as a soil additive.

So far, the two main phases of the mechanical side of this steam power plant have been presented. However neither of these will operate unless thousands of dollars of auxiliary equipment is also installed. Among other things, coal must be supplied, and cooling water must be circulated into the condensor. The immensity of those two auxiliary operations deserves further discussion.

AUXILIARIES

As was noted before, the condensor was not placed on a level with the river. The top of the condensor is sometimes 45 feet above the river level, and yet a siphon effect takes place. It has been said before, that water will not siphon over height of about 32 feet. Yet this circulating water system syphones better than 32 feet and pumps a pressure of 36 feet of water, no matter what the river level is. If one analyzes the friction in the condensor and the piping to the Mississippi river, he will find that a siphon of better than 32 feet is possible. The chief factor accounting for this is the pipe friction on the downstream side. The condensors for both the first and second units are connected to the river by two 96 inch pipelines. The untreated water that flows through these lines in one day is enough to supply

(*Continued on Page* 32)

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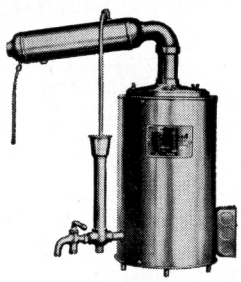

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● Claud M. Kellett, Jr. received his Bachelor of Electrical Engineering degree from Georgia Tech in 1950.

Claud's first year at Allison was spent in the company of other recent engineering graduates in a college graduate training program. This program helped him gain practical experience in the activities of selected departments throughout the Allison plants. On the completion of his training, a call to active duty with the Army delayed Claud's permanent assignment to an Allison department. However, the twenty-one months he was away did not diminish his opportunities in the least. When he returned early this year he was able to resume his career in engineering with the result that today he is an experimental engineer concerned with electronic instrumentation in the Research Group of the Transmission Test Department.

The torqmatic converter turbine that Claud is working with is a vital element in the operation of Allison heavy duty transmissions. Allison is the world's largest manufacturer of torqmatic drives for heavy duty Ordnance and commercial vehicles and equipment. The commercial converters and transmissions are used in scrapers, tractors, trucks, cranes, shovels and drilling rigs.

The problem presented to him in connection with the turbine was to find the level of residual stresses created in the turbine by repair welding performed on the hub. The feasibility of such welds might then be determined. Claud applied variable resistance type strain gages to the turbine vanes at their exits and read their strain levels with the strain indicator. Then he cut the vanes around each of the strain gages to relieve residual stress and re-read the strain levels. From the difference in strain between the stressed and relieved conditions he was able to calculate the residual stress induced by the welds.

Yesterday Claud was interested in torsional vibration and the electronic "know-how" required to present it for oscillographic recording. He knows that tomorrow the many tests of transmissions and component parts will each present unique problems. Pressure transducers, vibration pick-ups electronic flow meters and tachometers must be installed with a myriad of complicating factors ever present. Equipment not available must be designed and built, or existing equipment modified. A future at Allison holds a constant challenge of doing that which has not been done before.

Allison is looking for young men with degrees in **MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, AERONAUTICAL ENGINEERING** ***and*** **INDUSTRIAL ENGINEERING.** ***There are also a number of openings for majors in Metallurgy, Electronics, Mathematics and Physics.*** Write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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MERAMEC PLANT

(*Continued from Page* 30)

the city of St. Louis with half its daily needs.

The outlet of the siphon has a water seal so that at low river levels, the siphon will not be broken. When the river is below the outlet, or the temperature high, a valve in the outlet line is closed to maintain sufficient back pressure to prevent the river water from boiling and breaking the siphon. Thus, the circulating water system operates at all phases of river level and temperature.

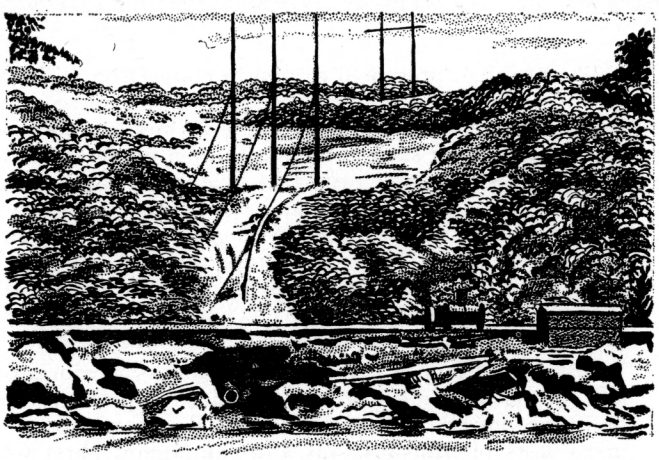
Every hour the boiler burns better than 50 tons of coal, and more than 600 tons of air. The coal is taken from a coal barge on the river, conveyed to a breaker house, broken into uniform size, and conveyed into coal bunkers. From the bunkers, the coal is metered into the coal mills, ground into talcum powder fineness, and blown into the boiler. Any time there is more coal available than what is needed to fill the bunkers, a storage pile is used. Excess coal is conveyed from the breaker house to a hopper in the yard. A huge scraper with 160 hp in each of two engines, carries 15 tons of coal from the hopper to the pile in one trip. Facilities are also available to move coal from the storage pile to the boiler bunkers. In case trouble develops along these lines, coal may be brought in by truck or rail. Thus the hungry boiler is sure of a full supply of coal at all times.

CONTROL ROOM

This power plant is very much like a human body. Impulses are sent from a brain or central control station and used to actuate the muscles or machinery. The Meramec Plant has such a brain. All controls for both unit boilers, turbines and associated equipment is concentrated in one central, air conditioned and sound proofed control room.

There, surrounded by dials and switches, instrument boards and control panels, the station operator has complete and detailed data on all phases of plant operation at his fingertips. If anything goes wrong, he is able to take instant corrective action without leaving his station. One operator will be responsible for the centralized control of each unit. Roving attendants, inside and outside the plant, handle local adjustments under his direction. In addition to the constant stream of routine data, automatic alarms have been built in for emergencies. If anything goes wrong, illuminated messages will flash on the appropriate panel, and loud signals will go into action.

Such is the power and control of one of the newest "kilowatt factories" in this area. Already other plants are generating more watts per unit and the industry is still growing.



The first submarine installation of a pipe-type cable system was recently installed under the Hudson River at Poughkeepsie, N.Y. Three cables, each nearly ¾-miles long, were simultaneously pulled into a six-inch welded steel pipe laid across the river bottom. The pipe was then filled with oil maintained at 200 lbs. pressure, enabling a 110,000-volt power circuit to cross the river safely.

This kind of system is called Oilostatic—a design which has long been first choice among utilities for handling large blocks of power by means of a high-pressure pipe-type cable system. Increased circuit reliability and savings on installation and maintenance costs are realized.

Oilostatic's new role as a submarine cable is typical of the significant contributions to better electrical service made by Okonite engineers.

• • •

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

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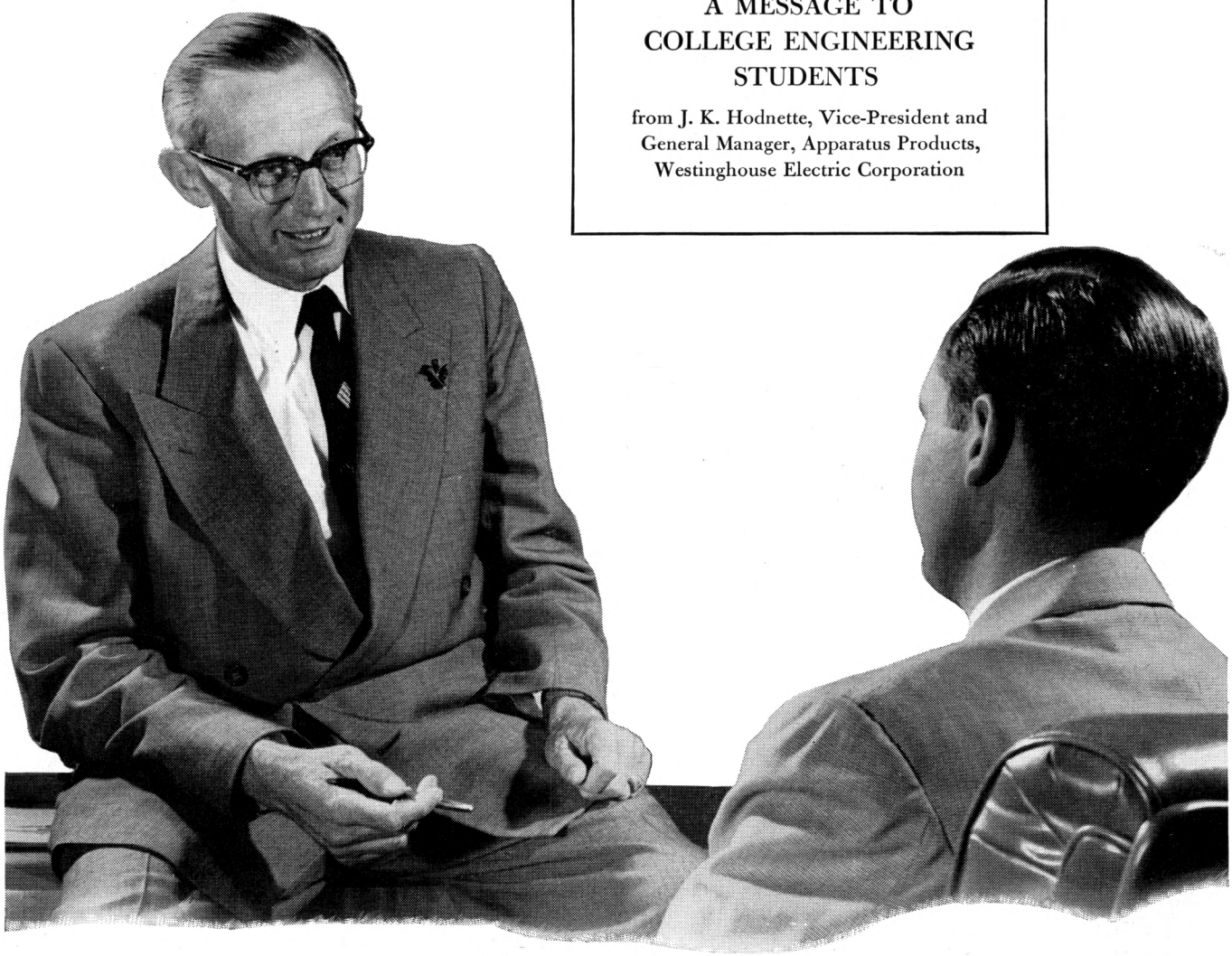
A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from J. K. Hodnette, Vice-President and General Manager, Apparatus Products, Westinghouse Electric Corporation



To the young man with a vision of success

Success means different things to different men. It can mean professional recognition, or great achievement, or exciting work, or many other things. Whatever its special meaning to you—keep its image in your mind, for you are already well on the way to achieving it!

If you are *determined* to become a research scientist, you *can* be. If you have a burning ambition to become a sales engineer, you can be. If you have your sights set on a top executive spot, you'll be there someday. One might think a large company like Westinghouse would have more pressing things to think of than the ambitions of its young engineers. On the contrary, nothing is more important . . . for our professional people are our biggest asset.

Here at Westinghouse, intensive efforts are made to help our professional men realize their individual goals —through extensive training programs, study programs leading to advanced degrees, leadership programs, and guidance in professional development. You are treated as an individual at Westinghouse.

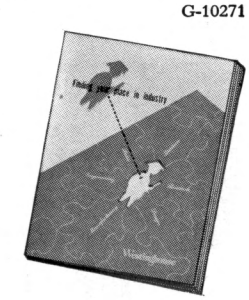
If you have the will, and are prepared, we can show you the way.

G-10271

YOU CAN BE SURE...IF IT'S
Westinghouse

For information on career opportunities with Westinghouse, consult Placement Officer of your University, or send for our 34-page book, *Finding Your Place in Industry.*

Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 N. Seventh Street, St. Louis 1, Missouri.



BLUE STEM LAKE

(*Continued from Page* 18)

stream. None of these pits are to be emptied to bed rock, but a minimum of six feet of impervious materials is left above the rock to insure against water leakage through the cavernous formations. As the material comes from these pits, it is placed in the embankment and worked until 95 per cent of maximum compaction is reached in the core and 90 per cent in the two shells.

Total compaction will be determined by the modified Proctor test which compares total compaction with maximum. Tests will be run daily to insure that the contractor is compacting the embankment as specified.

20,650 cubic yards of rock excavated from the spillway will be placed in riprap. The 500 foot spillway will require excavation of 55,000 cubic yards of rock and placement of 3,400 cubic yards of concrete. There will also be an auxiliary spillway 300 feet in width, for a safety device against floods; this will require some excavation but no concrete emplacement.

All trees and underbrush along the shore line from a contour five feet below to a contour two feet above normal reservoir level must be removed in order to have a clean shore line. All other trees in the lake bed will be cut. The soft wood is at the disposal of the contractor while the hardwood is removed from the lake bed and stock piled for disposal by the city.

A 30 inch prestressed concrete pipe will carry the water from the intake to a junction with the pipe line from Lake El Dorado nearby. And the city of El Dorado rises to meet its increasing need for water.

AROUND THE COLUMNS

(*Continued from Page* 19)

possibly be in San Diego for another three months of training. You will no doubt recall that Rex graduated this past August and was also commissioned in the United States Navy.

♣

Sam was in St. Louis once this summer and ran into a past, baldheaded, editor of this mag, and his consort, an E.E. instructor who rams electrons and their ramifications down poor peoples' throats. This is pure rumor, but I hear that they drank better than a quarter of a hundred dollars in beer in one night. Heard they got up from the table once—but they were gone so long, they missed the floor show.

♣

Always seem to pick on the E.E. instructors around here. Sam found that you can teach an old dog new tricks. I taught one, during the summer, how to throw beer cans out of car windows without the wind splashing that glorious, but sticky, foam all over his arm. Throw them out by holding, then releasing the bottom end of the can. It works wonders—and old dogs can learn.

♣

One of the newer instructors (an E. E., of course) swears up and down that a tree moved right in front of his high speed Black Hornet automobile. Sam has an opinion that trees generally stay in one place; relative, of course, to other immovable surroundings.



Cutters that give More Clean Cuts Per Dollar

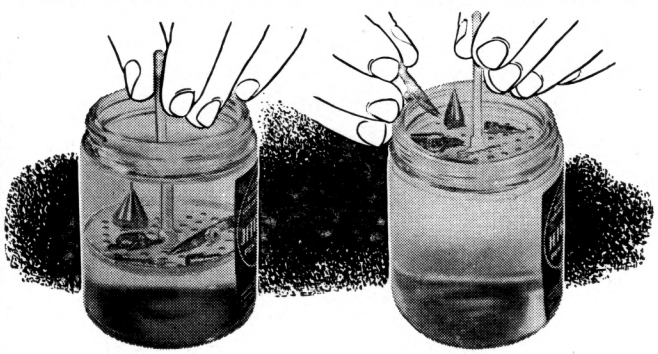
Every cutter in the broad Brown & Sharpe line is carefully designed and manufactured to lower *real* cutter cost . . . give more smooth, clean cuts per dollar invested. Complete selection of types and size to improve milling efficiency on any job. Write for illustrated Catalog.

Brown & Sharpe Mfg. Co., Prov. 1, R. I., U.S.A.

Brown & Sharpe B·S

for your added convenience . . . a handy new package for HIGGINS PEN CLEANER

It would be difficult indeed to improve on the popular cleaner which makes all your pens and instruments better than new . . . but we now make it even easier for you to use!



A plastic strainer in each 6 oz. jar invites you to drop instruments and parts unconcernedly in cleaner.

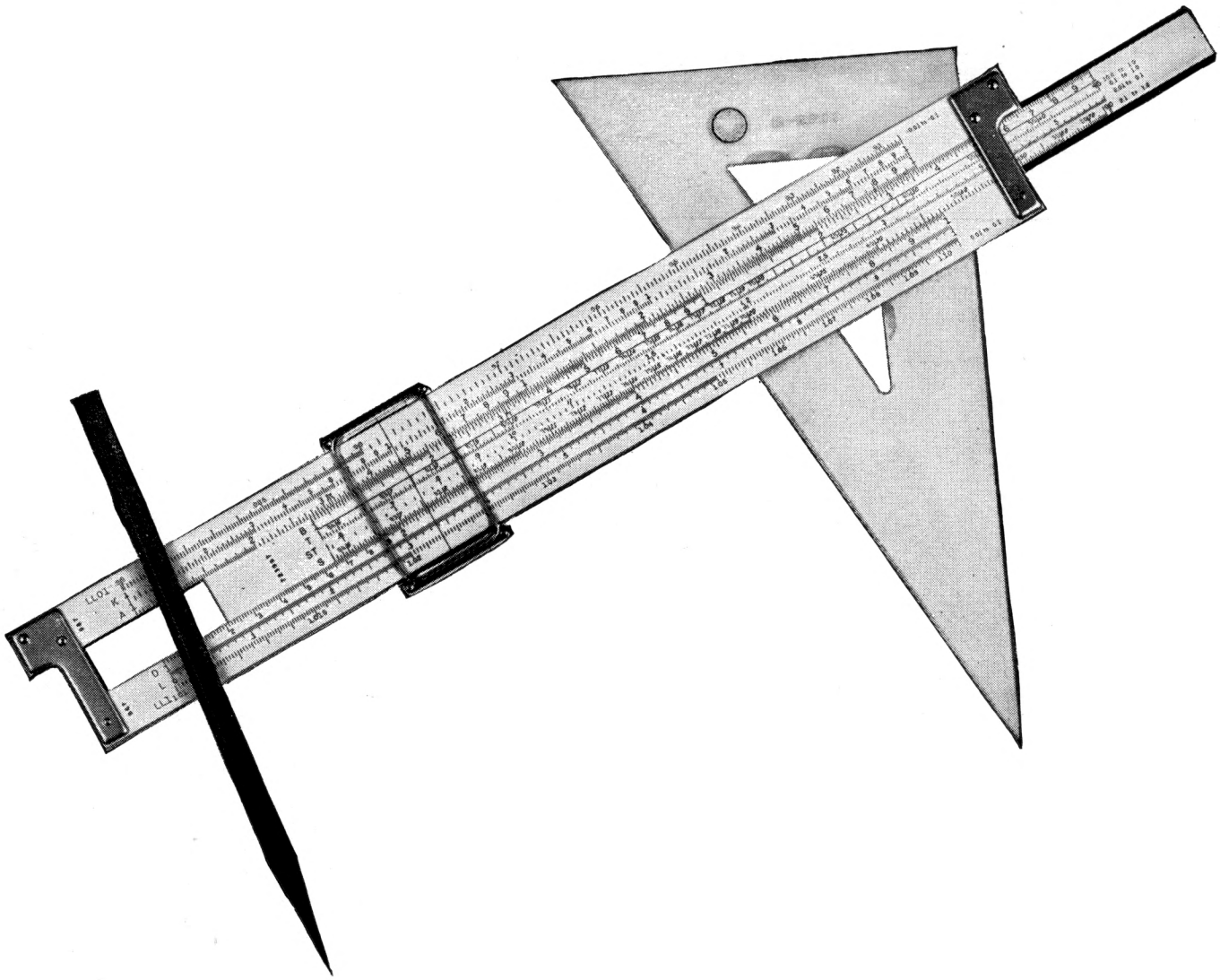
Simply lift strainer to retrieve thoroughly cleansed instruments without soiling fingers and without clumsy fishing in jar.

ODORLESS
NON-INFLAMMABLE
NON-VOLATILE • HARMLESS TO HANDS, CLOTHING, PENS AND INSTRUMENTS



HIGGINS INK CO., INC., BROOKLYN, NEW YORK

6 oz. jar



You'll find classmates—and a future—at Boeing!

Men from more than 120 top engineering schools are building rewarding careers at Boeing. So chances are, you'd be working with some of your classmates here. And in addition you'd be a member of an Engineering Division renowned for its trail-blazing contributions to both military and civil aviation.

If that's the kind of engineering prestige you'd like to enjoy, look into Boeing opportunities. This company has been growing steadily for 37 years.

It provides the finest research facilities in the industry. It offers you work on such exciting projects as guided missiles and the fastest known bomber in the world: the B-47 six-jet medium bomber, as well as the still-classified B-52 eight-jet heavy bomber.

You can work in Seattle, in the Pacific Northwest, or in Wichita, Kansas. Boeing provides a generous moving and travel allowance, gives you special training, and pays a good salary that grows with you.

Plan *now* to build your career as a member of Boeing's distinguished Engineering personnel after graduation. Boeing has present and future openings for experienced and junior engineers in aircraft

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also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

For further information, consult your Placement Office, or write:

RAYMOND J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

TECHNICAL ARTICLE Contest!

For the Best Article Published in

THE MISSOURI SHAMROCK

NOW!! THREE PRIZES

FIRST PRIZE, $25

Contributed By

Missouri Society of Professional Engineers

SECOND PRIZE, $15

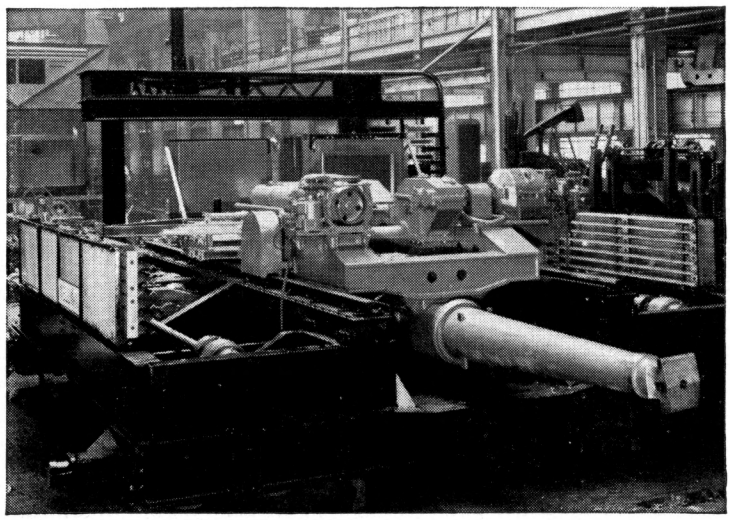
THIRD PRIZE, $10

OFFICIAL RULES

1. Articles may be technical or semi-technical on any engineering subject.
2. All students of the College of Engineering are eligible.
3. All articles should be 1200-3000 words in length.
4. All articles submitted become the property of the SHAMROCK and may be changed, edited, or published at the discretion of the staff.
5. Judges will be Dean H. O. Croft, Prof. M. M. Bolstad, Dr. Edwin Wetterstrom, Dr. R. H. Luebbers and the Editor of the SHAMROCK
6. Judging will be on a point basis for suitability, accuracy, reader interest, coherence, and general effect on the reader. Winners will be those with largest number of points.
7. Contest closes March 15, 1954.
8. Winners will be announced in the May issue.

Here is your chance to win a prize and have the fun of seeing your by-line in print!

Another page for **YOUR BEARING NOTEBOOK**

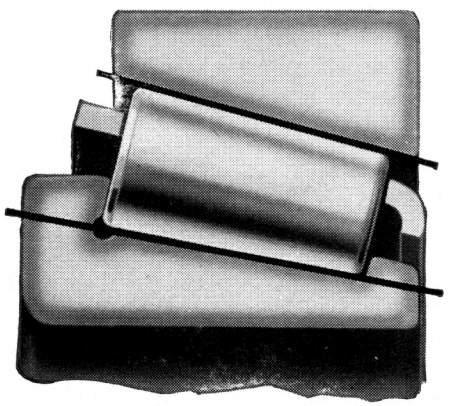


How to carry a floor charger's 12-ton overhung load

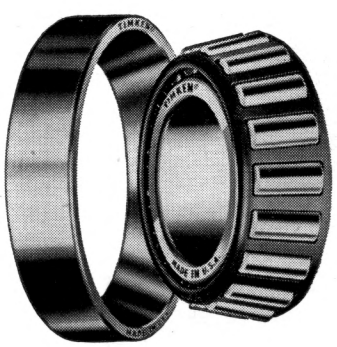
This floor charger charges and levels 12 tons at a crack in open hearth furnaces. The 12-ton overhung load and the terrific shock loads set up by the charging operation are carried by the peel shaft bearings. To take these loads and to keep the charger in top operating shape, design engineers specify Timken® tapered roller bearings.

Line contact gives TIMKEN® bearings extra load-carrying capacity

In Timken bearings, the load is carried on a line of contact between the rollers and races instead of being concentrated at a single point. Rollers and races are case-carburized to give a hard, wear-resistant surface over a tough, shock-resistant core. And to be sure of getting the highest quality bearing steel, the Timken Company makes its own.



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST —◎— LOADS OR ANY COMBINATION ✳

THE DEAN SPEAKS

(*Continued from Page* 12)

of the club how you may help, or ask the Editor of the Shamrock what you may do to make it an even better magazine.

Only by taking part in student activities will you begin to learn of the difficulties involved in human relations; of the importance of committee work; and of the contrariness of human nature in the operations of democratic lessons of your college career, which you may not learn either from books or in classrooms.

Your charted course is quite clear then: study consistently; waste no time; take advantage of the many intellectual entertainments provided in a great University center; sample books and magazines in the library; and take an active part in student activities. If you follow this course, from past experience we can almost guarantee that your educational experiences here will provide you with the best possible background for an outstanding career in the engineering profession.

NEWSTUFF

(*Continued from Page* 24)

giant synchronous motor is one of two such units built by the Westinghouse Electric Corporation in East Pittsburgh, Pa. The second unit will be installed in the near future, along with two 25,000-hp Westinghouse wound-rotor induction motors. Each 83,000-hp motor stands 21½-feet high, and weighs 225 tons. Their 122-ton rotors will turn at 600 revolutions per minute. In addition to the 216,000-hp four-motor drive, the rotating machine will have five compressors, now under construction at the Westinghouse plant in Sunnyvale, Calif. Work on these transonic and supersonic compressors is not expected to be completed for at least another year. The transonic compressor will be a single unit, but the supersonic compressor will be made up of four compressors coupled as one. Blades for the compressors measure two feet across the face, are six feet long, and will be mounted on a spindle 18 ft. in diameter. Weighing almost two thirds of a ton each, the blades will be solid forgings. Although the machine will have the highest stored energy of any rotating mass ever built, it can be brought to a halt in about three minutes by using its wound-rotor motors as brakes, the energy being dissipated in liquid rheostats. During operation, the wind tunnels will require 100,000 gallons of cooling water per minute to reduce the air discharge temperature to about 600 degrees F. However, air in the test chamber will be about 100 degrees F below zero. The transonic wind tunnel is scheduled for completion early in 1955. The supersonic tunnel will be completed in 1957.

Even more newstuff is in the air. Techniflex Corp. announces the full-scale production of a gadget that will automatically dim your lights when approaching another vehicle on the open highway . . . Eastman Kodak color scientists have published a 700-page book, "The Principles of Color Photography," the most complete color photography manual ever written. . . . And Morris Paint and Varnish Company announces a paint that will stop fires from spreading. When heated, it will release carbon dioxide to smother the flames.



● ALBANENE,* a K&E product, is the preferred tracing paper in thousands of drafting rooms. It is transparentized, not with messy oils that leak, but with a special synthetic transparentizer developed by K&E. ALBANENE does not turn brittle or lose its transparency with time. After years it is as good as new. *Trade Mark®

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"Allis-Chalmers Graduate Training Course Was Just What I Needed,"

says LOWELL E. ACKMANN

University of Illinois—B.S., E.E.—1944
and now manager, Peoria, Ill., Branch Office

"MY EXPERIENCE with machinery in the Navy during the war convinced me I needed a training course. There was so much equipment on board that was a complete mystery to me that I became very 'training-course minded'.

"After investigating many training courses, the one at Allis-Chalmers looked best to me then—and still does.

"In my opinion, the variety of equipment is what makes Allis-Chalmers such a good training spot.

"No matter what industry you may be interested in, Allis-Chalmers makes important, specialized equipment for that industry. Electric power, steel, cement, paper, rock products, and flour milling industries—to name a few, are big users of A-C equipment.

"Before starting on the Allis-Chalmers Graduate Training Course, I thought I would like selling, preferably technical selling but, as is often the case, I didn't know for sure. This course, together with some personal guidance, helped me make up my mind. That, too, is an important advantage of the GTC program.

"But whether you want to be a salesman or designer, production engineer, or research engineer, Allis-Chalmers, with its wide variety of equipment and jobs, is an ideal place to get off to a good start—without wasting time."

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control, pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

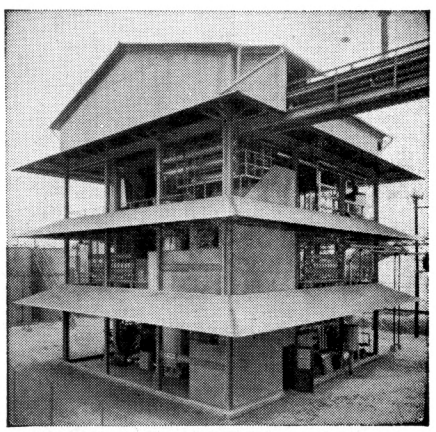
5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

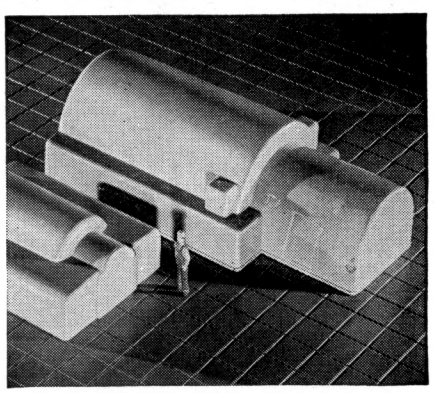
7. For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

C-5676



PROCESSING—Allis-Chalmers built solvent extraction plant processes one hundred tons of rice bran per day at oil processing plant in Texas.



POWER—Models show comparative size of generators having the same rating with and without super-charged hydrogen cooling. Allis-Chalmers is first to supply supercharged hydrogen cooling.

SHAMROCK



SEZ

A couple of our fellow E.C.M.A. members will pick up better than 100 bucks a piece on October 16. They published some winning essays that were submitted to the A. F. Davis Undergraduate Award Contest. This contest is sponsored by the American Welding Society and the rules for this year are in the Shamrock office now. We could very well use around 100 dollars, and so could the author of such a winning essay. Congratulations to the CORNELL ENGINEER and the WISCONSIN ENGINEER.

We haven't heard too much news from the engineering alumni of Old Mizzou, and you may notice the lack of articles about the grads in this month's Mizzou Memos. We don't publish this magazine for our own enjoyment, for there is only enjoyment in the finished product; but we do it for the alumni, students here, and future students who are presently in high school. Why not write us; tell us what you are doing, how many kids you have. Tell us what you did in school or what your nickname was. We want someone to say, sometime, "Oh yeh, I remember 'Stinky' —we used to do Thermo problems together." You still run into old grads once in a while. Ask them what they are doing, and above all, ask if they are subscribing to the Shamrock. We need your support, news-wise, money-wise, and spirit-wise.

You all may notice that there is an article contest this year, as in the past. This time, though, there are three prizes. That makes chances pretty good for collecting something more than pocket money. It seems that we always have to brow-beat to get articles, but we don't have to brow-beat to pass out prize money. Since the Editor has such a short memory, he hasn't written to the M.S.P.E. yet asking for first prize money. The M.S.P.E. has been very generous with us in the past, and we hope they will be as generous this year. Tentatively, we are planning on receiving money for first prize from the Missouri Society of Professional Engineers. The second and third prizes will be taken from the funds of the SHAMROCK. Read the full page ad which gives full contest details.

Late in the summer Ye Ed tried to get an idea of what the advertisers, alumni, and high school principals thought of the SHAMROCK. After he sent out about 70 questionnaires, he noticed a few ambiguous questions. One of them went something like this —"Do you find the jokes crude, disgusting, vulgar or humorous?" Most answers were "No." He hasn't received the number of replies he wanted, and yet none have been returned due to wrong address. So some people still have these things sitting on their desks. We even provided addressed envelopes for return of the questionnaire. Gentlemen, they cost money, and we need a return on our investment. From the answers received so far, there seems to be nothing wrong. Surely, we can't be pleasing all of the people all of the time. Ye Ed wanted to hear a little constructive criticism, and he has received less than little. If the SHAMROCK means so little, why not just mail us a couple hundred dollars, and we'll mimeograph two or three pages a month.

Anyhow, Ye Ed is going at this full swing. He is revising his questions and will have them in the November issue. He will expect everyone to invest in their own envelope and three cent stamp and answer the questionnaire with more than a "Yes" or "No." Maybe we will get a few results and report them to you.

Photography helps a New Steel Mill roll into action

Fairless Works, U. S. Steel's new Eastern Seaboard mill, is now starting operations—and growing—at the same time. And camera and film play their parts in both.



. . . to help locate ore, plot transportation, lay out plants, control quality, improve production, U. S. Steel puts Photography to work.

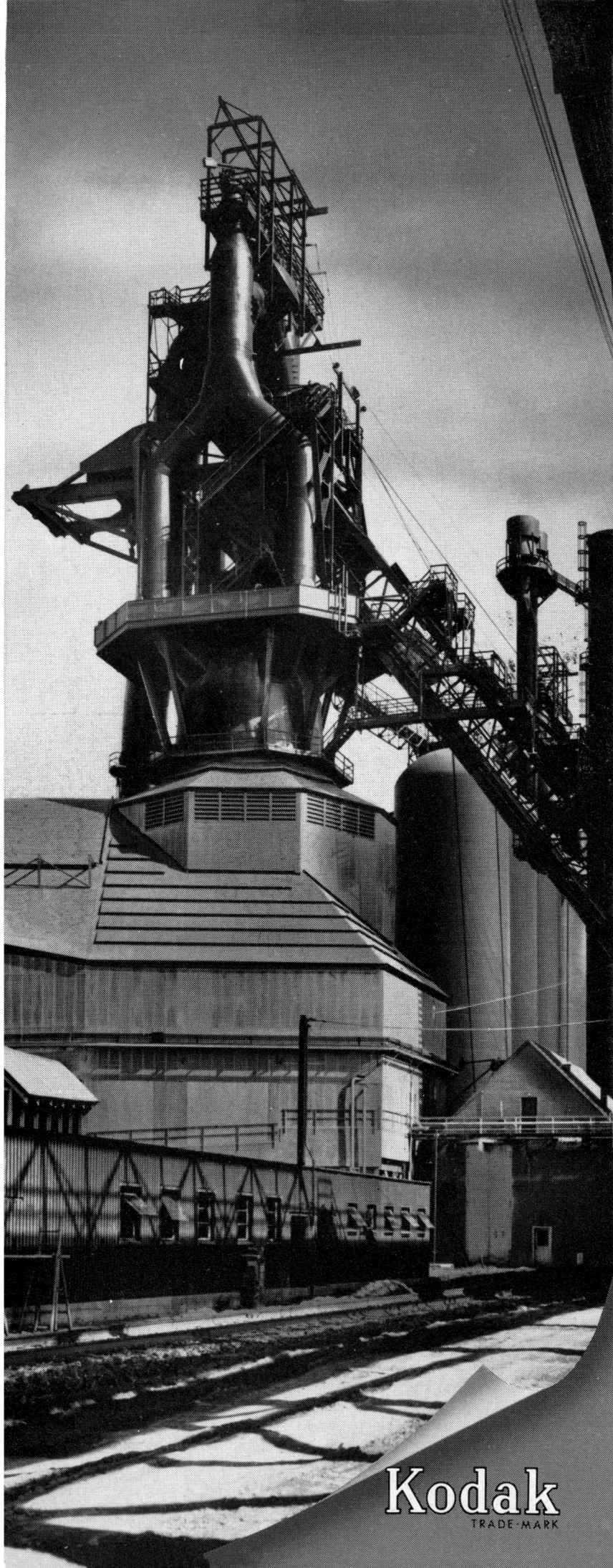
From ore through research and production, Photography is one of Steel's important operation tools. It helped locate and appraise the new Venezuelan Cerro Bolivar deposits which sparked this great new seaboard mill. It helped chart the ore's course to the sea—helped plan the plant and keeps a running record of its growth. And day after day it's at work in the research lab improving steel metallurgy, and on the production line controlling quality.

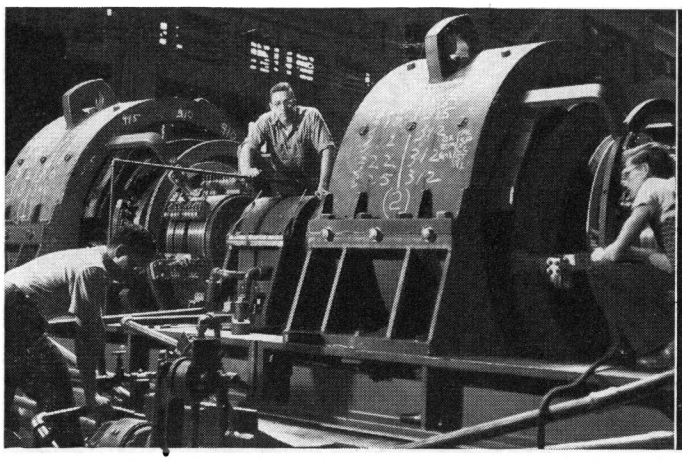
Countless numbers of America's varied industries, large and small, use photography in many ways to save time, speed accomplishment, increase production, and cut costs.

In fact, so many new applications of photography are being found, that many well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. Returning servicemen, too, have found new opportunity here.

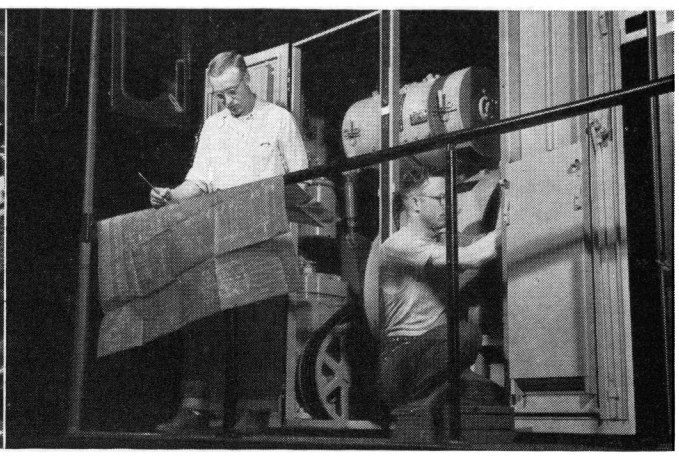
If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, New York





CHARLES SNYDER, R.P.I., (center) adjusting 5250 triple-unit d-c mill motor for use in a steel mill.



Engineers RICHARD RENK, IOWA STATE, (left) and ALLEN FRINK, CATHOLIC UNIV., make last-minute check on 1600-hp diesel-electric switcher before it is moved to test track.

THEY'RE "GOING PLACES" AT GENERAL ELECTRIC

Like these young men pictured here, hundreds of scientists, engineers, chemists, physicists and other college graduates are "getting ahead" fast at General Electric . . . . and they are working on projects with the assurance that their contributions are meaningful and important.

They are moving up rapidly because at General Electric a world of opportunity awaits the college man of today—a world limited only by his own ability and interest. The variety of General Electric products and the diversity of the Company's operations provide virtually unlimited fields of opportunity and corresponding rewards, both materially and in terms of personal satisfaction to young men who begin a G-E career.

New developments—in silicones, electronics, semi-conductors, gas turbines, atomic power, and others—springing from G-E research and engineering, are creating exciting new opportunities, and are giving college graduates the chance of finding satisfying, rewarding work.

And by placing prime importance on the development of talent and skill, developed through G-E training programs and broadened through rotational job programs, and by providing incentives for creative minds, General Electric is hurrying young men into success in an industry that is devoted to serving all men through the ever-increasing and ever-widening uses for electricity, man's greatest servant.

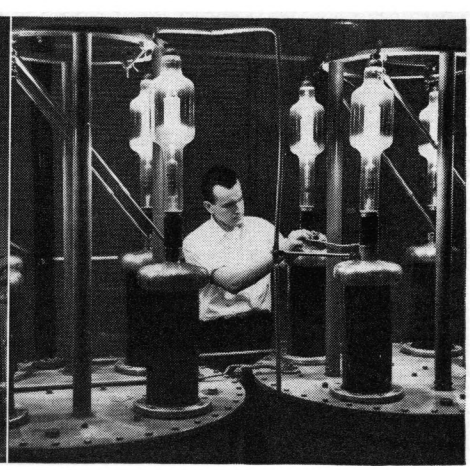
If you are interested in building a career with General Electric see your college placement director for the date of the next visit of the General Electric representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.



Test engineers E. K. VON FANGE, U. OF NEB., (left) and R. E. LOVE, U. OF TEXAS, work on stacker and stapler built by them for homework project.



Physicist ROGER DEWES, BROOKLYN POLY., working with scintillation counter in G.E.'s Engineering Laboratory.



ANTHONY TERZANO, PRATT INSTITUTE, checks connections on direct-current rectifier which charges 7,500,000-volt impulse generator in G.E.'s new High-voltage Laboratory.

GENERAL ELECTRIC

MISSOURI SHAMROCK

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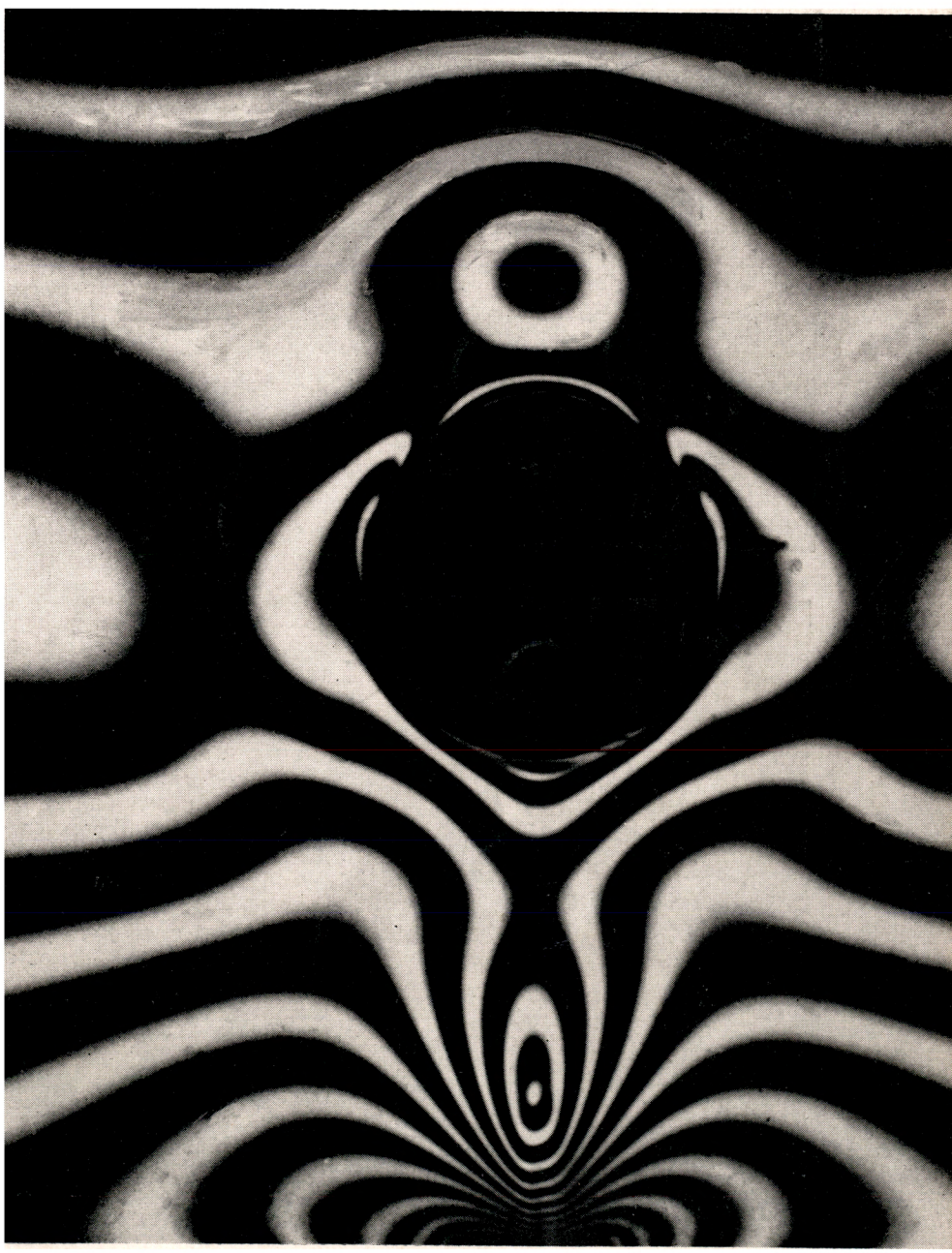
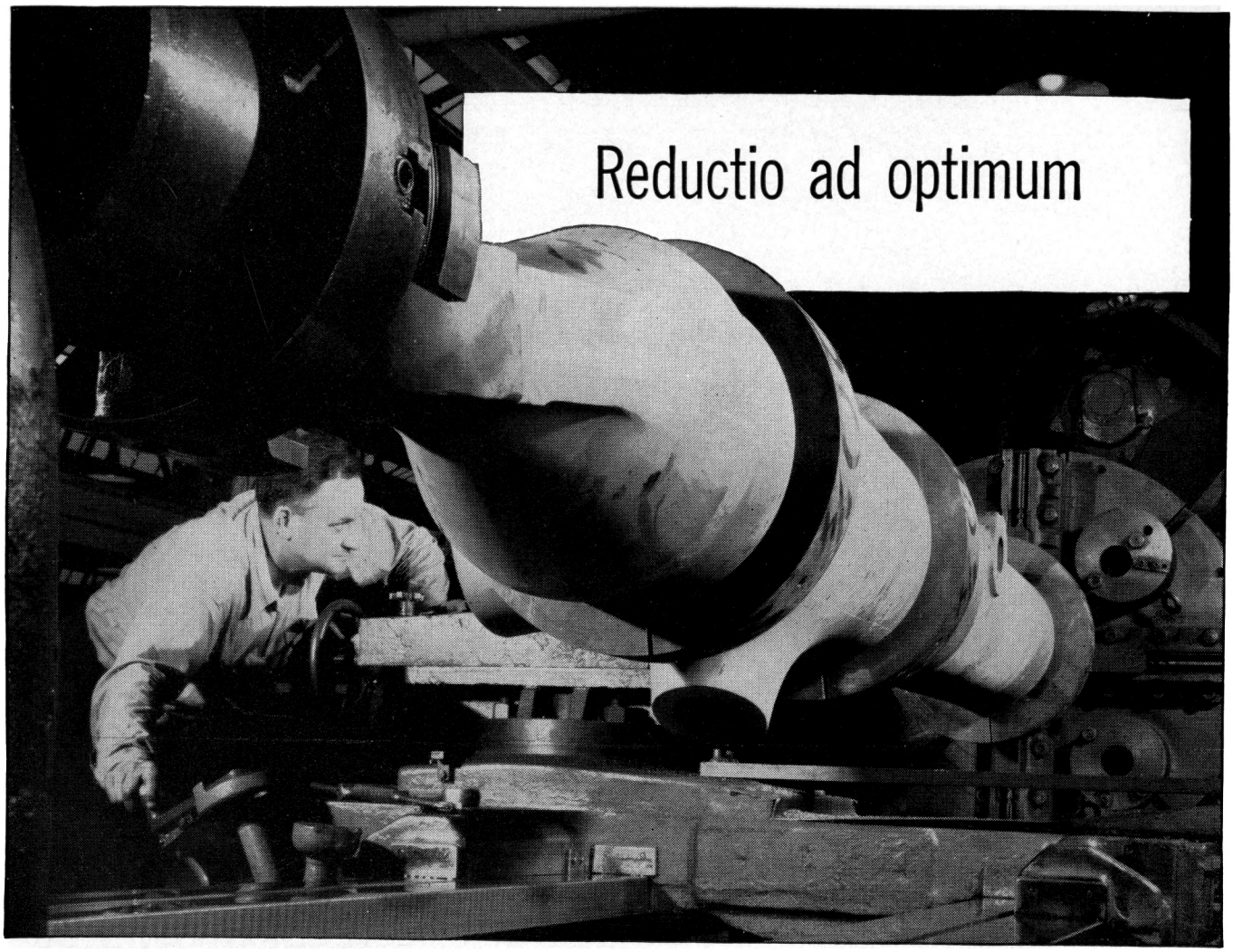
Member ECMA



November 1953
25c

Features: The Turbojet
Nickel: Shortage And Solution
Meter, Kilogram, Second





U·S·S CARILLOY electric-furnace aircraft quality steel meets every requirement for these vital parts. The precision machining and expert heat treatment it gets at Cleveland Pneumatic Tool Company complete the job.

● "Reduced to the most favorable degree" describes exactly what happens to the huge U·S·S CARILLOY steel ingots from which are formed the rugged main columns in the landing gears of *every* B-36.

To provide the tremendous strength and shock resistance required to safely cushion the landing impact of 179 tons of bomber weight —and, at the same time, to keep the weight of the landing gear as *low* as possible—calls not only for steel of the highest quality but also for unusual procedures in fabrication as well.

Consider these facts. The original ingot weighs approximately 37,500 lbs. From it are produced two cylindrical columns weighing only about 1200 lbs. apiece. Approximately 93% of the steel is removed by machining to proper contour and in hollow-boring the column. When finished, a mere 7% of the original ingot is left to do the job.

That U·S·S CARILLOY steel has been exclusively selected for this application—one of the most exacting in the aircraft industry—is, we believe, highly significant. The same care and skill, the same ability to meet requirements that are beyond the ordinary, go into every order of CARILLOY steel we make—whether it's an ingot of giant size or a few tons of special steel.

U·S·S CARILLOY is just one more example of the better steel products developed and produced by United States Steel. If you are interested in additional engineering training, why not investigate *your* opportunities with U. S. Steel? For more information, contact the Placement Director of your school, or write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

USS

UNITED STATES STEEL

Where do profits go?

To increase your standard of living

OUT OF EVERY DOLLAR YOU SPEND, less than 5¢ can be kept as profit by the average company supplying you. A good part of that 5¢ is then used to buy new machines. (Only 2¢ ever reaches the owners as dividends.)

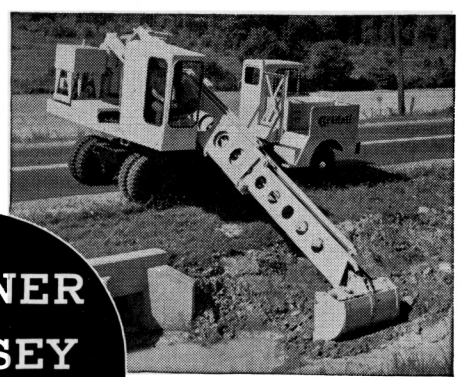
These new machines produce more, at lower cost. To stay in business in America's highly competitive system, machine owners pass on those lower costs to you in lower prices. (Remember your first mechanical refrigerator at $700, your first radio at $400?)

Stop the profits and you will stop this process of better and better values. As machines grow older, they will produce less and less and so what they produce will cost you more and more.

Remember that, next time you hear someone attack profits. He's recommending *higher prices for you.*

Statistics from:
National Association of Manufacturers;
Air Cond. & Ref. News;
Electrical Merchandising.

Warner & Swasey is a group of men who work hard, respect each other, and enjoy the satisfaction of group accomplishment. If that sort of life appeals to you, write Charles Ufford for employment opportunities here.



Gradall at work

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Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY



● Claud M. Kellett, Jr. received his Bachelor of Electrical Engineering degree from Georgia Tech in 1950.

Claud's first year at Allison was spent in the company of other recent engineering graduates in a college graduate training program. This program helped him gain practical experience in the activities of selected departments throughout the Allison plants. On the completion of his training, a call to active duty with the Army delayed Claud's permanent assignment to an Allison department. However, the twenty-one months he was away did not diminish his opportunities in the least. When he returned early this year he was able to resume his career in engineering with the result that today he is an experimental engineer concerned with electronic instrumentation in the Research Group of the Transmission Test Department.

The torqmatic converter turbine that Claud is working with is a vital element in the operation of Allison heavy duty transmissions. Allison is the world's largest manufacturer of torqmatic drives for heavy duty Ordnance and commercial vehicles and equipment. The commercial converters and transmissions are used in scrapers, tractors, trucks, cranes, shovels and drilling rigs.

The problem presented to him in connection with the turbine was to find the level of residual stresses created in the turbine by repair welding performed on the hub. The feasibility of such welds might then be determined. Claud applied variable resistance type strain gages to the turbine vanes at their exits and read their strain levels with the strain indicator. Then he cut the vanes around each of the strain gages to relieve residual stress and re-read the strain levels. From the difference in strain between the stressed and relieved conditions he was able to calculate the residual stress induced by the welds.

Yesterday Claud was interested in torsional vibration and the electronic "know-how" required to present it for oscillographic recording. He knows that tomorrow the many tests of transmissions and component parts will each present unique problems. Pressure transducers, vibration pick-ups electronic flow meters and tachometers must be installed with a myriad of complicating factors ever present. Equipment not available must be designed and built, or existing equipment modified. A future at Allison holds a constant challenge of doing that which has not been done before.

Allison is looking for young men with degrees in **MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, AERONAUTICAL ENGINEERING** ***and*** **INDUSTRIAL ENGINEERING.** ***There are also a number of openings for majors in Metallurgy, Electronics, Mathematics and Physics.*** Write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from R. S. Kersh, Vice-President,
Northeastern Region,
Westinghouse Electric Corporation



To the young engineer eager for a sales career

Show me an engineer with a friendly attitude, and an eagerness to help people solve their problems and I'll show you a good sales engineer.

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Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 N. Seventh Street, St. Louis 1, Missouri.



How your pipe dreams may become realities!



Lengths of Republic Electric Weld Casing are rapidly joined together and lowered hundreds or thousands of feet into an oil or gas well to line it with tough steel—to protect its walls against the tremendous pressures that otherwise might cause collapse of the hole.

YOU MAY NEVER DRILL for oil as a career. Nevertheless, this pipe has a message for you.

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Your pipe dreams of success in industry are more likely to flow with realities if you associate with a dynamic company. Some companies merely produce a material. Wouldn't you be better off with a company that not only produces a basic material, but also knows how to design and fabricate its own product? *That* company really knows what it is making—and selling. Such a company is Republic Steel.

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COVER

This is not a man from Mars or any other extra-terrestrial being; but it is a close-up of stress concentration around a hole in a beam. Such concentrations are photographed in polarized light through a plastic model.

—Photo by Dr. Wetterstrom

MISSOURI SHAMROCK

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NOVEMBER, 1953

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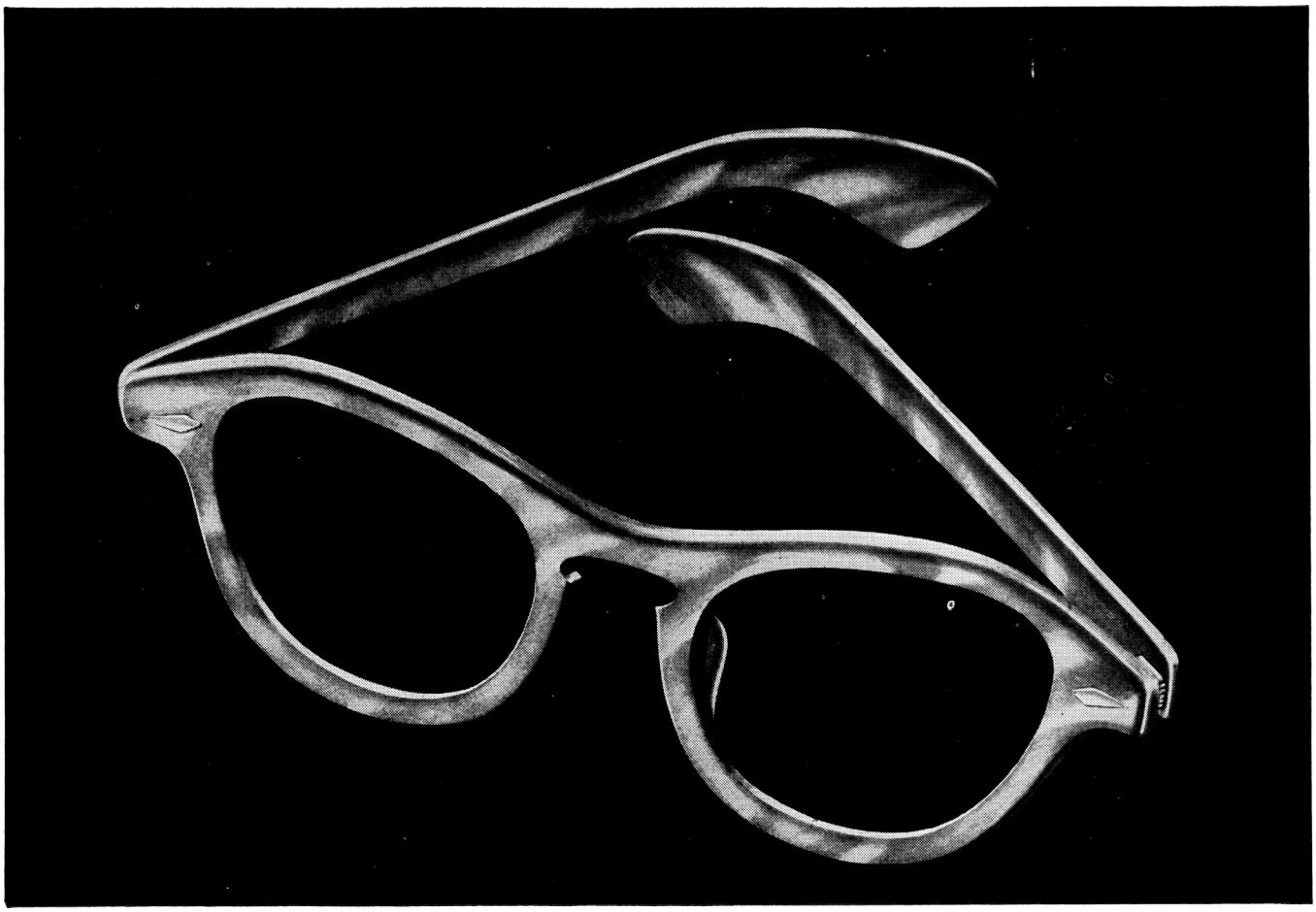

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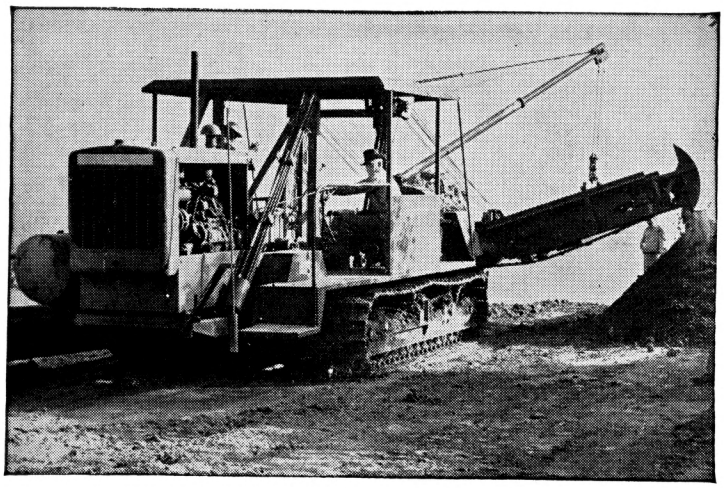
Another page for **YOUR BEARING NOTEBOOK**



Big trencher gouges out 13 cu. yards per minute!

This big digger crawls along at 10 to 12 feet per minute digging a ditch 7½ feet wide and four feet deep. To keep it operating with minimum maintenance in this tough service, the engineers specified a total of 69 Timken® tapered roller bearings in the differential, transmissions, and track rollers. Line contact between rollers and races gives Timken bearings extra load-carrying capacity. Tapered construction enables Timken bearings to take radial and thrust loads in any combination.

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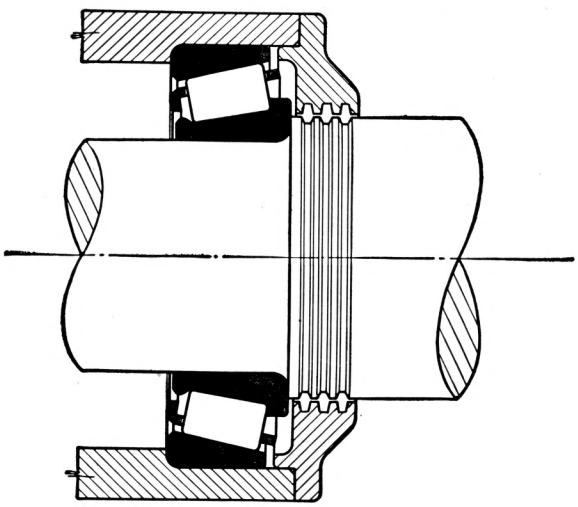

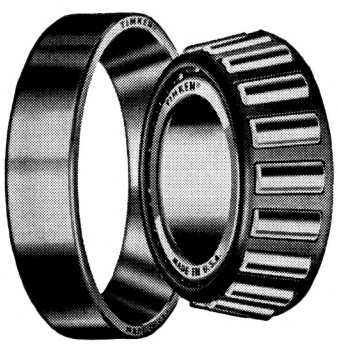

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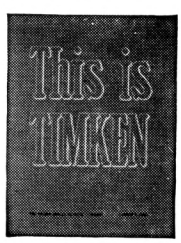

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Adding youth to steel...for you

Just a "pinch" of vanadium helps steel to serve you better

STEEL IS LIKE PEOPLE. It, too, can become tired with too much shock and strain, or too much exertion. Fortunately for all of us, scientists have learned the secret of imparting the stamina of youth to steel.

SECRET OF YOUTH—It's done by adding small amounts of vanadium—often with other alloying metals—to the molten steel, usually as it comes from the steelmaker's furnace.

Thus, the springs of your car and other hard-working parts of automobiles, locomotives, ships, and aircraft withstand constant shock and strain.

WHAT IS VANADIUM? This special tonic for steel is one of the earth's rarer metals. Most of America's vanadium ore comes from the Colorado Plateau. After being concentrated and smelted, the refined metal is shipped to the steelmakers.

Vanadium is but one of many alloying metals that are used to improve today's steel. Just as vanadium makes steel shock-resistant and enduring, chromium makes it rust-resistant, tungsten makes it strong at high temperatures, manganese makes it tough at low temperatures, and silicon gives it important electrical properties.

UCC AND ALLOYS—The people of Union Carbide produce more than fifty different kinds of alloying metals, in hundreds of varying compositions and sizes. They also work closely with steelmakers in developing and improving the alloy steels that go into nearly everything that serves us today.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Ask for booklet F-2.*

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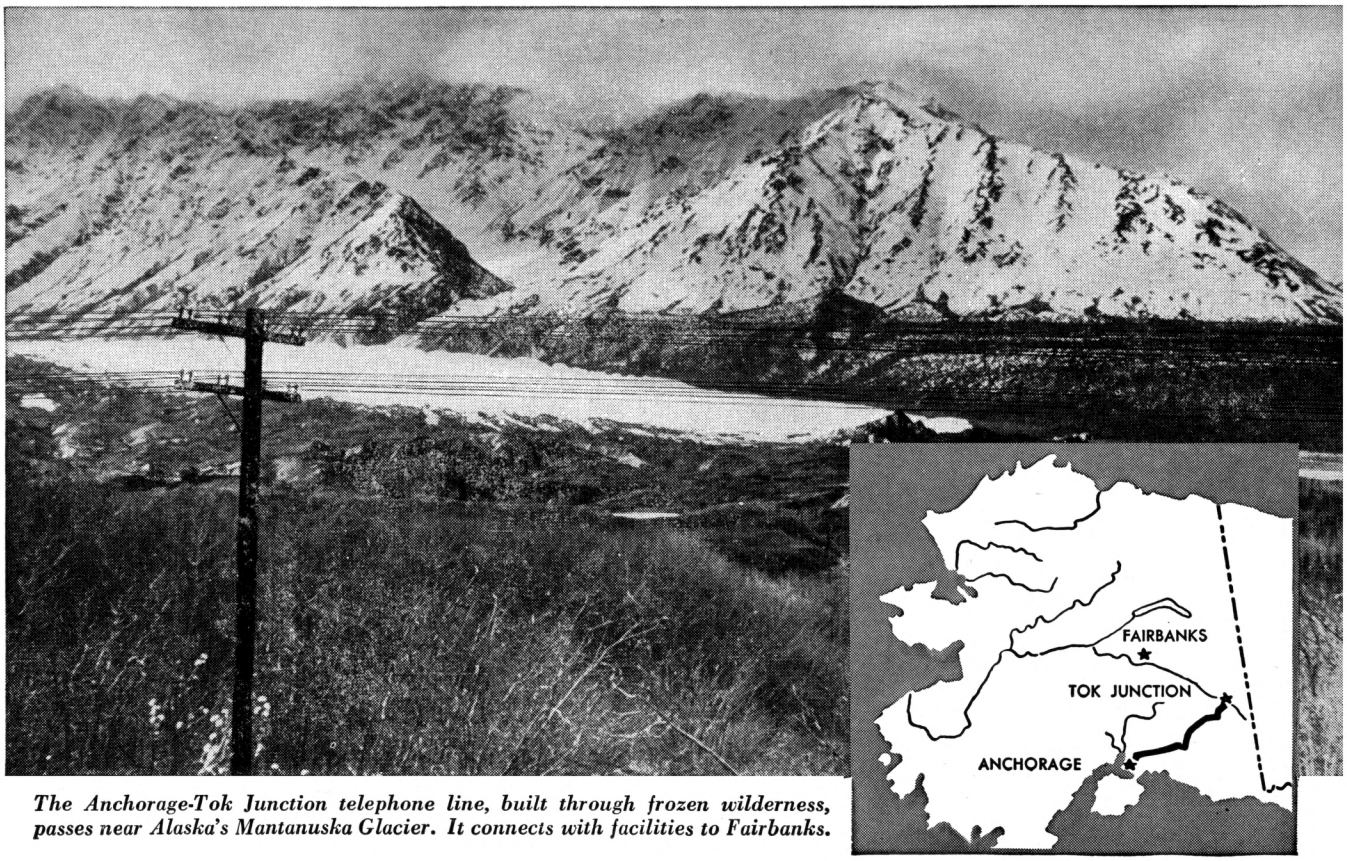


The Anchorage-Tok Junction telephone line, built through frozen wilderness, passes near Alaska's Mantanuska Glacier. It connects with facilities to Fairbanks.

The line is through to Tok Junction, Alaska

Ever hear of permafrost? It's sub-surface earth, permanently frozen hard as rock. But it was only one small problem in pushing through Alaska's newest telephone line

As the nation's defense perimeter was pushed northward, it became plain that high-speed communications were needed for Alaska. The Army Signal Corps asked the Bell System to help build a modern telephone line for our strategic northern outpost. Today the line is a fact.

But the 330-mile route between Anchorage and Tok Junction on the Alcan Highway called for all the resourcefulness and skill of Bell System and Army engineers.

What type of line? Engineering studies and surveys proved that weather, expense and maintenance problems made it impractical for the new line to be aerial or buried cable or radio relay. The answer was open-wire pole line plus carrier equipment. But stringing this line through frozen wilderness was rough business.

The line had to cross two high mountain ranges. Average spacing between poles was 155 feet, but to bridge rivers, ravines and steep mountainside descents called for long-span crossings, ranging from 400 to 1800 feet.

Getting the right vehicles, tools, and materials to the right places when needed was a major feat of planning in this wilderness. The line called for 15,000 poles of varying lengths, 2500 crossarms, 1,325,000 pounds of copper-steel wire and 2400 tons of hardware.

Dynamite licks permafrost. Bulldozers, pole-hole diggers and big trucks battled their way over tortuous mountain roads. The simple process of setting poles proved almost impossible in some areas because of a volcanic silt hardened by permafrost. No drill was tough enough to withstand its pumice-like action. The problem was licked by punching holes and using small dynamite charges.

But now the work is done. Engineers have turned their talents to other parts of the vital communication system—building a long distance dial switching system between Anchorage and Fairbanks.

And so it is with the fast-growing telephone company. There always is a new frontier to conquer—in research, at the Bell Laboratories, in manufacturing at Western Electric, or in one of the operating companies serving the changing requirements of a constantly shifting population. Check now with your Placement Officer on the opportunities which await college engineers in the Bell System.

BELL TELEPHONE SYSTEM



—Photo Courtesy of Westinghouse

Slightly larger than a 40,000 KW generator, this generator, when completed, will be capable of generating 100,000 KW. For complete story, read NEWSTUFF.

Seminar . . .

There are many times when we seniors wonder whether we know any convenient "tricks of the trade." We then wonder how we can learn some of the more general ones, so that we may use them immediately. How can we get the jump on the other engineer, and apply some of the more useful ideas which we usually learn by experience? In our own college there is a place for learning these tricks; and it is in a Senior Seminar. Many of the instructors have been in the engineering field, have taught for many years, and have a wide and varied experience due to both teaching and work in the field. If two hours were spent each week in an informal non-compulsory discussion period, led by one or two instructors, any ideas brought forth would be beneficial to any student who has an interest in a particular field. Why not tap this vast reserve of knowledge and give the student a chance to use some of this yet unknown reserve?

D. B. A.

DO NOT JUDGE

the TURBO-JET

By M. A. McDanield, M.E., '56

The theory of operation of the Turbojet engine is relatively simple. As in other jet propulsion engines it draws air into the intake and sends this air to the compressor which raises the pressure 4 or 6 atmospheres. From the compressor the compressed air enters into the combustion chamber where the air is heated to a high temperature and the pressure further raised by mixing of fuel and the ignition of mixture by an electric spark from a conventional spark plug. The air leaves the combustion chamber and enters the turbine assembly which increases the velocity of the air creating turbulence. The exhaust assembly, which consists of the nozzle and tailpipe, functions to reduce turbulence due to rotation of the turbine wheel, and to concentrate the flow of the exhaust gases. The temperature of the gases and the pressure are gradually reduced as they move toward the tailpipe outlet. At the outlet, the pressure will be equal to atmospheric pressure, but the velocity and temperature of the gases is very high. The velocity of the jet stream in a given turbojet engine depends, for the most part, upon the turbine inlet temperature, the velocity of the jet increasing with temperature. Since propulsion efficiency is directly related to the ratio of the flight speed to jet stream velocity, for a given flight speed there is a certain turbine operating temperature for best over-all efficiency.

BASIC ASSEMBLIES

There are our basic assemblies which make up the turbo-jet engine:

The first is the Accessory Assembly which is usually mounted on the front of the unit. It includes such necessary parts as the *generator,* which in most engines is a direct current unit rated at 30 volts and a minimum of 200 to 300 ampheses. The starter is designed to operate at the same voltage used in the aircraft electrical system. The starter is geared to the compressor rotor shaft through the gear, and an overriding clutch in the gear case. This makes it possible for the starter to be used to turn the engine rotor only until the engine is operating under its own power. The *main fuel pump* is usually a pressure loaded, positive displacement gear type. It is capable of delivering fuel at a discharge pressure of 500 p. s. i. The *tachometer generator* is a generator which is used with a suitable indicator to record the turbine rotor speed. There are several other smaller parts located in this assembly also.

The second general assembly is located behind the Accessory Assembly and consists of the compressor unit. The compressor unit is either of two types; the centrifugal type of the axial flow type. The main distinction between the two is the line of air flow through them. The centrifugal compressor is very similar in design and operation to the supercharger used in piston engines. It consists of a diffuser, a rotor, and a casing. The rotor is made up of a series of blades which are pointed radially from the axis of revolution of the compressor. As the rotor revolves, air is drawn into the blades near the center where the blades are curved. Centrifugal force causes the air to move outward from the axis of rotation. The linear

velocity is greater at the rim than at the base of the blades and the air is ejected at high velocity. As the air leaves the rim of the rotor, it has a large resultant velocity in a direction which closely approximates tangential velocity. The rotor imparts a radial velocity to the air and at the same time the air is dragged around as the rotor revolves. Thus, the air leaving the rim of the rotor has a velocity which is the resultant of the two forces. By the process of diffusion into larger space, the air velocity decreases and the pressure increases. Then the air at the increased temperature flows through the casing to the outlets connecting with the combustion chamber. Single stage centrifugal compressors are practical for pressure ratios up to about 4:1. Higher pressures can be achieved, but at a decrease in efficiency.

The axial compressor is very similar in some respects to the airplane propeller. Like the propeller the rotor has a number of blades with an airfoil section. The blades extend radially from a central axis and are pitched at an angle comparable to the propeller angle. The actual direction of flow is the resultant of the tendency of the air to move parallel to the axis of the rotor and also in the direction of rotation of the rotor. The pressure developed by a single stage is approximately 5 to 8 p. s. i. or about a ratio of 1½:1. Thus it is always necessary in practice to construct the axial compressor in stages within the casing. Most compressors are built in 6 to 14 stages of compression and are designed so that a row of fixed blades alternate with the rotor blades. The function of these fixed (stator) blades is to re-direct the air leaving one stage so that it enters the next stage at the proper angle of attack. The blading in compressors must be very carefully designed to prevent entry shock, to keep air velocities below sonic velocity, and to prevent turbulence. The blade may be constructed of either steel or a suitable light alloy, such as aluminum. The speeds of rotation of axial compressors are usually lower than these used with centrifugal type compressors, and the range of speeds is not wide.

COMBUSTION

The next assembly in the turbojet engine is the combustion chamber where, for the first time, the fuel is actually mixed in with the compressed air. There are also the annular combustion chamber and the individual combustion chamber.

In the individual combustion chamber there is a group of individual combustion chambers grouped around the engine and the compressed air is introduced into each chamber, which consists of an outer casing and flame tube where the fuel is introduced by nozzle. The fuel is sprayed into the chamber in a continuous stream. The fuel pressure to the nozzles is high to secure a large pressure drop and a high degree of atomization. The mixture ratios at the beginning of combustion range up to about 14 parts of air to 1 part of fuel and the combustion temperatures to about 3,500 degrees Fahrenheit. The ignition of the mixture is completed by the use of a spark plug similar to a conventional one. It is located close to the fuel nozzle and burning is started in the other chambers through tubes which connect the flame tubes.

The annular combustion system permits the designing of an engine with a smaller diameter and is usually used with the axial flow compressor. The compressed air is introduced into an annular chamber around the turbine shaft and the mixing and ignition of fuel are similar to the method used in the individual combustion chambers.

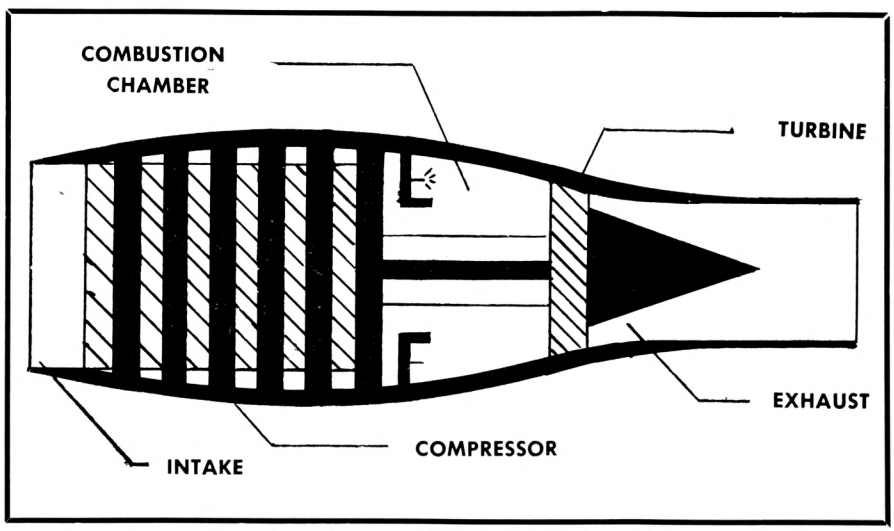
ROTOR ASSEMBLY

The turbine rotor assembly consists of the turbine blades, wheel, and the shaft. The high temperature gases from the combustion chambers go through nozzles in the stater which direct them at high velocity into the turbine blades. The direction of the gases reverse as they strike the blades and as a result, a force is developed which moves the blades. Because of the high velocity of the nozzle gases, the turbine of the single stage turbine system must operate at high speeds for efficient conversion of the energy of the gases to mechanical power. This assembly is located at the end of the combustion chamber.

EXHAUST

The last assembly, the exhaust assembly, serves to smooth the flow of the turbulent gases exhausted from the turbine and to convey the gases to the nozzle orifice in a more concentrated flow. Actually, the exhaust assembly consists of the cone, a tail-

(*Continued on Page* 24)



Schematic Diagram of the turbo-jet engine.

NICKEL Shortage and Solution

By Jim Chatham, M.E. '56

If less is heard about the nickel than about the other metal shortages the reason may be the same as that which accounts for relative public ignorance about the nickel industry in general.

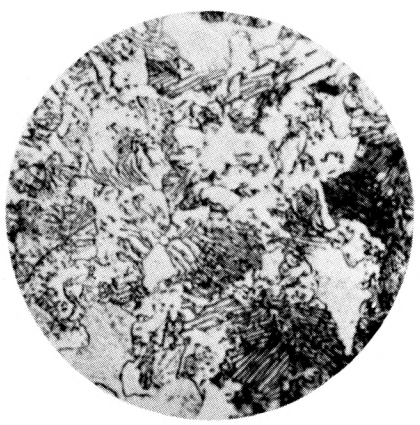
In peace time there is plenty of nickel: the industry has to spend a lot of its time just trying to dream up and sell new uses for the metal. In war time there is never enough nickel and probably never will be. Even now, in a short-of-global-war defense effort, there is a solid shortage of nickel.

Much of the shortage is caused by defense requirements dealing with the Korean War. In the U.S., the military gets about 65% of the supply, and a good deal of the remainder goes into defense-supporting industries. Also one of the major causes of impending shortages is governmental stockpiling.

WARFARE IMPORTANCE

Nickel has become increasingly more important in modern warfare, particularly in this age of jet planes which require much nickel for high-temperature parts. Jet engines might as well be called nickel engines because of the high nickel content. Many jet jarts contain six or seven different metals, including lots of nickel. In atomic equipment, gun recoil systems, bullet jackets, bomber fire walls, aircraft exhaust valves, and so on, steel's resistance to high temperature and corrosion is largely dependent on nickel.

The development of gas turbines and jet engines has been particularly dependent on high-nickel alloys in the Nimonic and Inconel groups. Other high-nickel alloys, because of their exceptional resistance to corrosion, are widely used in food processing, chemical process industries, and marine construction.



SAE 2340 treated, shows the ferrite and pearlite.
—Photo from M.E. Labs.

UNIVERSAL SHORTAGE

Nickel seems to be short all over the world. This statement is brought to light by the fact that it is on the international list of short materials.

New restrictions of the use of nonferrous metals have been announced by the Council of the Organization for European Economic Co-operation. The council has asked its eighteen member countries to ban the use of nickel and nickel-plating alloys in the manufacture of five hundred products, ranging from household articles to automobiles.

In the first of April, 1953, Japan entered into the U. S. market with prices that were four times the domestic price. They were from $2.10 to $2.50 per lb. against the U. S. price of $.65 per lb. The suppliers still bought the nickel at this high price. The fact that it was bought pinpoints the desperate nickel supply situation.

UNITED STATES

U. S. consumption in the year just ended totaled 72,175 tons, most of which went into stainless and alloy steel. 31,000 tons went into non-ferrous alloys, and 17,600 tons went for other purposes such as cast iron alloying and plating.

The International Nickel Co. of Canada currently produces more than

(*Continued on Page* 24)



SAE 2340 showing the martersitic structure. Nickel, although in solution, allows this kind of heat treatment. X500.
—Photo from M.E. Labs.

METER, KILOGRAM, SECOND

By Harold Busby, E.E. '55

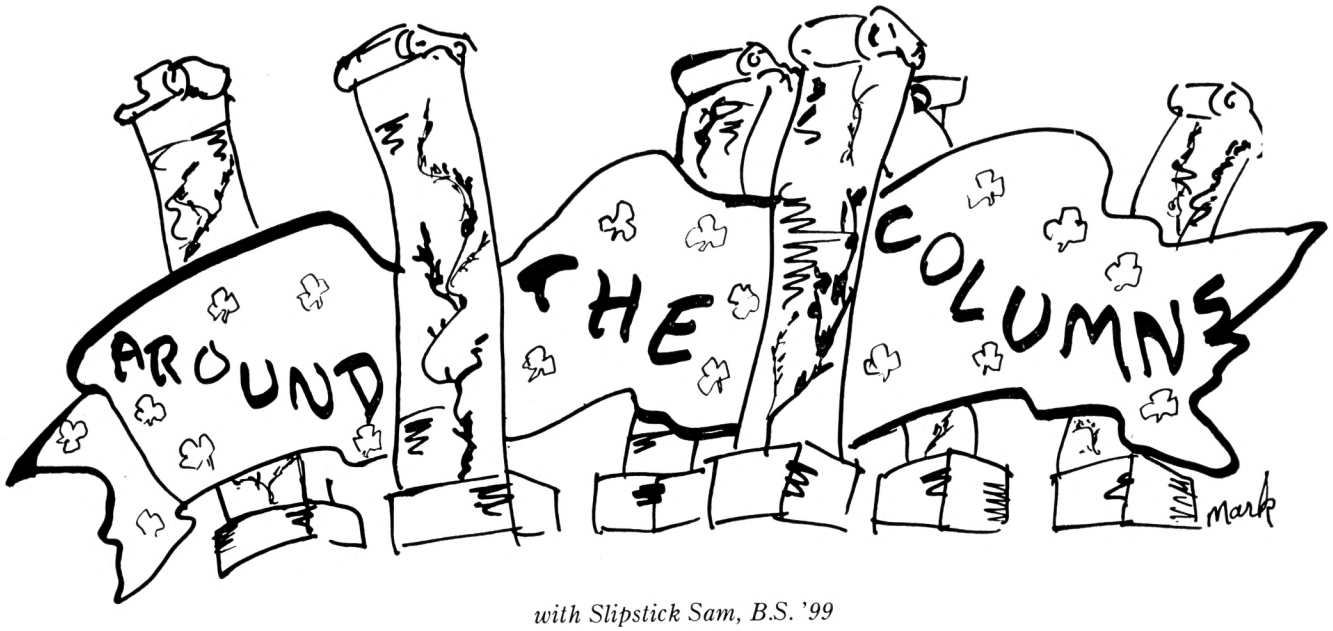
When electricity was first used by the public the engineers were immediately confronted with the problem of which system of units was to be used in which to make their measurements. Because the existing systems (electromagnetic and electrostatic) had been developed for use in the laboratory, they were very awkward to deal with in a practical situation. For example: the quantity of current in the electrostatic system was much too small and the abampere (electromagnetic unit of current) was a little too large for convenience. Therefore, the resourceful engineer originated a system of units which would be applicable to every-day life. In order to keep relatively close to the classical systems it was decided that the practical unit of current (ampere) should be exactly one-tenth of the abampere. This, then, was the beginning of many so-called practical systems. Out of all of those which were put forth the MKS system is the only one that remains. It is based on the traditional dimensions of Mass, Length, and Time, but the sizes of the units have been changed. Instead of the centimeter, gram, and second, the kilogram, meter and second were chosen as fundamental.

Maxwell discovered that in order to develop an electrical system of units a fourth dimension must be arbitrarily chosen. In the electrostatic system the permittivity of free space (epsilon-zero; hereinafter designated "Z") was chosen and set equal to unity. In the electromagnetic system permeable (mu-zero; hereinafter designated "W") was so chosen. The RMKS system is similar to the e.m. in that W was picked as the fourth fundamental quantity. It could not, however, be set at unity because the practical engineer had already designated that the unit of current be one-tenth of the abampere. It is now necessary to define the abampere in order to obtain the value of W.

The abampere was originally defined in terms of magnetic pole strength, but the more modern approach is through observation of the force between two wires carrying current. This force was found to be proportional to the length of wire, amount of current in each wire, and inversely proportional to the distance of separation. Symbolically: $F = 2WI_1I_2l/r$ where W is constant of proportionality. (This equation is more rigorously derived through integration of the Biot-Savart differential equation.) In the e.m. system this equation could be used to define the abampere by setting W equal to unity. If two current carrying wires one centimeter long and one centimeter apart experience a force of two dynes the amount of current flowing is one abampere. Decreasing this current by one-tenth

(*Continued on Page* 30)

Quantity	Symbol	Name of Unit			Defining Equation	Fundamental Expression		
		Electrostatic	Electromagnetic	MKS	MKS	E.S.U.	E.M.U.	M.K.S.
Length	L	Centimeter	Centimeter	Meter	Fundamental	L	L	L
Mass	M	Gram	Gram	Kilogram	Fundamental	M	M	M
Time	T	Second	Second	Second	Fundamental	T	T	T
Permeability	μ (W)	Stathenry / Centimeter	Abhenry / Centimeter	Henry / Meter	Fundamental	$\frac{T^2}{L^2\epsilon}$	μ	μ
Permittivity	ϵ (Z)	Statfarad / Centimeter	Abfarad / Centimeter	Farad / Meter	$4\epsilon = \frac{1}{c^2}$	ϵ	$\frac{T^2}{L^2\mu}$	$\frac{T^2}{L^2\mu}$
Current	I	Statampere	Abampere	Ampere	$F = \frac{2\mu I^2 l}{r}$	$\frac{M^{1/2}L^{3/2}}{T^2\epsilon^{1/2}}$	$\frac{M^{1/2}L^{1/2}}{T\mu^{1/2}}$	$\frac{M^{1/2}L^{1/2}}{T\mu^{1/2}}$
Charge	Q	Statcoulomb	Abcoulomb	Coulomb	$Q = \int I\,dt$	$\frac{M^{1/2}L^{3/2}\epsilon^{1/2}}{T}$	$\frac{M^{1/2}L^{1/2}}{\mu^{1/2}}$	$\frac{M^{1/2}L^{1/2}}{\mu^{1/2}}$
Voltage	V	Statvolt	Abvolt	Volt	$V = \frac{\text{Weight}}{Q}$	$\frac{M^{1/2}L^{1/2}}{T\epsilon^{1/2}}$	$\frac{M^{1/2}L^{3/2}\mu^{1/2}}{T^2}$	$\frac{M^{1/2}L^{3/2}\mu^{1/2}}{T^2}$
Resistance	R	Statohm	Abohm	Ohm	$R = \frac{V}{I}$	$\frac{T}{L\epsilon}$	$\frac{L\mu}{T}$	$\frac{L\mu}{T}$
Capacitance	C	Statfarad	Abfarad	Farad	$C = \frac{Q}{V}$	$L\epsilon$	$\frac{T^2}{L\mu}$	$\frac{T^2}{L\mu}$
Inductance	L	Stathenry	Abhenry	Henry	$V = L\frac{di}{dt}$	$\frac{T^2}{L\epsilon}$	$L\mu$	$L\mu$



with Slipstick Sam, B.S. '99

Well, hello there kiddies, this is your ole Sam bringing you some more chatter about the doin's both in and out of that ivy covered structure we lovingly call home.

♣

It is a known fact that the Engineers Club is the backbone of our organized activities such as St. Pat's Week, St. Pat's Ball and the annual beer-bust out on the Hinkson. Of all the organizations on the Missouri campus, the Engineers Club is by far the most beneficial to you followers of St. Pat. Remember guys, this is your club and it will be just as successful as you make it. Lets all get behind





Bill Ellis and Kenny Walton and show everyone how much spirit we have.

♣

Ole Sam wandered into C.E. 240 the other day and picked up the local rumor about Sangster. It seems that someone has gobbled up all of his white chalk and replaced it with the colored variety. I have a feeling that it is the same syndicate that is running a "goodies" ring with Little Blue Riding Hood.

♣

Who was seen smiling the other day; none other than "King Carl Evans". His students have a system, if there is going to be a quiz he cracks a smile and if it is going to be a hard quiz he chuckles. I'll bet it was a dandy because last Wednesday he was roaring with laughter.

♣

Just an after thought: How does petite little Barb Wasser wear her slide rule with no belt or belt loops.



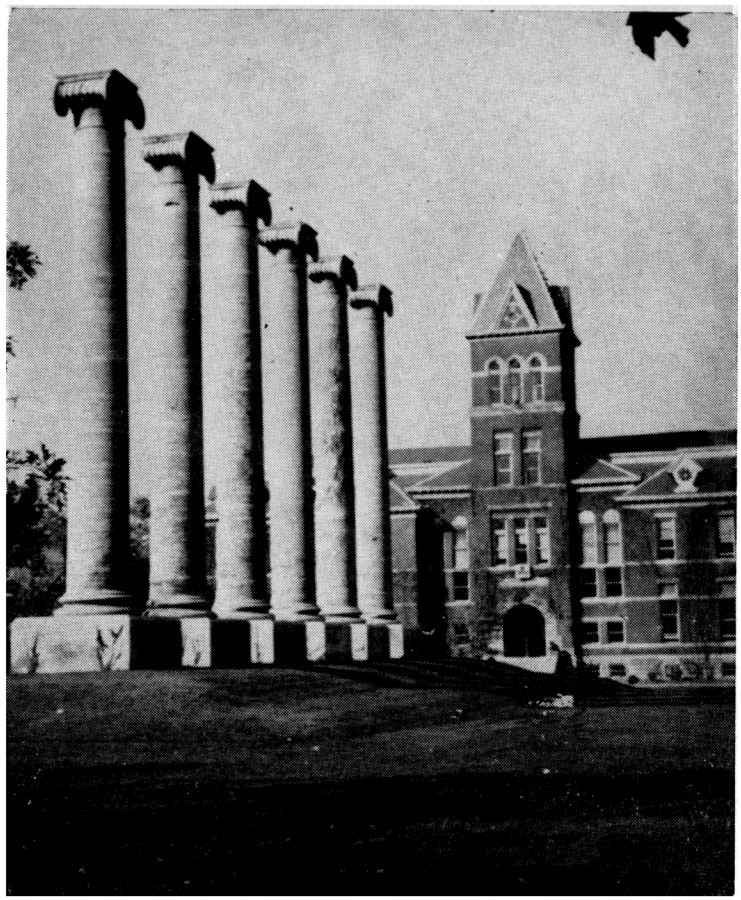
Me thinks she is the reason for perfect attendance in H. A. Larue's survey-in class.

♣

Sam understands that Les Ripka C. E. '52 whom you all remember as L. L. got himself hitched this summer to Susan Hall, a former student

(*Continued on Page* 28)

MIZZOU MEMOS



By Don Brooker

W. E. PEARSON, E.E. '51, made page 11 of a recent edition of the Allis-Chalmers *Sales News*. He completed their graduate training course in June of this year and was assigned to the Switchgear department. Pearson is a member of Tau Beta Pi, Eta Kappa Nu, ACES and an associate member of AIEE.

J. F. LEUCK, E.E. '49, can be located in Kansas City . . . 3001 Swift, North K.C., to be exact. He is associated with the Phillips Petroleum Company.

LYMAN L. FRANCIS, M.S. in M.E. '50, is giving the boys a hard time out in Pullman, Wash., where his is an assistant professor in M.E. at Washington State College.

PROF. MILO BOLSTAD brings word as to why General Electric builds such fine jet engines. He was working for G.E. at Evendale, Ohio, this past summer and ran into a whole slew of M.U. boys in the Gas Turbine Division plant which makes the J-47 and J-73 jet engines in use on the B-47 six jet bomber and F-86 Sabre Jet fighter. These gents are C. W. La PIERRE, an E. E. in the '20s, and now vice-president of Aircraft Turbine Division of G. E. Company; HAROLD SLUSHER, M. E. '42; STEVE PAULINY, M.E. '49; MERRILL KORTH, M.E. '51; JOHN JORDAN, E.E. '53; and JIM LUTH, E.E. '53.

The following communication is printed as received:

The Federation of Churches
Dow and Frances,
announce the beginning
of a new church,
Although small at present,
Eight pounds,
this Church is expected
to grow rapidly.
Dedication services were conducted
at Menorah Hospital, October seventh
with
Dr. Jacob P. Farney officiating.

If you don't remember DON CHURCH as an E.E. '49, maybe you recall the guy who used to put on tumbling acts at the half at the basket ball games. That's him.

As space permits, we pass on the name, degree, year, home address, position and boss (in that order) of some of the grads who have shelled out two bucks and now get the *Shamrock* because they are paid-up members of the Missouri Engineering Alumni Association.

M. KAMAL AL-IMAN, M.S., C.E. '51, 6400 Larsen Lane, Shawnee, Kan., Designer, Howard, Needles, Tanimen and Bergendoff. (Should have said bosses in this case.)

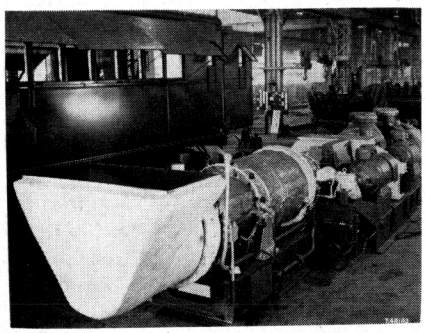
E. R. BEGOLE, Ch.E., '36, 125 Clark St., Augusta, Kan., Assistant

(*Continued on Page* 26)

NEWSTUFF

By Mike McDanield

News of some of the latest developments in the industrial world have reached the offices of Ol' Shamrock and we pass them along to the struggling engineers of old Mizzou.



Described below is this two stage, gas turbine driven, air compressor. *—Cut Courtesy Westinghouse*

The U. S. Army Corps of Engineers is testing a new trailer mounted gas turbine to determine its suitability for supplying compressed air. The gas turbine, two multi-stage centrifugal air compressors, a 50 hp starting motor, and a 60 kw generator and auxiliaries are all mounted on a fabricated steel bedplate. The simple open cycle gas turbine develops more power per unit of weight and volume than any other type of prime mover, and is thus ideally suited for this mobile unit.

The plant requires only two external connections for starting—electric power for ignition and motor-driven auxiliaries, and distillate fuel for the gas turbine. Once started, only the fuel connection is needed, as the 60 kw generator supplies the auxiliary motors. Westinghouse supplies the 8,750 rpm gas turbine, Clark Brothers the compressors, and the Dresser Stacey company installed the plant.

General Electric has now on the market a unit which it says is the latest work in year round air conditioning. It is an all-electric machine called a heat pump which burns no fuel, uses no water, yet automatically heats and cools your home to the desired temperature.

Once the thermostat is set to the desired temperature the heat pump heats or cools your home throughout the year at that temperature. The reverse in cycle is completely automatic—from season to season, with the same day, or even hourly if necessary.

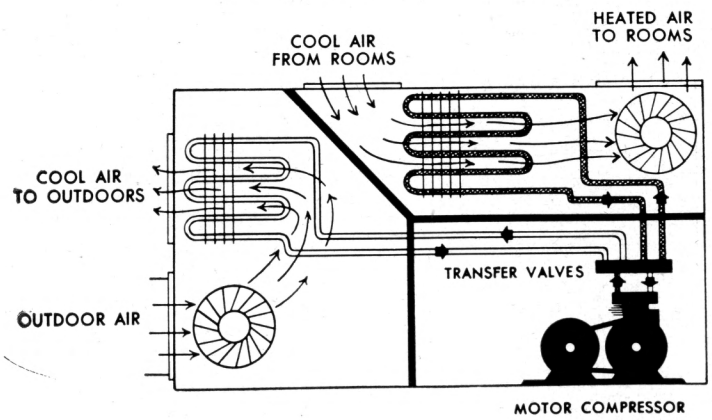
The weathertron, as the unit is called, operates on the principle of four basic laws of nature: One—Heat exists in the air at all temperatures, both above and below zero down to absolute zero (273° C). Two—Heat always tends to flow from a higher temperature to a lower one. Three—All gases cool on expansion and become warmer when compressed. Four—Heat is absorbed when a liquid changes to vapor and heat is given off when vapor condenses to a liquid. The weathertron works on much the same principle as the ordinary refrigerator. In winter it expands a refrigerant and sends it through a coil where it extracts heat from the out-door air. The heat laden refrigerant gas is then compressed and pumped through another coil and the heat is released into the house. Air from the house is blown through the refrigerant coils at this point. The air absorbs the heat from the tubs in the coil and warms the rooms as it is gently circulated.

The main difference between the refrigerator and the weathertron, other than the difference in their capacities, is that the weathertron is built to automatically reverse its cycle of operation so that in summer, heat is picked up from inside the house and dumped outdoors.

The G.E. weathertron is compact in size and can pass through a 28 inch door. It can be placed in almost any location. Since it does not burn any combustible fuel, its location is

(*Continued on Page* 22)

HEATING OPERATION



BULLARNEY



Governor, looking at newly-constructed WPA dam: "Migawd, the water! It's supposed to be on the other side!"

♣

Textbook style: "The puissance of hydrochloric acid is incontestable; however, the corrosive residue is inharmonious with metallic persistence."

ChE. style: "Hydrochloric acid eats the hell out of steel.

♣

And there was the EE who called his girl Carbon because as she got warmed up, her resistance went down.

♣

The bum slept under bridges and viaducts for years—then he switched to culverts. Does this make him a Man of Distinction?

♣

Junior: "Pop, can I have a dime?"

Pop: "What did you do with the dime I gave you last week?"

Junior: "I spent it."

Pop: "What the hell are you doing, keeping a woman?"

♣

Thousands of lives have been destroyed by whiskey, but just look at all the boats that have been wrecked by water.

♣

Pete: "Want to go steady?"

She: "Oh, yes!"

Pete: "Ever try castor oil?"

♣

Mae: "Would you go the limit with a man if you really loved him?"

Fay: "And how; I'd even raise the limit."

♣

A newly married couple boarded the Golden State Limited for their berth and the bride about every two minutes would exclaim: "Johnny, I just can't convince myself that we are married." This went on and on for half an hour. Finally a voice from the other end of the car shouted, "Johnny, will you convince her so we all may go to sleep?"

♣

A new bride was asked what she had found to be the biggest thrill of marriage. "It was certainly thrilling when Bruce took me to the license bureau. It was another thrill when the minister pronounced us man and wife. I got an awful bang out of seeing Bruce sign the register 'Mr. and Mrs.' I do believe, though, that my biggest thrill was thumbing my nose at the house detective."

♣

A boy and a girl were out driving. They came to a quiet spot on the country lane and the car stopped. "Out of gas," said the boy. The girl, carefully opened her purse and pulled out a bottle. "Wow!" exclaimed the boy. "You've got a whole pint—what kind is it?"

"Gasoline," replied the girl.

♣

Newton's tenth law—the dimmer the porch light the greater the scandal power.

♣

The efficiency expert died after many years of faithful service and his company had arranged an elaborate funeral. The pallbearers were carrying the casket out of the church, when suddenly the coffin lid popped open and the expert sat up and said, "If you put this thing on rollers, you can lay off four men."

♣

An expert in autos says you can't tell exactly how far a couple has gone in a car, merely by looking at the speedometer.

♣

She: "Are you on the rowing crew?"

He: "No, I'm not."

She: "Then stop stroking."

♣

The young wife was not anxious to have a family right away. She visited her old family doctor to seek his advice.

"Well, there's one way that never fails," he said. "Simple, too. You just lean over and touch your toes ten times without bending your knees."

"Is that so?" said the girl. "Before, or after?"

"Instead of," said the old doctor.

♣

Beneath this stone lies Murphy,
They buried him today;
He lived the life of Riley,
While Riley was away.

♣

A widow is the most fortunate person in the world. She knows all about men and all the men who know anything about her are dead.

♣

He: "Sir, may I have your daughter for my wife?"

Father: "Bring your wife around and I'll see.

♣

It's amazing what some women get away with, and still keep their amateur standing.

♣

Modern proverb: Never run after a woman or a streetcar. There will be another along in a minute. Those after midnight, though fewer, go faster.

♣

Absence may make the heart grow fonder—but presents bring the best results.

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For years the two sexes have been racing for supremacy. Now they have just settled down to neck and neck.

BULLARNEY



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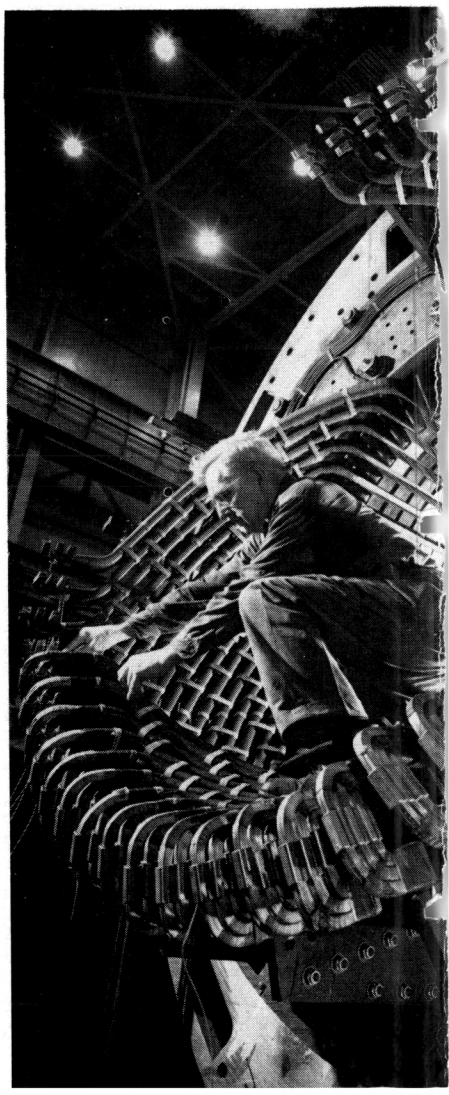
—Cut Courtesy Westinghouse

Central air conditioning is supplied to passenger aircraft from a conditioner at the port. Trap doors on the apron supply flexible hose that carries fresh air to the ships.

SINGLE SHOTS OF ITEMS OF ENGINEERING INTEREST

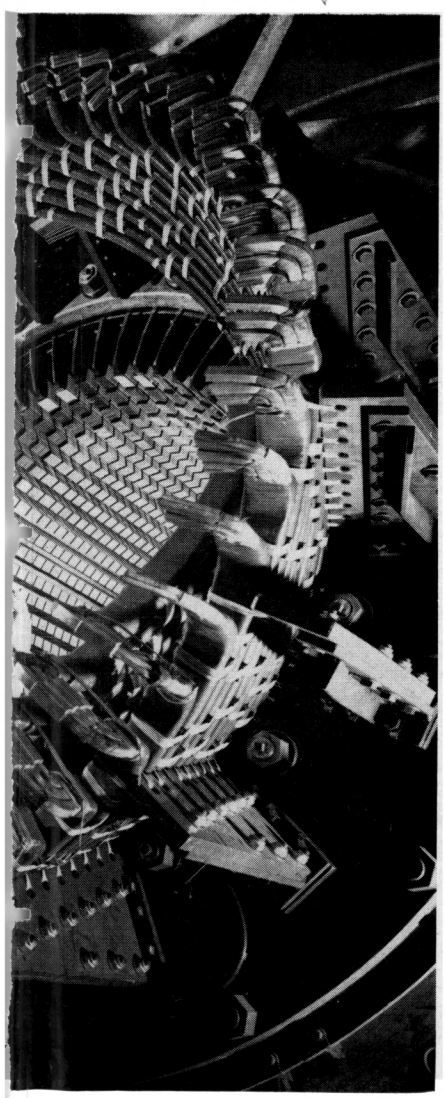
KW
PI



The tape-wound copper coils of at striking pattern at the Westinghouse plant. Here a workman applies insulat for a 135,000-kw turbine generator. This factured in the firm's new 1000-ft. gene capacity to produce large generators.

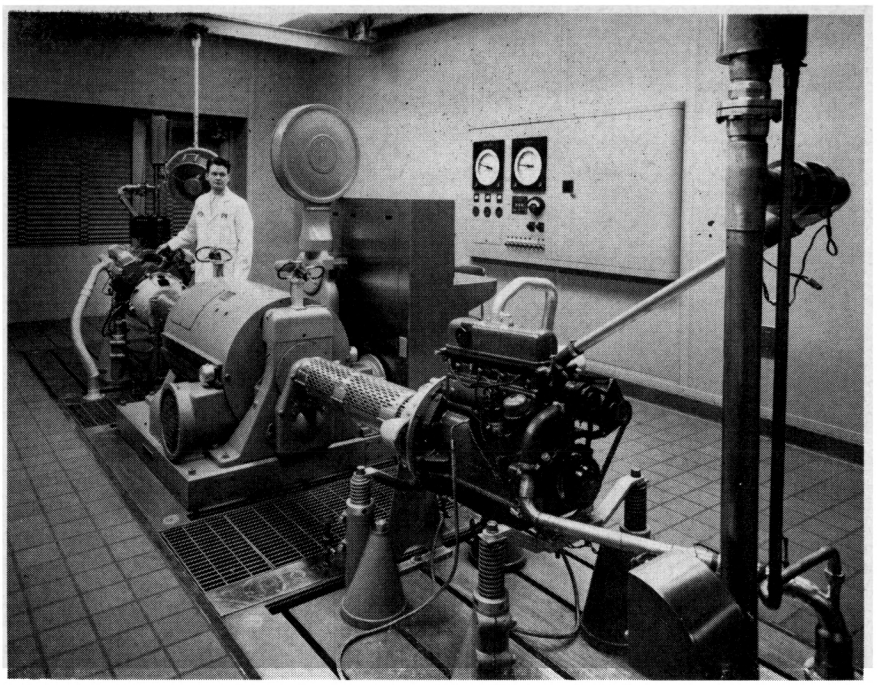
/IK

C



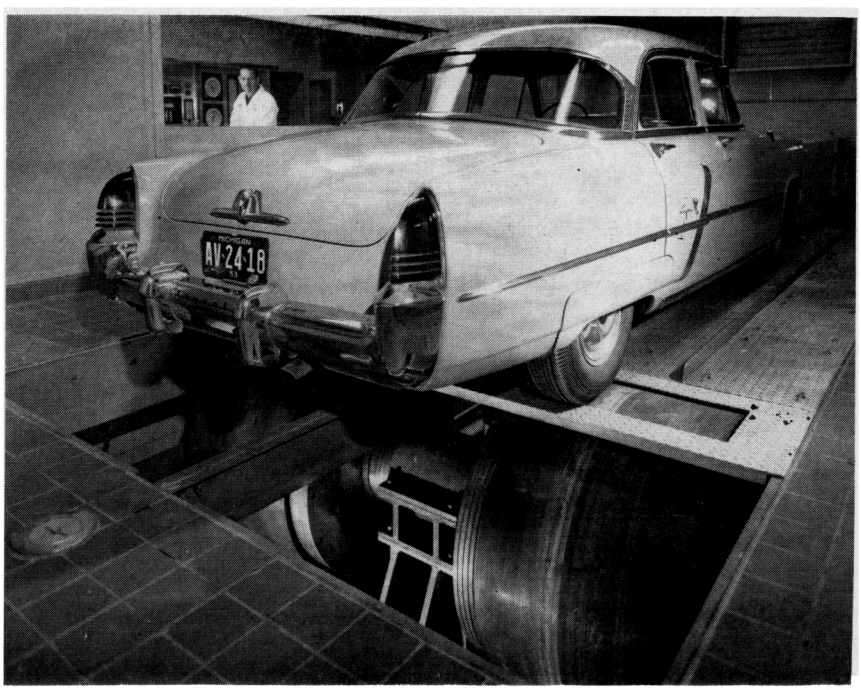
—*Cut Courtesy Westinghouse*

giant electric power generator form a Electric Corporation's East Pittsburgh ng tape to the coil ends of the stator hydrogen-cooled machine is being manu- ator aisle which has double the plant's



—*Cut Courtesy Westinghouse*

An operator adjusts one engine on test at Ford Motor Company, while the engine in foreground is being set up for similar tests. Dynamometer (in center) is equipped with a double-extended shaft to permit dual mounting. In this test, the speed-torque curve of the engine is obtained; also data on such items as optimum spark setting, carburetor adjustment, and fuel consumption.



—*Cut Courtesy Westinghouse*

Overall performance of an automobile is obtained in this chassis test. The dynamometer is coupled to two large drums in contact with rear wheels of car. Flow of air is supplied to front of car, providing cooling corresponding to speed. Special plates are bolted to the drums to provide proper inertia for the car under test. Electronic controls simulate wind resistance and road grades.

NEWSTUFF

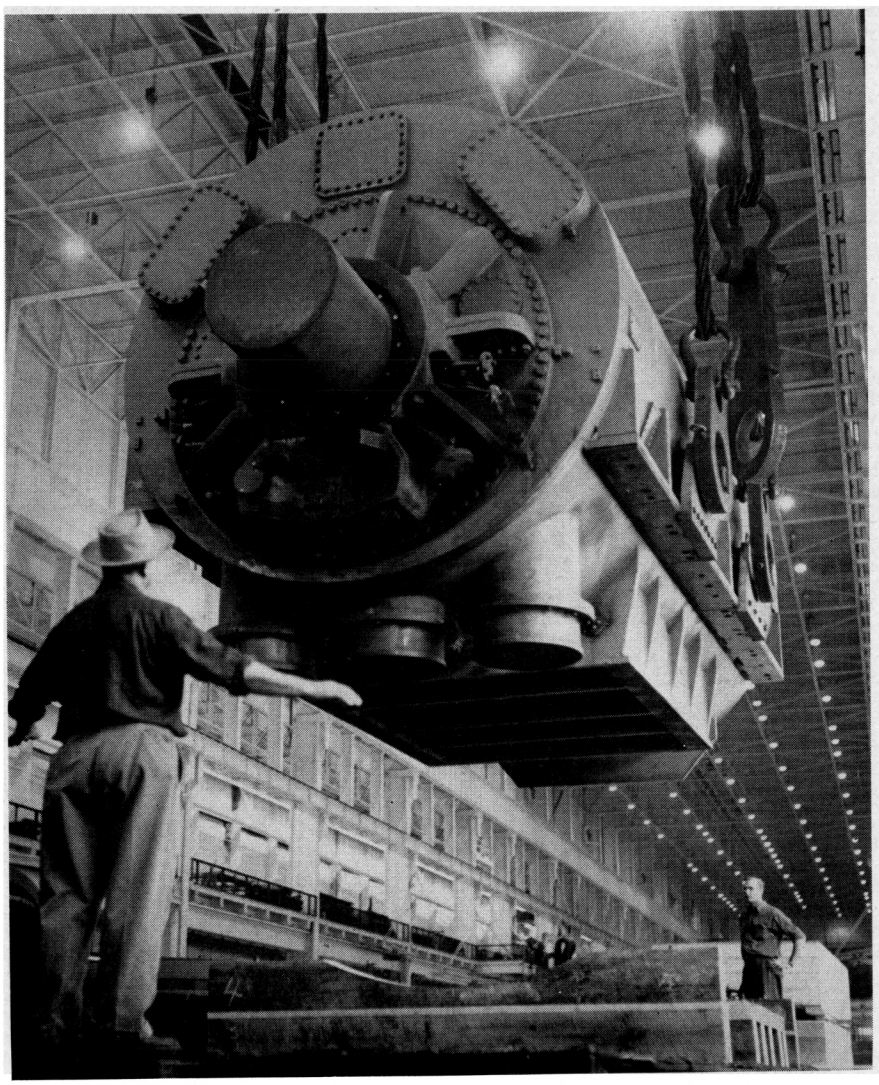
(*Continued from Page* 18)

not dependent on a chimney. This makes it very adaptable for use in clinics, offices and small stores.

The world's first completely inner-cooled generator described by engineers as one that will literally open a new era in the history of power generation has been purchased by the Niagara Mohawk Power Corporation for installation at Buffalo, N. Y. The new unit is rated at 100,000 kilowatts and is powerful enough to light a city the size of Nashville, Tennessee. However, it is only slightly larger in physical size than the average 40,000 kilowatt machine.

The new generator weighs about 350,000 pounds, which is about 150,000 pounds lighter than the average 100,000 kilowatt unit. The key to the increase in power rating which the physical size is much smaller lies in the new Westinghouse developed cooling system for large turbine generators.

This system is designed in such a way that the cooling agent, hydrogen gas, comes in intimate contact with not only the bare copper of the coils in the rotating part of the generator, but also with the copper coils of the stationary part of the machine. After carrying the heat away for disposal, the hydrogen gas is then recirculated through the machine. Up to this time the hydrogen had been able to pick up only the limited amount of heat that seeped through the insulating jacket covering the copper and steel.



—Cut Courtesy General Electric

The world's first inner-cooled generator is shown above. Slightly larger than the average 40,000 KW generator, it will be capable of 100,000 KW power production.

The Navy and the Westinghouse Electric Corporation have announced that Westinghouse has developed and placed in production a new high-power, low-weight turbojet engine known as the J-46. An outgrowth of the well-known J-34 engine, the new aircraft power plant has just successfully completed the defense department's grueling 150 hour qualification test, which all new engines must pass to be eligible for quantity production.

This test is equivalent to more than 75,000 miles of actual flight. About 16½ feet long and less than three feet in diameter, the engine is of the axial-flow or straight-through design which, since the initial flight of the company's first jet engine in 1944, has become the standard of the industry. It weighs approximately 2,000 pounds.

Then there was the fellow who had a hobby of collecting stones and putting them in his bathroom.

He had rocks in his head.

Professor to early class: "Order, please."

A drowsy voice from the rear of the room: "Two more beers."

Phone Conversation

"Is this the Salvation Army?"

"Yes."

"Do you save bad girls?"

"We do."

"Well, how about saving me three or four for Saturday night?"

C.E.: "Hey, don't spit on the floor."

M.E. "S'matter, does it leak?"

TURBOJET

(*Continued from Page* 13)

pipe, and jet orifice. The outside shell around the cone is in the shape of a slight angled frustrum and is located directly behind the turbine. When the engine is located in the fuselage of an airplane it is necessary to extend the frustrum with a cylinder called the tailpipe. The hot gases, coming from the nozzle on the end of the tailpipe form the thrust with a high velocity jet. To prevet excessive heat loss the tailpipe is lined with aluminum foil layers separated by copper screening.

In some turbojet engines there is a fifth assembly which is called the "Afterburner". It consists of a second fuel nozzle located near the end of the tailpipe to reheat the gases. It may be turned on or off at will and produces an immediate effect on the thrust of the engine. This assembly is in increasing use in our operational fighter planes.

LONG'S BARBEQUE
We Specialize in
BARBECUE SANDWICHES
Also Short Orders Served in
Evenings
208 South 9th

NICKEL

(*Continued from Page* 14)

80% of the reserves at Sudbury, Ontario.

The Defense Materials Procurement Agency has signed an agreement with M. A. Hanna Co. for the development of the Hanna nickel deposits at Riddle, Ore. Hanna has owned and explored the Riddle deposit for years. But it has shunned production; the ore is low grade and too expensive to produce under peace time economics.

But the economics today are not peace time—not with the DMPA (Defense Materials Procurement Agency) agreement. One Hanna subsidiary is going to develop a mine at its own expense, $4.3 million. It will produce ore at a cost of about $4.10 a ton and sell it to the government for $6 a ton.

The U. S. now imports more than 90% of its nickel, nearly all of it from Canada, and apart from Hanna, the only other prospective producer is at Fredericktown, Missouri, where National Lead Co. gets a nickel-copper-cobalt concentrate as a product of its lead production. The company is building a plant to separate the three metals and is due to get going toward the end of 1953; it will produce a modest 1.9 million lbs. a year.

A sizeable addition to normal supply comes from the Nicaro plant in Cuba owned by the U. S. Government. This plant was built during World War II. Closed down in 1947, it has been reactivated and will produce about 30 million lbs. of nickel a year—about 14% of U. S. consumption.

The U. S. supply actually is fixed by the International Materials Conference, which parcels out the entire free world supply. The high-cost nickel that the U. S. is digging up goes into this ditty. DMPA says that without controls the U. S. demand would be over 300 million lbs. of nickel a year.

When the present restrictions are lifted, the non-defense demand for nickel may well prove smaller than it was before the emergency. Many users have learned that they can get along with less nickel, sometimes via substitutes like manganese and boron.

In the auto industry, chrome on cars barely pass the regulation 0.001 in. of nickel that is the governmental minimum to be used. For a while chrome was even banned from trucks and heavy duty transportation, to conserve the little nickel that we had. There seems to be no satisfactory substitute for nickel in the auto industry. Copper-chrome and zinc alloys have been used, but generally substitutes are too brittle and tend to crack.

The pressure on nickel is in part due to the innate conservation of engineers and melt foreman in armament steel mills. They naturally dread any change in their melts. The fact is that the amount of nickel used in some steels can be safely reduced by substitution of another alloy metal. This was done in World War II to produce the N. E. series of National Emergency Steels, and more could probably be done about this than is being done.

It is to be expected that the increased production will reduce the limitations on use, at least temporarily. But high-nickel alloys will remain relatively expensive, and consumption

(*Continued on Page* 34)

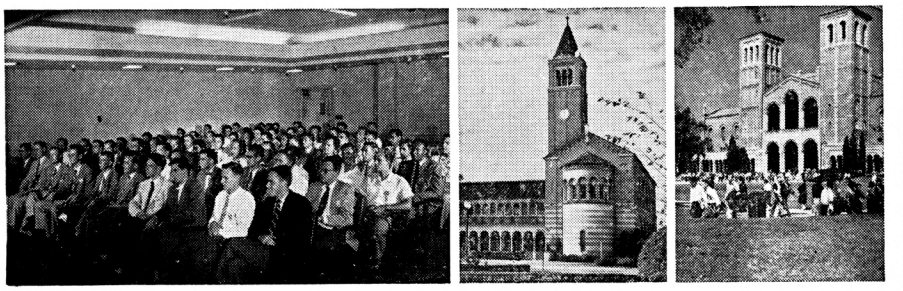


ENGINEERS
and PHYSICISTS

To those interested in advanced academic study while associated with research and development in industry, the following practical programs are offered:

1
HUGHES COOPERATIVE FELLOWSHIP PROGRAM

for Master of Science Degrees



A group of participants in the Hughes Cooperative Fellowship Program (above left). Fellows study for Master of Science degrees at either University of Southern California (center) or University of California at Los Angeles (right).

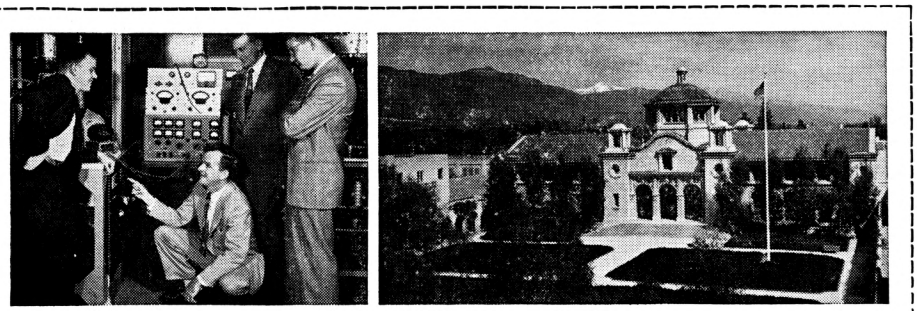
This program is to assist outstanding individuals in studying for the Master of Science Degree while employed in industry and making contributions to important military work. It is open to students who will receive the B.S. degree in Electrical Engineering, Physics or Mechanical Engineering during the coming year and to members of the Armed Services being honorably separated and holding such B.S. degrees.

Candidates must meet entrance requirements for advanced study at the University of California at Los Angeles or the University of Southern California. Participants will work full time at the Laboratories during the summer, and 25 hours per week while pursuing a half-time schedule of graduate study at the university.

The salary will be commensurate with the individual's ability and experience. Tuition, admission fees and books for university attendance will be provided. Provision is made for an allowance to assist in paying traveling and moving expenses from outside the Southern California area.

2
THE HOWARD HUGHES FELLOWSHIPS

in Science and Engineering



(From left to right) Hughes 1952 Fellows Truman O. Woodruff and Allen I. Ormsbee discuss tube processing station in Electron Tube Laboratory with 1953 Fellows Roy Gould and Baxter H. Armstrong. Their advanced study is at California Institute of Technology (above).

Eligible for these fellowships are those who have completed one year of graduate study in physics or engineering. Successful candidates must qualify for graduate standing at the California Institute of Technology for study toward the degree of Doctor of Philosophy in physics or engineering. In summers they will work full time in the Hughes Laboratories in association with scientists and engineers in their fields.

Fellows may pursue graduate research in the fields of physics, electronics engineering, electronic computing, aerodynamics, propulsion engineering, mechanical engineering, or information theory.

Each appointment is for twelve months and provides a cash award, a salary, and tuition and research expenses. A suitable adjustment is made when financial responsibilities of the Fellow might otherwise preclude participation in the program.

HOW TO APPLY: *For complete information concerning either of these Hughes Fellowship programs, consult your Placement Officer or write directly to us. Please indicate the particular program in which you are interested. A detailed explanatory brochure and application forms will be mailed promptly.*

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MIZZOU MEMOS

(*Continued from Page* 17)

District Superintendent, Sacony-Vacuum Oil Co., Inc.

WILLIAM R. CHYNOWETH, E.E. '40, 106 Stephen Place, North Syracuse, N.Y., Engineer, General Electric Co.

HAROLD E. GROVE, E.E. '29, 315 North 12th, St. Louis 1, Mo., Electrical Engineer, Union Electric.

ROBERT S. HALL, E.E. '50, 2604 Louis Avenue, Brentwood 17, Mo., Field Engineer, Hughes Aircraft Co.

J. ROBERT JEANS, E.E. '50, 101 Green Tree Road, Clifton, New Jersey, Senior Engineer, Federal Telecommunication Labs.

ERNEST H. THOMAS, Ch.E. '46, 1611 A. Paula Drive, Honolulu, Hawaii, Technical Director, Pacific Chemical and Fertilizer Co.

CHARLES E. WAGAMAN, M.E. '52, 759th AC and W Squadron, Naselle, Washington, 2nd Lt., U. S. Air Force.

Incidentally, BOB "CATFISH" ELLIS, E.E. '51, is looking for letters from some of the other men he trotted around with in school. He wants to get the Minnicks', the Magee's, and all the rest to come down for St. Pat's Week this year. Catfish's address is, 1230 Amherst Pl., St. Louis 12, Mo. His phone number is PArkview 7643.

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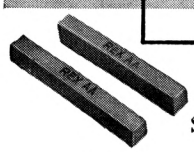
What's Happening at CRUCIBLE

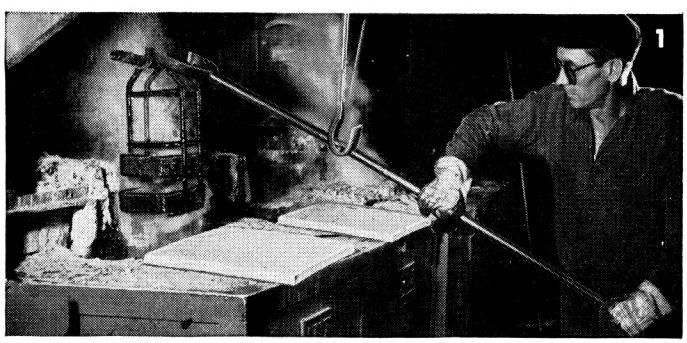
about REX HIGH SPEED tool bits



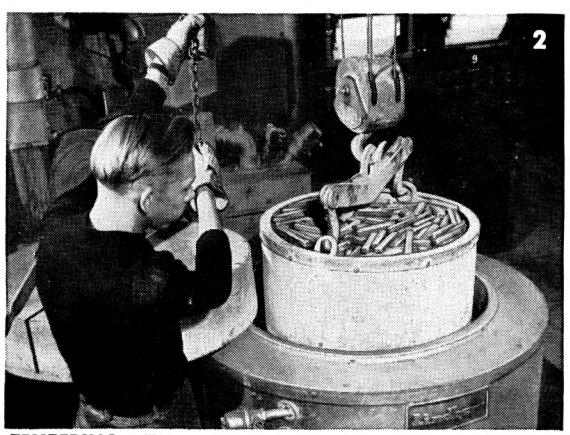
Many millions of REX High Speed Tool Bits have been produced, in recent years, at Crucible's Sanderson-Halcomb Works, Syracuse, New York.

Our Tool Bit Department is actually a manufacturing plant in itself, where production is counted in pieces—in sharp contrast to the larger production units of most other phases of steelmaking.

REX High Speed Tool Bits are made from high quality high-speed steel bar stock, produced at Crucible's Sanderson-Halcomb Mill. Bars are cut to tool bit lengths, heat-treated, grit-blasted or ground, and inspected.



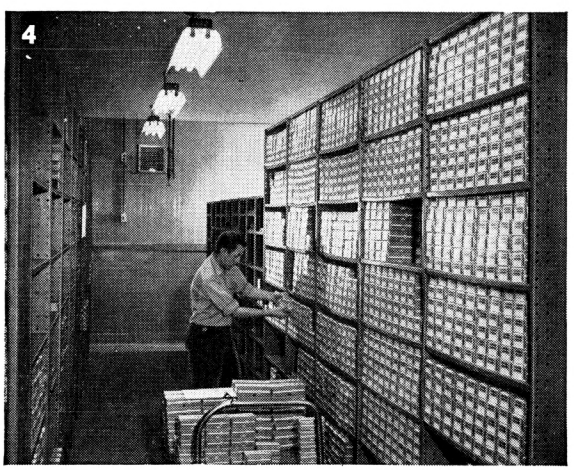
HARDENING — Small batches of REX High Speed Tool Bits are hardened in modern salt bath furnaces. The bits are then quenched in either salt or oil.



TEMPERING — Tempering is done in circulating air furnaces. All of the steps illustrated help insure a correct combination of maximum red hardness, toughness and abrasion-resistance necessary for continuous high cutting efficiency.



TUMBLING — Prior to inspection and packaging, REX High Speed Tool Bits are cleaned by tumbling.



STOCKS — REX High Speed Tool Bits are stocked in standard packages in Crucible's warehouses.

Uniformity Each individual REX High Speed Tool Bit possesses the same uniform high quality. Each bit is inspected by the magnetic particle method . . . and representative bits are tested for microstructure and hardness. These tests control quality of the finished product . . . insure that REX bits will give higher production from each grind, and a minimum of "down-time" on your machine.

Crucible Engineering Service Available

Crucible engineers are available to work with you in the selection of the proper REX grade for highest cutting efficiency on your particular job.

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AROUND THE COLUMNS

(*Continued from Page* 16)

at Christian College. He worked for a while as chief bridge designer for the Erector Set Co. The wedding must have been a lively one, because Tom Skinker, best man and Frank Frier started them off right on their honeymoon by putting limburger cheese in the air vent of L. L.'s car. Susie and Les thought it was the least to say the most.

♣

Homecoming is real long gone,
Mid-semester is here at last
"Roll",
Homecoming is real long gone,
Mid-semester is here at last
Sammy made the famous "Honor Roll",
And it knocked him on his—slide rule.
Oh well, there's still nine weeks,
We can't get slow or shoddy
Got to keep hitting those books
'Cause the Army is hot for my BODY!

♣

Did you know that Jesse Wrench, that Grand old man of "Give 'em Hell" fame has a nephew attending M.U. now. He is Jim Wrench, a sophomore in civil engineering.

♣

You loyal followers of St. Pat all remember Egon Doerring, honor graduate of last year. Slip Stick Sam is happy to report that he is working for Texaco Oil Co. in Houston Texas. It's common knowledge that he would someday marry Betty Nichols. Well, she finally trapped him on July 18. Right now he is waiting for his orders? Ha.

One of Egon's best friends, Ron Shutz married Bev Hodge this summer and is completing his studies at Washington University in St. Louis.

THE DU PONT DIGEST

Design

AND DEVELOPMENT

Call for Knowledge, Ingenuity, Teamwork

Making new products in large amounts, devising new processes, and improving old ones—such problems are the job of Design and Development. An example was the development of a large-scale process for making "Orlon" acrylic fiber starting from small laboratory samples of polyacrylonitrile.

Quantity production of polymer was only a beginning. A whole set of new and unusual problems arose in spinning the fiber, because polyacrylonitrile decomposes before it melts, and it dissolves only in high-boiling solvents.

A team of Du Pont technical men—chemical and mechanical engineers, instrumentation specialists, metallurgists, and materials handling experts undertook to find a solution. Here are a few of the problems they met:

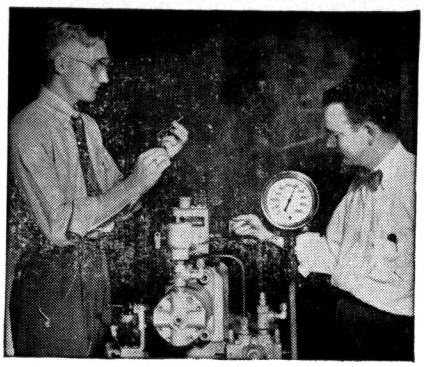
1. Solve problems in heat transfer and fluid flow arising from the fact that the spinning solution must be blanketed with inert gas to prevent fire hazards.

2. Design a system for controlling the temperature of the viscous spinning solution within ±0.5°F. at hundreds of points in the plant.

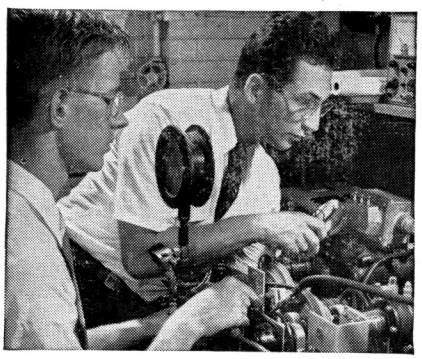
3. Design new mechanisms for winding yarn at high speed without any deviation in yarn tension.

4. Design air conditioning and ventilating systems to remove fumes from specific spots, but still allow easy access to all areas.

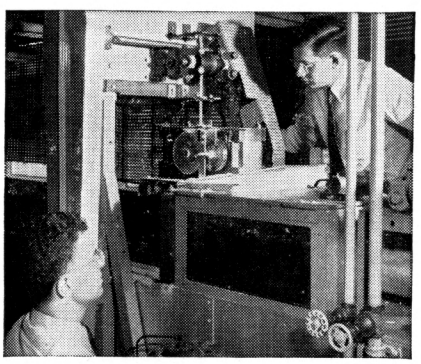
Among Du Pont's many research and engineering activities, Design and Development jobs provide great opportunity for the knowledge, ingenuity, and teamwork capacities of men in a great variety of technical fields.



The characteristics *of a super-pressure pump, designed by Du Pont engineers and made in Du Pont shops, are studied by Ralph C. Grubb, B.S.M.E., Tennessee '51, and Paul D. Kohl, B.S.M.E., Purdue '46.*



Albert Rand, *B.S.M.E., M.I.T. '50 (right) develops controls for chemical equipment.*



Carl Hellman, *B.S.Ch.E., Syracuse '50, and J. M. McKelvey, Ph.D.Ch.E., Washington '50, search for new ways to coat plastic on wire.*

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MKS

(*Continued from Page* 15)

would decrease the force exerted by one-hundredth since the force is proportional to the square of the current. In terms of the MKS units this equation will now define the ampere. If two current carrying wires one meter long and one meter apart experience a force of one-hundredth of two dynes, the current flowing is one ampere. Since one dyne is 10^{-5} newtons this force will be 2×10^{-7} newtons. Going back to the defining equation $F = 2W I^2 l/r$. We know that the $I^2 l/r$ quantity is unity and that the force is 2×10^{-7} newtons. This means that W in the MKS system must be 10^{-7} units. In the rationalized MKS system W is set equal to $4\pi \times 10^{-7}$ units in order to simplify subsequent equations. The defining equation has not been changed any by doing this! It is merely rewritten in the form $2W I^2 I/4\pi r$.

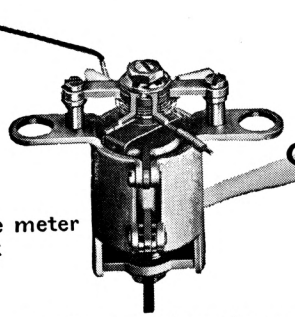
The unit quantity of charge (coulomb) can now be defined as the amount of electricity passing a point in one second when one ampere of current is flowing. The volt is the amount of potential between two points when one joule of work is done in moving one coulomb from point of lower to point of higher potential. The unit of resistance (ohm) may be defined by Ohm's law.

Now that we have defined the common electrical quantities we can turn our attention to the more abstract ones. They are harder to understand simply because no one actually knows what they consist of. We started our discussion by observing the force between two current carrying wires. The force was not caused by the current itself, but by something due to the current. Not knowing the mechanical structure of this something, it was given the name Field (or Flux) and early investigators conceived lines of force (or flux) to represent this field. The concept of lines of flux is purely imaginative, but it has been applied and proven practical, so it is commonly accepted. One line is called a Weber and may be defined through the phenomena of voltage generation. It was found that when a conductor was cut by these lines of flux (either through movement of the field or movement of the conductor) that a voltage was induced in the conductor, and that the amount of voltage was dependent solely on the rate at which the lines were cut. This was expressed in the equation $e = d(\text{phi})/dt$ where phi is in webers and e in volts. Since the volt has already been determined, this equation then defines the weber.

Another physical phenomena which will aid us in our definitions of field quantities is the fact that a force is exerted on a charge when it moves perpendicularly through a magnetic field. This force is proportional to the size of charge, velocity of charge, and an unknown factor which is a function of the field and is designated B. This quantity B may be more fully understood through the application of dimensional equations. (A short explanation of dimensional equations may be found at the end of this article.) From the defining equation for B ($F = QVB$) we can write the dimensional equation

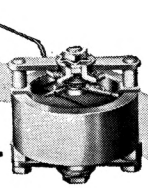
$$B = \sqrt{MW} / T\sqrt{L}$$

(*Continued on Page* 32)



full bridge meter movement

CREATING SOMETHING SMALLER...



unique core type movement

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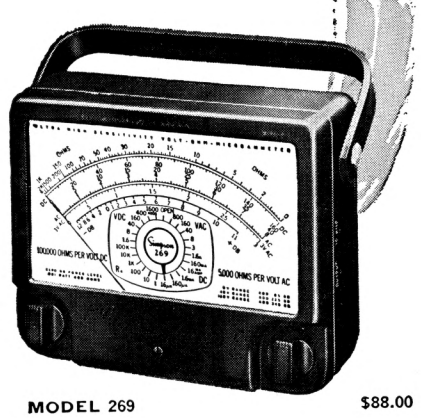
A unique core type movement was designed by Simpson engineers. Its specifications for accuracy are so extremely rigid that unusual production methods had to be devised to build these core type movements in commercial quantities. Simpson engineers did this, too.

Today, laboratories, manufacturers, schools, and television servicemen have available to them a completely portable volt-ohm-microammeter . . . an electronic tester so sensitive that many of its 33 ranges are comparable in sensitivity to those of a vacuum tube voltmeter. In addition, this unusual product eliminates practically all of the disadvantages of a VTVM . . . drift, tube replacement, warm-up time, resulting in necessity for recalibration,—no AC outlet or line cord required.

This is just one more example showing what creative engineering can do to solve a problem.



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MODERN FARMERS like J. A. Parks of Maloy, Iowa, using the gang plow above, can produce much more in much less time than the farmer of just a few years ago. In the horse-powered days of farming it took as many as 35 man-hours to produce and harvest an acre of corn. Now, on many mechanized farms, it is done in fewer than 11 man-hours. In addition, the shift from animal power to machine power released about 72,000,000 acres of cropland from producing feed for horses and mules to producing food for the nation's tables.

WHAT EVER HAPPENED TO THE MAN BEHIND THE PLOW?

THE "man behind the plow" is still very much in the picture, but he's *up front now*. And because he is, you and your family—even the world—are better fed today.

Not many years ago the American farmer walked behind the old horse-drawn plow, worked longer hours and produced much less than he does today. But that was before the development of the "hired hands" that never tire—the tractors, trucks and implements which do the work of many men, and the petroleum fuels and lubricants which keep them running.

In the last 50 years or so, while America's population was growing from 75,000,000 to more than 150,000,000 a remarkable change was taking place in agriculture. Today 8,000,000 *fewer* persons on America's farms are producing food for 75,000,000 *more* Americans.

Yet America has never been better fed. It has never been better equipped to export needed foods to other countries for normal requirements, or to combat famine—an ally of communism—wherever it appears.

Never have so few fed so many so well.

To help make ours a more abundant land, Standard Oil pioneered in delivering petroleum products right to the farmers' doors in the quantities needed and at reasonable prices. This on-the-spot delivery, started way back in 1910, was vital to the rapid growth of mechanized farming in the Middlewest—one of the most productive agricultural regions in the world.

So many rural customers have learned to depend on Standard Oil products and services that we now serve far more Midwestern farmers than any other oil company.

Standard Oil Company

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Chicago 80, Illinois

STANDARD

MKS

(*Continued from Page* 30)

Multiplying top and bottom of this equation by $\sqrt{L^3}$ gives

$$B = \sqrt{MWL^3} / TL^2$$

Since phi $= \sqrt{MWL} / T$, it is obvious that $B = phi/L^2$ or flux per unit area.

The ratio of B to W occurs many times when dealing with electromagnetism and is used to define another quantity which is labelled H. The units of M may be found by dividing the dimensional equation of B by W. This results in $\sqrt{M} / T\sqrt{WL}$. Multiplying top and bottom by $\sqrt{L}$ leads to I/L. This is more commonly written with a pure number N to give $H = NI/L$. (Ampere Turns/Meter.

Coulomb provided the key to the problem of electrostatics when he noted the force exerted between two charged bodies. He expressed the phenomena by the equation

$$F = KQ_1Q_2/r^2$$

where r is distance of separation and K is constant of proportionality. In the electrostatic system K is set equal to unity and this equation was then used to define unit charge. Since we have already defined Q, this equation may now be used to determine the value of K. In the rationalized MKS system this equation is written

$$F = Q_1Q_2/4\pi Zr^2$$

where $\frac{1}{4}\pi Z$ has replaced the K. Epsilon (Z) is a function of the surrounding medium and is given the name permittivity.

Epsilon could be determined from Coulomb's law, but the more practical method is through the remarkable relationship existing between electromagnetics and electrostatics. If the electromagnetic dimensional equation for charge (QM) is divided by the electrostatic dimensional equation for charge (Qs) we gain an insight into the mysteries of electricity which is most enlightening.

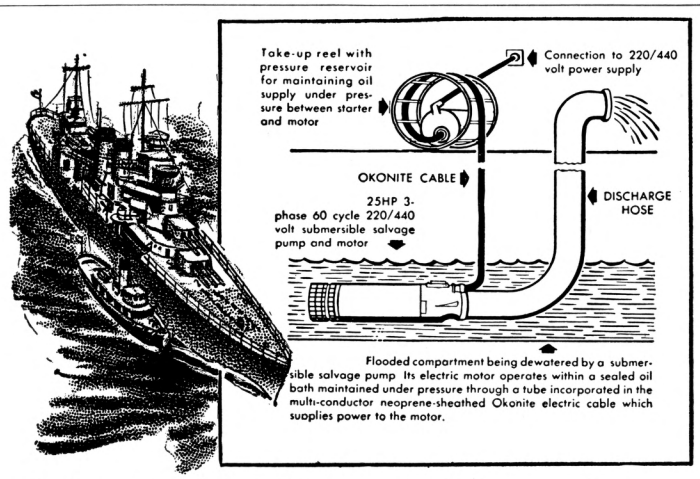
$$Qm = \sqrt{ML}/\sqrt{W} \; ;$$
$$Qs = \sqrt{ML^3Z/T}$$
$$Qm/Qs = T/L\sqrt{WZ} \; ;$$
$$QmL/QsT = I/\sqrt{WZ}$$

Qm and Qs can both be expressed in terms of electrons which makes their ratio a pure number. This leaves us with the amazing result that $1/\sqrt{MZ}$ is a velocity. Knowing that Qm is about 6.24×10^{19} electrons and that Qs is about 2.08×10^9 electrons we can obtain 3×10^{10} cm. per sec. as the value of this velocity. This is one of the reasons that light was thought to have an electromagnetic origin.

Getting back to the determination of epsilon (Z) in the RMKS system we can substitute $4\pi \times 10^{-7}$ for Mu (W) and 3×10^8 meters per second for e in the equation $WZ = 1/e^2$ and arrive at $Z = 8.85 \times 10^{-12}$ units.

There is one more observable fact which will aid our system of units. This is the force experienced by a static charge in an electrostatic field. In effect, that is what Coulomb's law considers, but no mention is made of the field. When expressing this phenomena we just say that the force is proportional to the charge and to the field. F = QE, where E is a function of the field. To determine the units of E we can turn again to dimensional equations and divide F

(*Continued on Page* 38)



Seriously crippled by an aerial torpedo **during World War II, the cruiser USS Honolulu struggled home 12,000 miles under her own power.**

This historic trip was made possible by the vessel's salvage pumps which were served by unusual "double-duty" Okonite cables. These specially made cables not only supplied power to the electric motors in the pumps, but also maintained a constant oil supply to the pumps through a tube *in the same cable.* Despite many weeks of submersion in oily sea water, the Okonite cables retained their original properties.

● ● ●

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

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9th & University



THE HYDROSTATIC TEST

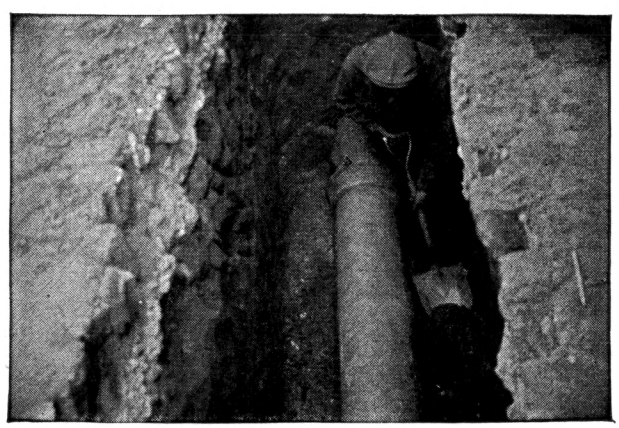
Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES

NICKEL

(*Continued from Page* 24)

in the next decade is not likely to go much above 200,000 tons.

In fact, substantial growth of the demands for nickel in high-temperature alloys for jet and rocket construction and atomic energy may in time force the development of marginal deposits that will raise the price of nickel.

Canada seems to be leading in the research for new ore bodies. They have reserves all over the world. Most of the new deposits are in the Western Hemisphere.

Deposits in Brazil controlled by Ventures, Ltd. of Canada contain 10 to 20 million tons of ore with 2½% nickel content. Newly discovered deposits on the North rim of Ontario's Sudbury basin are being developed by Falconbridge, which is a Canada firm. INCO controlled deposits in Venezuela could supply a large tonnage of submarginal nickel, probably 15,000 tons a year.

The only U. S. deposit that has been recently discovered is at Moa Bay, Cuba. It was discovered by Freeport Sulphur Co. and will add an estimated 500,000 tons of nickel to U. S. reserves. The ore averages 1.35% nickel.

Many industries have learned to conserve nickel during production. An example of this conservation is a simple change in the method of dumping nickel storage tanks. This method, which is equally applicable to small plants using acid-copper and nickel, is saving G. M. Pontiac Division an estimated $9,600 per year. Estimated monthly saving of nickel plating solution is 1200 gallons. The method, developed from the suggestion of a Pontiac employee, requires no special equipment.

Prior to adoption of the new dumping method, Pontiac pumped down its storage tanks to about the six inch level and then dumped each of the tanks. Since this operation had to be repeated every six to eight weeks, disposing of the residue in the tanks—as well as the resulting loss of nickel—presented a serious problem. Now, instead of dumping the tanks, they use the new plan. They pump the remaining solution into the next tank and then repeat the process until all of the tanks have been emptied. When all of the liquid is in the last tank the solution is permitted to settle for 24 to 48 hours. Then some of the solution is pumped from the top back into a clean storage tank. This operation is repeated periodically over six to eight weeks, until most of the concentrate remaining in the last tank can be removed with a shovel.

INCO's efforts, in these days of heavy demand, were discussed by Dr. John F. Thompson, chairman of the board in a letter to the shareholders of the Company on November 13, 1952, it follows as:

In the present emergency, when the free world has need for every pound

(*Continued on Page* 38)

Just published . . . the most practical, helpful modern text on mechanical drawing . . .

TECHNICAL ILLUSTRATION

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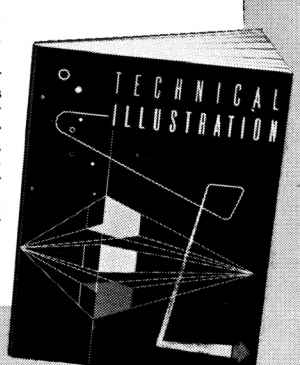

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You'll be at the head of the jet parade at Boeing

For long-range opportunities, it's hard to beat the jet aircraft field. If *you* want to get into this exciting branch of engineering after you graduate, get in at the head of the parade—at Boeing.

Through the fighter-fast B-47 six-jet bomber, and the giant new eight-jet B-52, Boeing has acquired more experience designing, flying and building multi-jet aircraft than any other company, either here or abroad. In addition, Boeing is the first American company to announce its entry into the jet transport field.

Engineering graduates will find in the aviation industry an unusually wide range of experience, and great breadth of application — from pure research to production design, all going on at once. Boeing is constantly alert to new techniques and materials, and approaches them without limitations. Extensive subcontracting and major procurement programs, all directed and controlled by engineers, afford varied experience and broad contacts and relationships.

Aircraft development is such an integral part of our national life that young graduates can enter it with full expectation of a rewarding, long-term career. Boeing, now in its 37th year of operation, employs more engineers today than even at the peak of World War II. Its projects include guided missiles, research on supersonic flight and nuclear power for aircraft.

Boeing engineering activity is concentrated at Seattle in the Pacific Northwest, and Wichita in the Midwest. These communities offer a wide variety of recreational opportunities. Both are fresh, modern cities with fine residential sections and shopping districts, and schools of higher learning where engineers can study for advanced degrees.

There are openings in ALL branches of engineering (mechanical, civil, electrical, aeronautical, and related fields), for **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING.** Also for servomechanism and electronics designers and analysts, and physicists and mathematicians with advanced degrees.

For further information consult your Placement Office, or write:

RAYMOND J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

HOW TO CREATE SUCCESSFUL DESIGNS

SIMPLY being able to create a unique machine design is no longer enough to insure a successful career in product engineering. Today, more than ever before, a machine design must be strong and durable, *yet be the lowest in cost,* to be acceptable to company management.

As a result, many new designs are of welded steel construction and existing designs are being converted to eliminate excessive material and to reduce the number of shop manhours needed for fabrication.

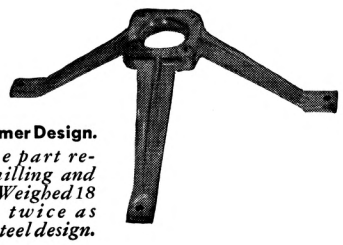


Fig. 1. Former Design. *Machine part required milling and drilling. Weighed 18 pounds, twice as much as steel design.*



Fig. 2. Present Construction. *Bearing Housing and arms are 10 gauge metal. Weighs only 8½ pounds. Cost 30% less to manufacture.*

HOW TO DESIGN FOR WELDED STEEL

As a result of such economies, it is important that forward-thinking engineers maintain close contact with the rapid progress in the arc welding industry. Latest data on design for welded steel construction is available in bulletins and handbooks. Write to The Lincoln Electric Co., Cleveland 17, Ohio.

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

Here is the tentative program for the Fourth Annual Diesel Power Plant Conference. The conference is a service of the Adult Education and Extension Service. Everyone is invited.

Monday, November 16

8:00 Registration, Engineering Hall—Fee $5.00

8:50 Opening Session — Mechanical Laboratory
Presiding—Ralph Scorah
Department of Mechanical Engineering

1. Welcome to the University
   Huber O. Croft, Dean College of Engineering
2. Extension Service
   Amos J. Snider, Director Adult Education and Extension Service
3. Program Announcements
   Carl Sneed, Program Chairman, Ass't Prof. of Mechanical Engineering

Cooling Water and Equipment

9:15 4. "Vapor Phase" Cooling
   R. L. Brasfield, Central States Engineering, Inc. St. Louis, Missouri

10:30 5. Engine Water Treatment
   T. C. Messplay, Jr., Messplay Equipment Company, Kansas City, Missouri

11:45 Luncheon — Room 214-215 — Memorial Student Union

Fuels and Lubricants — Mechanical Laboratory

1:15 6. Panel Discussion, Fuels and Lubricants
   Chairman and Moderator, A. L. Heintze, Staff Engineer, Sinclair Refining Co.

6:00 Dinner Session — Room 214-215 — Memorial Student Union
Presiding
George W. Elliott, Ass't Prof. of Mech. Engr., Director of Engineering Placement

7. "Operator's Panel" Discussing
   James B. Corn, Superintendent of Utilities, Cameron, Missouri, Chairman

Tuesday, November 17

Operating Session — Mechanical Laboratory
Milo M. Bolstad, Associate Professor of Mech. Engr.

9:00 8. Bearings
   Harold Lambertus, Sales Manager, American Bearing Corporation, Indianapolis, Indiana

10:25 9. Preventive Maintenance
   George A. Schauer, Superintendent Field Service Division Fairbanks, Morse and Co.

11:45 Luncheon — Room 214-215 — Memorial Student Union

Engine Session — Mechanical Laboratory
Presiding—Carl Sneed, Assistant Prof. of Mech. Engineering

1:15 10. Piston Rings
   H. G. Braendel, Chief Engineer Wilkening Manufacturing Co., Philadelphia, Pa.

2:45 11. Dual Fuel Operation
   George A. Schauer, Superintendent Field Service Division Fairbanks, Morse and Co.



Owner goes 'round the world in 40 seconds!

With this new multi-wave portable you can circle the globe in the time it takes to twist a dial.

That's because the RCA Victor Strato-World radio has Electronic Band Spread Tuning.

Instead of being squeezed together on one band segment, short-wave stations are in spread formation across the dial of your 7-band Strato-World. You tune London, Rome, Moscow, Tokyo just like local stations.

There's real *one-handed* portability, too. The Strato-World is a trim 23 pounds, with batteries . . . or it can be plugged into an electrical outlet. Smartly styled, with genuine cowhide case!

Here is the performance, the engineering and design you've come to expect from RCA Victor, a division of the Radio Corporation of America. See this globe-trotting, pace-setting portable at your RCA Victor dealer's.



CONTINUE YOUR EDUCATION WITH PAY—AT RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to College Relations Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RCA ® *RADIO CORPORATION OF AMERICA*

World leader in radio—first in television

To our Readers and Advertisers:

The purpose of this Questionnaire is to evaluate the material in the SHAMROCK for the general reader. Please give a qualifying statement if you feel it is needed.

1. Are you pleased with the reading material in the SHAMROCK? .....
2. Have you found the layout of the reading material pleasing? .....
3. Could the calibre of the material be more or less technical? .....
4. Has any of the material helped you or your associates? .....
5. Is there any special feature you would like included in the magazine? .....
6. Do you think there is too much devoted to one feature? .....
7. Has any feature received your special interest? .....
8. Would more graphs and illustrations help you understand the articles? .....
9. Does the advertising attract your attention? .....
10. Can you suggest any improvement in the advertising layout? .....
11. If you were in a position to advertise in the SHAMROCK, would you do so? .....
12. Are there too many pages of advertising in the SHAMROCK? .....
13. Is the quality of the printing and paper satisfactory? .....
14. Have any of the photo cuts been of poor quality? .....
15. Is the SHAMROCK available to the students in your local high school? .....
16. Are you an Alumnus? ..... Are you an advertiser? .....
17. If you are an alumnus, please note in this questionnaire some news of yourself and any other engineering alumni you know.
18. Name .....

    Address .....

For High Schools:

The SHAMROCK is mailed to every accredited high school in Missouri. This is done to acquaint the student with engineering, and help him choose his career. The purpose of this questionnaire is to evaluate the material in the SHAMROCK for the High School students.

1. In what way is the SHAMROCK made available to the students? .....
2. Does the office and teaching staff read the magazine? .....
3. Is there any special feature you would like included in the magazine? .....
4. Has any feature received your special interest? .....
5. Are you pleased with the reading material in the SHAMROCK? .....
6. Is there too much devoted to one feature? .....
7. Would you have a high school student read the jokes? .....
8. Is the quality of the paper and printing satisfactory? .....
9. Have any of the cuts been of poor quality? .....
10. Are you a student? ..... Teacher? .....
11. High School ..... City .....
12. Can we get any better distribution of the SHAMROCK in your school?

NICKEL

(*Continued from Page* 34)

of its various metals, the Company's resources in research and technical knowledge have been equally valuable in promoting the most efficient use of every pound of its production and when technically possible, the use of alloys of lower content and even materials containing no nickel at all.

If more of the producers and nations of this world would take this stand on the nickel situation, the nickel problem could be solved with little or no trouble at all.

M K S

(*Continued from Page* 32)

by Q. This gives $E = \sqrt{MLW}/T^2$ and when we multiply top and bottom by L it results in $\sqrt{ML^3W}/T^2L$ which is volts per meter.

DIMENSIONAL EQUATIONS

The Dimensional Equation is a simple and invaluable guide when considering systems of units. It is merely the expression of a quantity in terms of fundamental quantities. The fundamental quantities in the MKS system are Mass, Length, Time, and permeability (Mu = W). (This last has not been universally accepted.) As an example we could use velocity and acceleration. The defining equation for velocity is L/T, which is also a dimensional equation. The defining equation for acceleration is V/T, which is not a dimensional equation. The dimensional equation is found by substituting fundamental quantities for derived ones, thus; $|A| = L/T^2$. Since F = MA, the dimensional expression for F would be $|F| = ML/T^2$. Work equals Force times Distance, or $|W| = ML^2/T^2$.

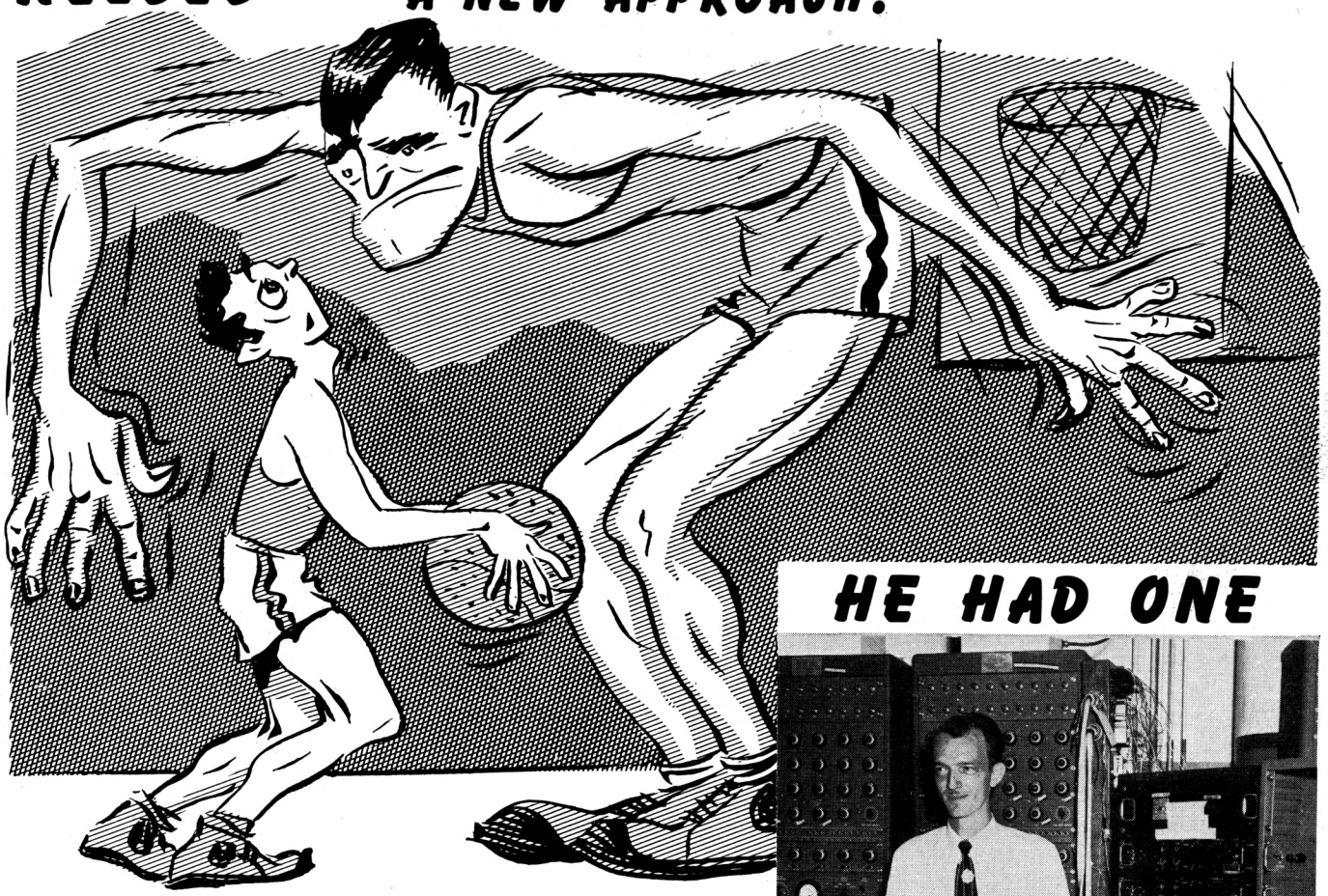
We can now turn to the electrical units. The defining equation for currents, $F = 2WI^2L/4\pi r$ gives current the dimensions: $|I| = \sqrt{ML}/T\sqrt{W}$. Multiplying Current by Time will give the expression for charge.

$$|Q| = \sqrt{ML}/\sqrt{W}.$$

Voltage is work divided by charge, or, $|V| = \sqrt{ML^3}/T^2$. Flux is voltage times Time, or $|phi| = \sqrt{ML^3W}\ /\ T$.

An example of a nelectrostatic dimensional equation could be obtained from Coulomb's law $F = Q_1Q_2/ZL^2$. $Qs = \sqrt{FZL}$ or $|Q| = \sqrt{ML^3Z}/T$.

NEEDED--- A NEW APPROACH!



HE HAD ONE

Prime contractors to our Armed Forces—M. A. C. is engaged in the design, development and production of airplanes, helicopters and guided missiles. One of the newer products of McDonnell ingenuity, the F101 Voodoo, will soon join the arsenal of the U. S. Air Force.

McDonnell engineering planners are constantly alert to new materials, new equipment and new techniques. A Flight Test Hanger, Propulsion Laboratory, Altitude Test Chamber and Wind Tunnel are recent additions to our engineering facilities. We are also interested in new engineering talent—men who can contribute original thinking—*engineers with a new approach.*

If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when the McDonnell representative will visit your school. Ask him about the McDonnell Graduate Study Plan. You may also write to:

Technical Placement Supervisor
Box 516, St. Louis 3, Missouri

BOBBIE S. SHARRAH
Assistant Chief Dynamics Engineer — Missile Engineering Division
B.S.A.E. Iowa State College '45
M.S. Applied Mechanics Washington University '52

Pictured in front of our REAC installation, Bob Sharrah exemplifies the type of pioneering spirit essential in missile engineering. He developed a new and useful approach to the problems of stability of guided missile control systems as influenced by aeroelastic effects. At twenty-eight, Bob also points up the youthfulness of M.A.C.'s engineering management.

If your interests lie in the field of missile development, a challenging career awaits you at McDonnell. We need more young engineers like Bob Sharrah—*engineers with a new approach.*

BUILD YOUR FUTURE WITH A COMPANY . . . . YOUNG IN YEARS, YOUNG IN SPIRIT AND IDEAS

McDONNELL *Aircraft Corporation*

SHAMROCK



SEZ

HONORS have been won by ol' SHAMROCK! Seems that SHAMROCK is a member in the Engineering Colleges' Magazine Association, or E.C.M.A. for short, which has members all over the country. And of ALL member magazines, our mag had the best covers for the year of 1952/53! Just to make sure of quality, Ol' SHAMROCK took third place honors for editorial, and is now grinning all over his face. A lot of backpatting is still due to Mike Chiarrotino, last year's editor, for his editorials, and to Liiv & Reim, photographers who covered the covers. —Such performance demands an encore, and so let's go to town with Dave Aldag, and do some more winning this year.

COMPLETING QUESTIONNAIRES sent out by SHAMROCK is the first way engineers can help to make SHAMROCK place in E.C.M.A. By filling out the circulars, YOU can criticize your magazine from the the standpoint from which it is judged most—appeal to students. So look in the preceding pages for a copy of the questionnaire, fill it *right now*, and drop it over to SHAMROCK office, or mail it to Room 233, Engineering Building.

SHAMROCK SIGN in front of Engine Building was subject to a replacement crusade last year, with suggestions to Engine Club to take action. Well, at the October meeting a courageous member finally proposed a solution, and was seen running around with odd shaped neon tubing the next day. So Ol' SHAMROCK thinks this is a wonderful year as far as student spirit is concerned.

ENGINE CLUB membership could show more spirit, though with all this big freshman crowd this year, the membership is only around 350 out of a possible 800 students eligible. In previous years the membership has at least exceeded 50 per cent. Seems that around St. Pat's Week everybody joins ENGINE CLUB anyway—and so have missed out on three-fourths of the year's activities. It's not necessary to take a course in Engineering Economics to figure out who's losing on the deal.

HOMECOMING FLOATS by both the ENGINE CLUB and the Civils were a good indication of how to advertise us. After all, not much is heard from the engineers during the year until St. Pat's Week. A bouquet from Ol' Shamrock to the guys who pitched in from their study time to work on the floats!

Another chance to tell the campus about us is the Engineers' Club Fall Dance, scheduled for November 14th. Volunteers for the dance committee will receive St. Pat hours, which will make them eligible for an honorary St. Pat's degree in their senior year. —Ol' Shamrock's dancin' feet are itching already.



YE ED

Photography helps assemble it in any language



Pictures help boss the job when this drilling rig is set up for action half way around the world . . .

Before shipping a drilling rig overseas, National Supply frequently first sets it up here for tests and paints the complex parts in *coded colors*. Then a color photograph is made.

Why? To serve as a graphic guide when the rig reaches its buyer. He has only to follow the photograph—matching color to color—and the rig virtually assembles itself. As a technique, this use of photography makes unskilled labor more efficient, slices through the problem of language barriers.

National Supply's experience is an example of how photography saves time, cuts cost, reduces error, improves output.

As a matter of fact, so many reasons for photography, so many ways of using it are being found, that well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. This number has included many returning servicemen.

* * *

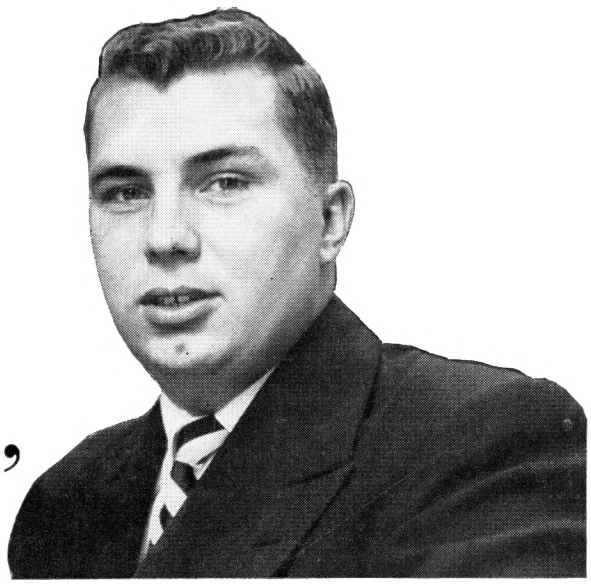
If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.

Kodak
TRADE-MARK

JOHN B. NOLTE, Purdue University, asks:

"What is G.E.'s Manufacturing Training Program?"



The Manufacturing Training Program at General Electric is a program of basic training for manufacturing leadership, including planned rotational work assignments and related classroom study for outstanding young men who are interested in a career in manufacturing. It was organized to meet the increased demand for effective manufacturing leadership and technical "know how," in line with the expansion and development of the Company's operations by developing trained men to fill future key positions in the organization.

Who is eligible for this program?

In general, the Program is open to college graduates with degrees in engineering and science, and a limited number of business administration and liberal arts graduates. We are looking for outstanding young men with sound educational backgrounds, well-balanced personalities, demonstrated thinking abilities, and having the potential to develop toward top level responsibility in key assignments.

How long is the program?

The normal length of the Program is three years. However, some individuals may be able to complete their training in a shorter period because of previous knowledge or experience in manufacturing work.

What type of work assignments are made?

Work assignments are provided in all phases of manufacturing and related functions so that each man will acquire knowledge of manufacturing engineering, including manufacturing methods and techniques, shop operation, production control, personnel administration, labor relations, engineering activities, sales and manufacturing co-ordination, and general business administration.

In addition to job assignments, classroom courses cover such subjects as Company organization, manufacturing operations, labor and personnel relations, business administration, law and relationships between manufacturing and other functions of the business. Progress on the job and in classroom work is carefully observed and reviewed periodically with each man to assist him in his career.

What happens after training is completed?

After completing the training program, graduates are placed in operating departments and divisions throughout the Company in positions where leadership and initiative are needed. All placements are made in relation to the aptitudes, abilities, and interests of the graduates.

At General Electric, manufacturing operations involve the administration and supervision of activities of more than 100,000 men and women in more than 100 plants, who are involved in the making of some 200,000 different products.

The wide scope of these activities, the great variety of products, and the diversity of manufacturing activities offer limitless opportunities and exciting challenges to college graduates today.

Manufacturing training is a foundation for leadership—and an opportunity to build a satisfying, rewarding career in one of America's most important industries.

If you are a graduate engineer, or a graduate with definite technical inclinations that include an interest in the career possibilities in manufacturing, see your college placement director for the date of the next visit of the General Electric representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.

You can put your confidence in—

GENERAL ELECTRIC

MISSOURI SHAMROCK

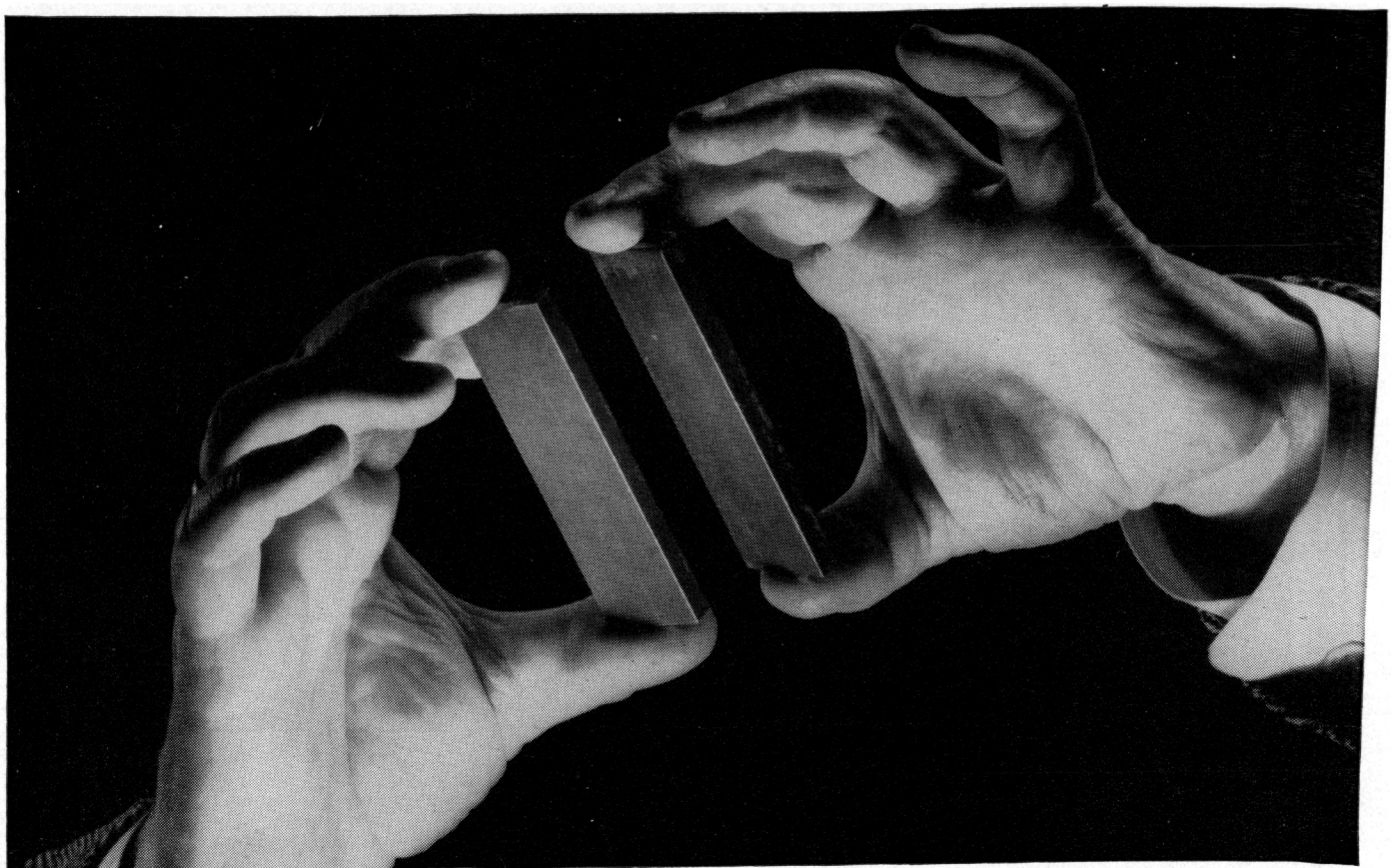
Published by Student Engineers—University of Missouri—Columbia, Missouri
Member ECMA



December 1953
25c

Season's
Greetings

Features: Engineering & Medicine
My Curriculum For EE Degree
Pi Tau Sigma National Convention



. . . but one does more!

HERE you see two pieces of steel. They are the same size, the same shape, the same weight. Although they look exactly alike, one of these steels is far more valuable—in terms of what it can do.

It's the piece on the right—one of the U·S·S High Strength Steels—and it has greater strength than the ordinary carbon steel shown on the left. This means that with U·S·S High Strength Steel you can reduce the weight of a railroad car, a truck, a bus, or of many other steel products . . . *without reducing their strength.*

U·S·S High Strength Steel in a ¼" thickness can frequently be substituted in a design which uses ⅜" ordinary carbon steel, without sacrificing strength in the equipment.

Or—you can work it this way. Simply use U·S·S High Strength Steel in the *same* thickness as ordinary carbon steel. Then, equipment will be stronger and more rugged . . . but it will weigh no more!

Furthermore, one of these high strength steels—U·S·S COR-TEN—has high resistance to atmospheric corrosion—4 to 6 times that of plain steel. Think what this means in increased life!

Very fine, you say, but what will all this cost? Well, here's the real pay-off. Surprisingly enough the products improved with U·S·S High Strength Steels usually cost no more . . . because pound for pound the steel does more. Its slightly higher initial cost per pound is often offset by the fact that less steel is needed. And, in the long run, many products made from these better steels actually cost less because they last longer, and are cheaper to operate and maintain.

1933 USS HIGH STRENGTH STEELS UNITED STATES STEEL 1953
TWENTY YEARS OF PERFORMANCE

Developing special steels for special customer needs is an important job of United States Steel metallurgists and engineers. With their tremendous background of practical experience, they are ready to work on any problem that involves the more efficient use of steel. United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

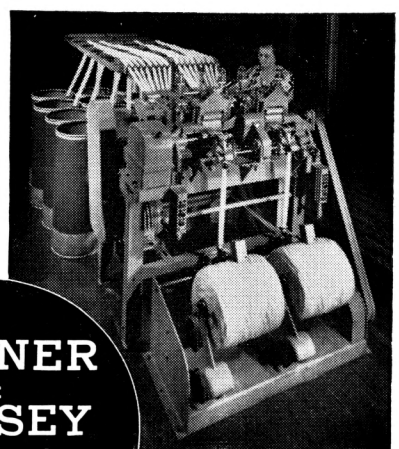
UNITED STATES STEEL

"Friendly" government vs. "selfish" business

THE GOVERNMENT will carry a letter for you from Texas, say, to New York for 3¢. But the government loses money on the trip, and you have to pay taxes to make up the difference.

Business carries a gallon of gasoline the same journey from Texas to New York for 1/5th of 3¢, does it almost as fast. It may not be door-to-door delivery, but it's a lot harder to handle, in spite of which business makes a profit—and out of which it pays taxes to support government business ventures such as the post office.

Since time began, the hope of private profit is what has stimulated the drive for efficiency and low costs, out of which everyone benefits. If that is business selfishness, the world needs more of it.



WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

***Pin Drafter** processing wool for yarn*

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

Leonard was faced with your kind of decision!



Meet Leonard Harris and read his story. In many respects, the problems he had may parallel yours today. He made his decision seven years ago, and he's glad he did.

Leonard Harris graduated from Ohio State University in 1943 with a degree in Chemical Engineering. After serving in the armed forces, he began looking into the organizations that offered promising civilian careers. And although he had many attractive offers, he chose Columbia-Southern because it gave him the opportunity to start training immediately in the field for which he felt most qualified. In his case, that field was plant operation.

Harris says, "I recalled the instructors in school had a high regard for Columbia-Southern. I knew the parent company, Pittsburgh Plate Glass, and was favorably impressed with it. Also, I was quite impressed with the sincere, down-to-earth attitude of the people with whom I made my initial contact and I wasn't disappointed on that score after joining the company."

Today, Leonard Harris is an important part of Columbia-Southern's management team. As superintendent of the Chlorine Area in the Barberton Plant the following departments come under his direct supervision: Chlorine, Caustic Soda, Pittchlor, Sodium Hypochlorite, Perchlorethylene.

Harris feels that a technical graduate should look for the following (1) a company in which he can produce and get real satisfaction from his work, (2) a company where opportunities are obvious, and (3) a company which shows no trace of employee stagnancy.

Columbia-Southern is such a company. We will be glad to discuss your interests. This pertains to graduates in all business and technical fields including engineering, research and development, sales, plant design, mining, construction, maintenance, production, accounting, transportation and related fields.

For further information, write now to Dept. P at our Pittsburgh address or any of the plants.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

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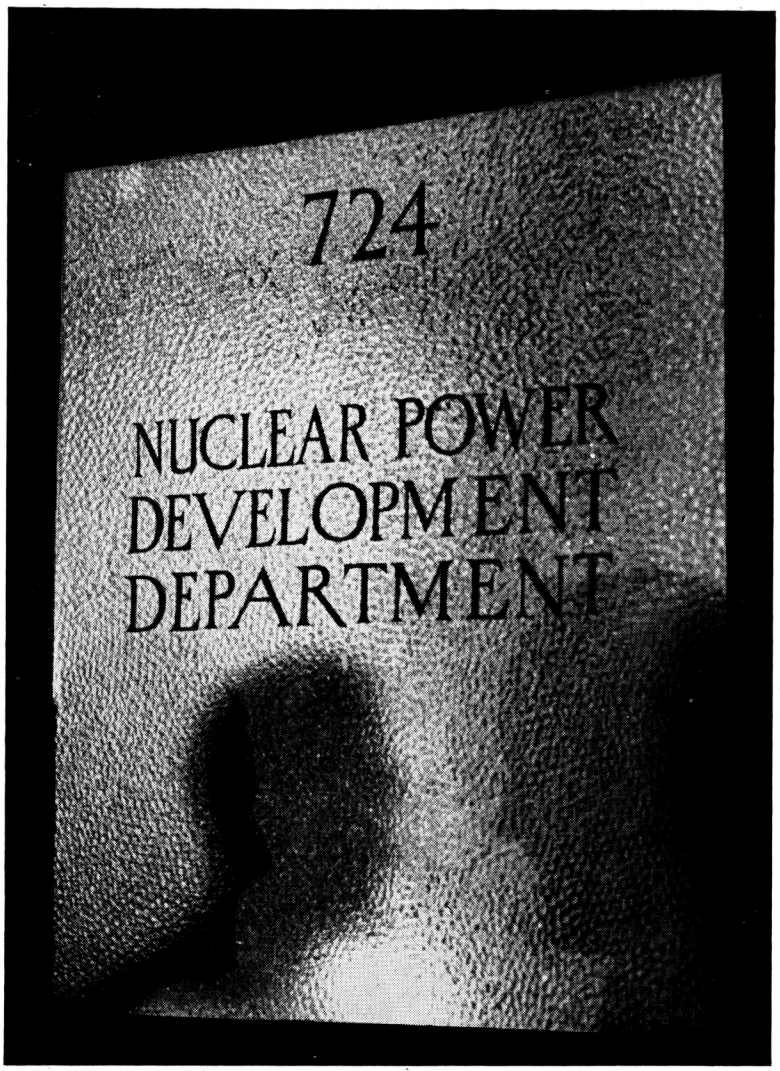
Men for Uncharted Frontiers



Here are challenging opportunities – industrial pathfinding in Power System Engineering • Engineering Planning • Research

Although the door pictured above cannot be opened for you immediately, Detroit Edison is working toward that day when jobs will be available to you in this exciting new field. Our engineers, teamed with those of Dow Chemical Company, are one of the nation's industrial atomic research groups. They are studying the use of nuclear heat in thermal electric generating plants. Their aim is to develop a process from which energy from nuclear reactors will run our power plants.

Meanwhile, there are important jobs to be done in other departments–Power System Engineering; Engineering Planning, Design and Construction; Research. The challenge of the future is in the development of new engineering materials and processes, and the improvement of existing ones. Modern as our steam generating plants are, they can and will be improved by young engineers like you. There are ever new problems in our complicated distribution system needing to be solved. You will have our new a.c. network analyser and the most up-to-date equipment available, to aid you in this work.

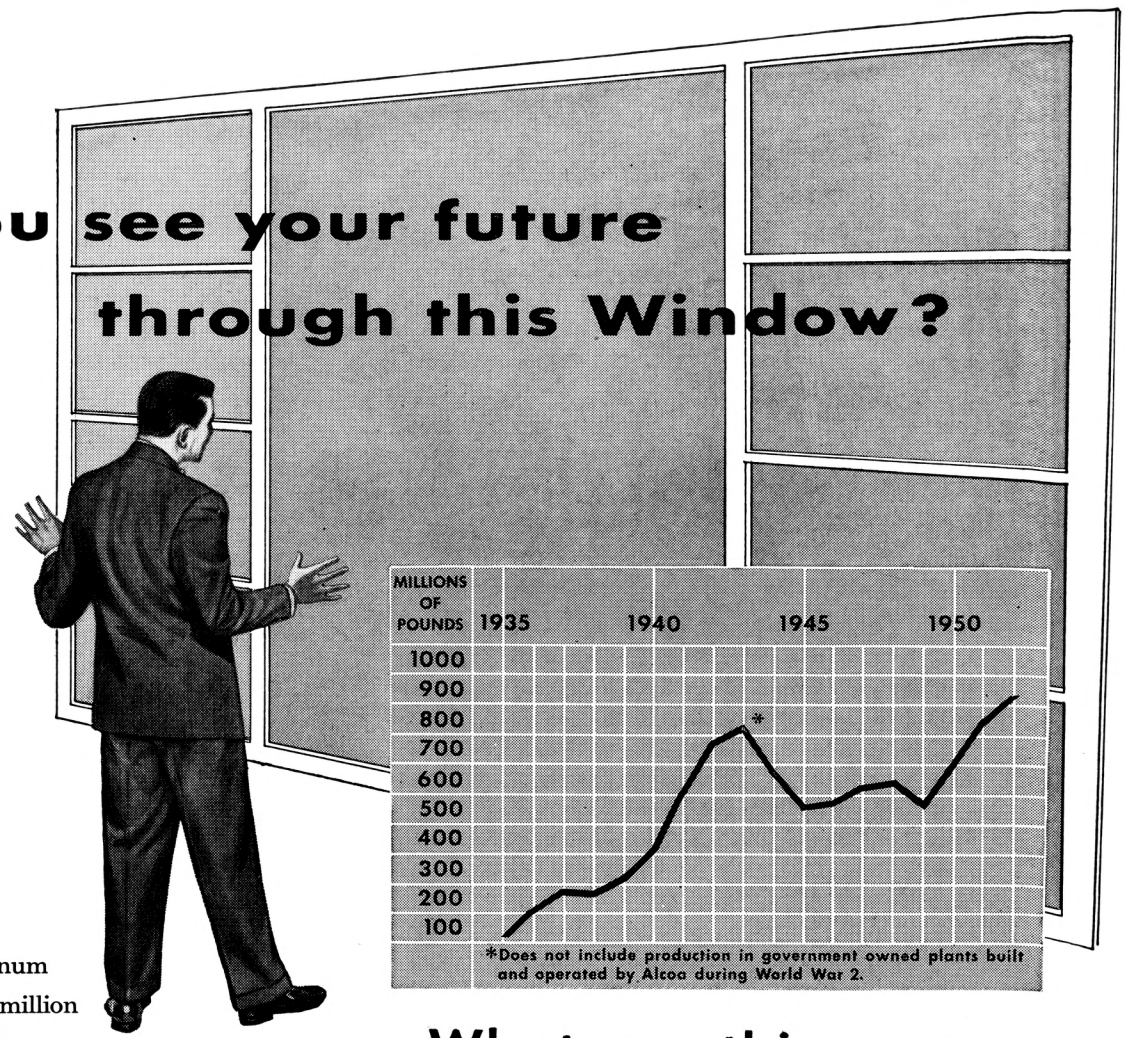
Detroit Edison offers a firm foundation on which to build a career. We have an excellent on-the-job training program. During this period you get acquainted with the work of our main departments.

Edison's personnel policies are modern and progressive. We have group insurance, hospitalization, retirement and annuity plans.

Many career opportunities are now available. Stop in and see us. You may find just what you want in this rapidly growing public utility.

THE DETROIT EDISON COMPANY 2000 SECOND AVENUE DETROIT 26, MICHIGAN

Can you see your future through this Window?



This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1952. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director. ALUMINUM COMPANY OF AMERICA, Pittsburgh, Penna.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

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COVER

—Photo by Henn Liiv

Here is the Tripod we know. Your Tripod may be gone, but the tradition lives on. He is getting old now, and will probably be replaced by another, but this is our presentation of Tripod, the dog we know.

MISSOURI SHAMROCK

VOL. XX 20 NO. 3

DECEMBER, 1953

♣

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MEMBER
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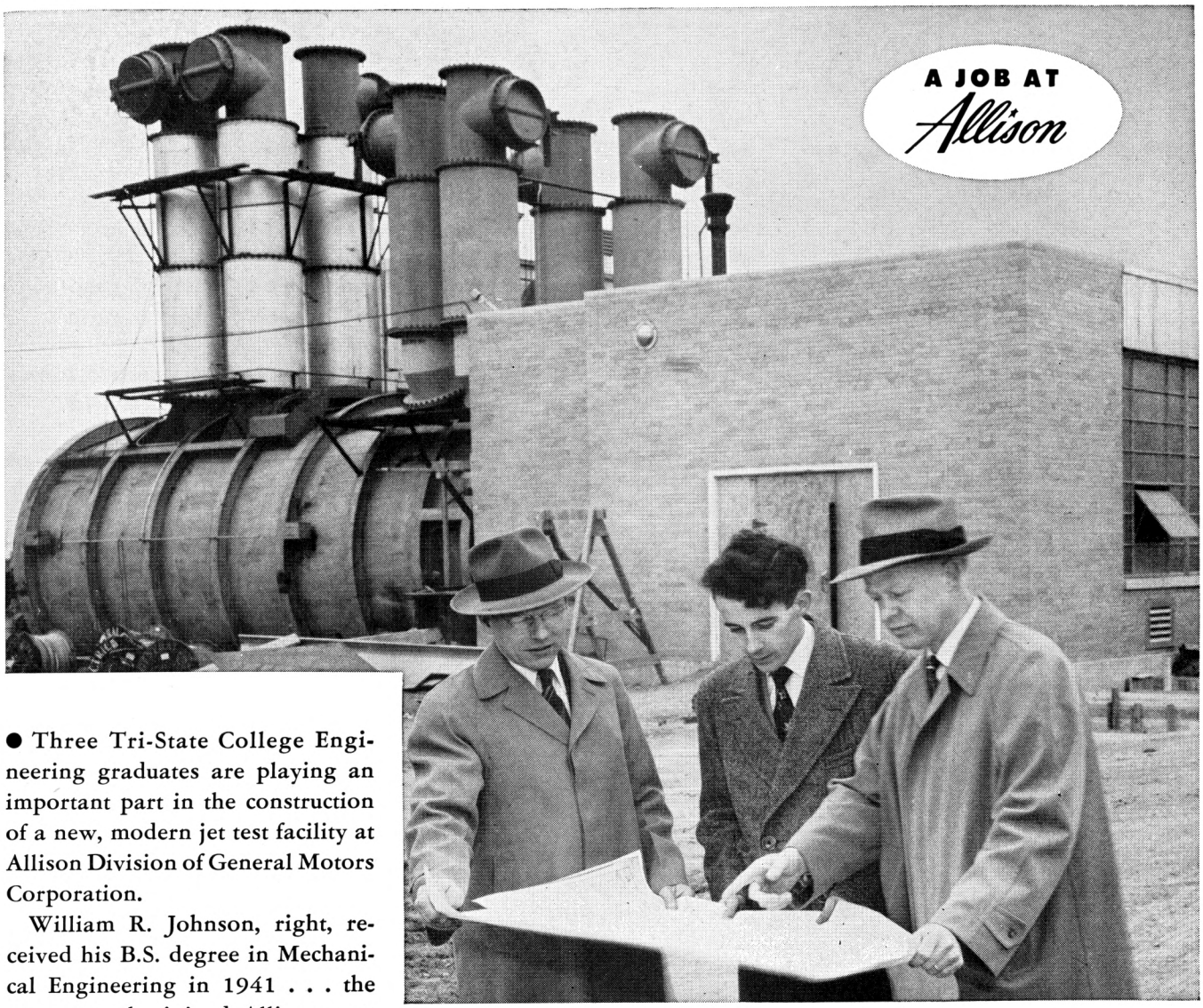


● Three Tri-State College Engineering graduates are playing an important part in the construction of a new, modern jet test facility at Allison Division of General Motors Corporation.

William R. Johnson, right, received his B.S. degree in Mechanical Engineering in 1941 . . . the same year he joined Allison as a junior test engineer. In 1952, after several promotions and a period in military Service, he became an engineering supervisor and was assigned the responsibility of engineering the eight jet engine test cells at the new experimental plant. The new test cells—revolutionary in design—make use of huge 100-ton steel tanks calculated to withstand an ultimate internal pressure of 175 PSIG.

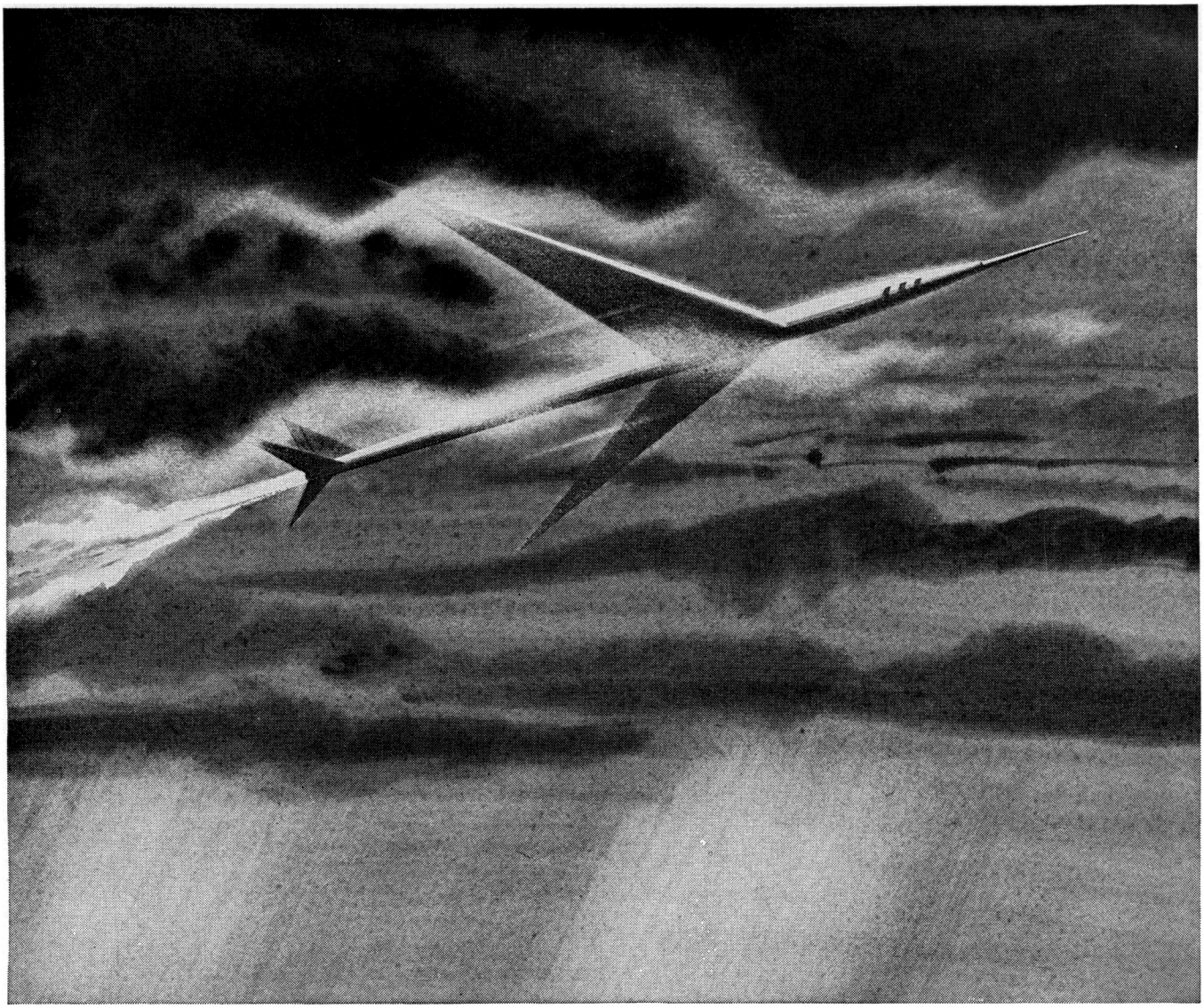
H. F. Prang, left, was graduated in '42 with a B.S. in Mechanical Engineering. Later, he joined Allison as a draftsman in connection with the development of sleeve type bearings for aircraft engines. From the beginning of the new test plant program, he has been supervisor of drafting in the "Experimental Jet Facilities Group" which provides all designs of test equipment in the building.

Edward G. Delaney, center, received his B.S. in Mechanical Engineering in 1951. He was recently promoted to the "Test Projects Control Group" at Allison. His job will be to use the new equipment and facilities in the testing of jet engines. He will be running individual tests on components, and coordinating proper control installations on experimental engines.

Allison's long range engineering program is expanding, offering unlimited opportunities to young graduate engineers. We think you, too, will like it at Allison, the only manufacturer whose jet engines have accumulated more than 3,000,000 hours in the air!

Allison **DIVISION GENERAL MOTORS CORPORATION • Indianapolis, Ind.**

Design, development and production—high power TURBINE ENGINES for modern aircraft . . . heavy duty TRANSMISSIONS for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for aircraft, Diesel locomotives and special application.



Do you want to get ahead in engineering?

Then—after you graduate—join a company that's expanding in fields where big engineering futures lie.

At Boeing you'll find plenty of room to get ahead in such projects-with-a-future as a major guided missile program . . . research in supersonic flight and nuclear-powered aircraft . . . America's first-announced jet transport . . . and the revolutionary B-47 and B-52 jet bombers.

You'll find Boeing a stable 37-year-old company, that has grown practically continuously. For example, Boeing now employs 6000 engineers in contrast to 3500 at the peak of World War II. And although Boeing is a large concern, it is so organized that each engineer is an individual who stands out—and progresses—in proportion to his ability.

Boeing is constantly alert to new techniques and materials — and approaches them without limitations. Extensive subcontracting and major procurement programs — directed and controlled by engineers—give you a varied experience and broad contacts with a cross section of American industry. No industry, in fact, matches aviation in offering such a wide range of experience, or breadth of application — from pure research to production design, all going on at once.

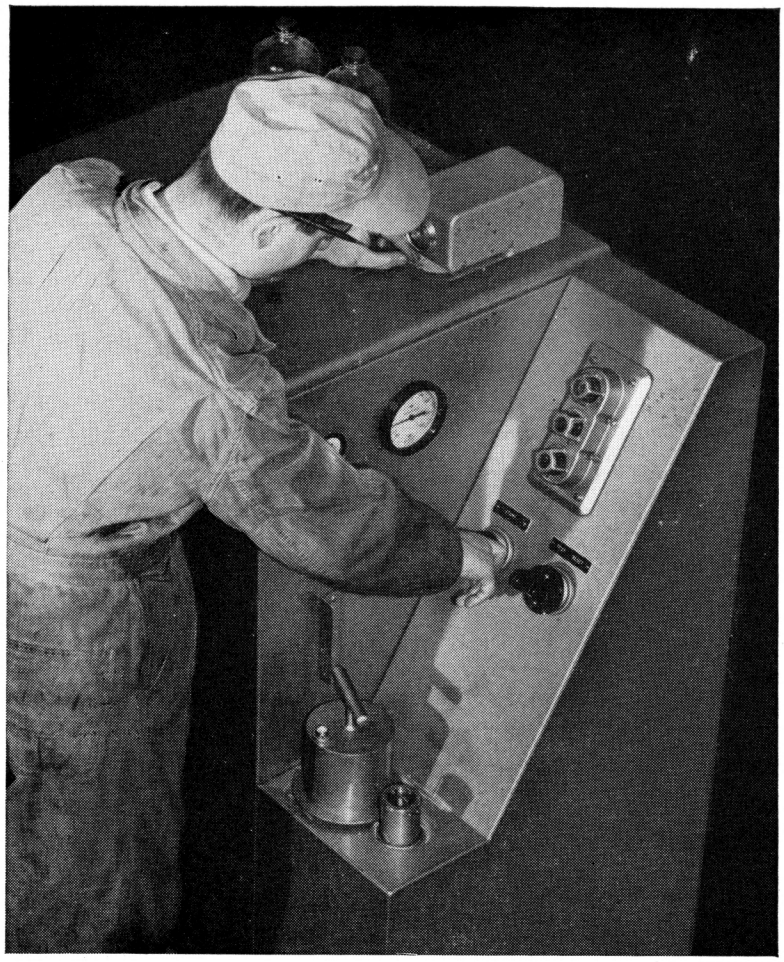
Boeing engineering activity is concentrated at Seattle in the Pacific Northwest, and Wichita in the Midwest. These communities offer a wide variety of recreational opportunities. Both are fresh, modern cities with fine residential and shopping districts, and schools of higher learning where you can study for advanced degrees.

There are openings in ALL branches of engineering (mechanical, civil, electrical, aeronautical, and related fields), for **DESIGN, RESEARCH and PRODUCTION.** Also for servo-mechanism and electronics designers and analysts, as well as physicists and mathematicians with advanced degrees.

For further information, consult your Placement Office, or write:

RAYMOND J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING



THIS NEW FLASH POINT TESTING MACHINE is so accurate that a sample with as little as 1/10 of 1% unsafe material in it will cause a rejection. Recently developed by Standard Oil's Engineering Research Department, this revolutionary device reduces the average time from 20 minutes for a flash test to two and a half minutes, avoids human errors in testing flash point, can be used right at the loading rack.

Adventures in Research

The flash point testing problem that was solved with the machine shown above is only one of the many problems presented to Standard Oil's new and growing Engineering Research Department.

In the last few years, it has developed and put into operation instruments to measure vapor pressure, 158° point, acidity and viscosity. Ultrasonic generators have been built for general use in providing energy for experimental purposes. The department is studying application of radioactive isotopes to instrumentation and control problems related to refinery operation.

One of our research divisions is carrying out an extensive theoretical study of stresses in pressure vessels having flat, conical, hemispherical, toriconical or torispherical heads.

In our work on product evaluation, we have developed a new test for quenching oils based on the fundamental heat transfer relationships involved.

Problems such as these are the daily fare of Standard Oil's Engineering Research Department. Here is a challenging opportunity for young men with advanced training in chemistry and engineering. Many and varied problems continually arise in the design, construction and operation of petroleum industry equipment.

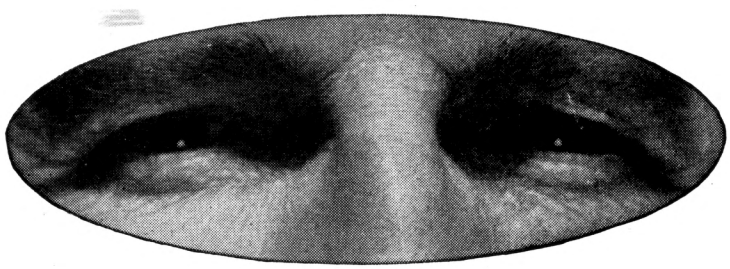
Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

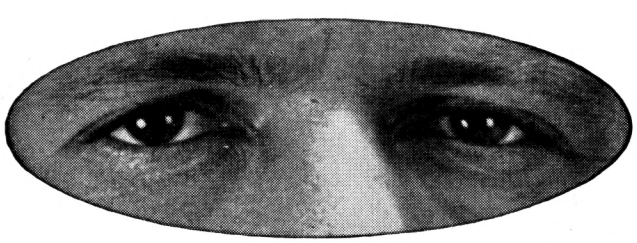
STANDARD



WHAT GOOD WOULD YOU EXPECT



STEEL MEN TO SEE



IN PLASTIC PIPE?

● Is it reasonable for men who make steel to recognize that plastic pipe can do things steel cannot?

Certainly they're quick to see steel do many things plastics can't.

Republic Steel produces plastic pipe. But Republic also lists among its products titanium sheet, aluminum windows and powdered iron. Each has qualities that outdo steel on some jobs.

Republic Steel Corporation is not only iron ore mines and blast furnaces. It is men earning a living by providing other men materials for them to use in earning their livings. It is men providing pipe where pipe is needed —seamless steel pipe; welded steel pipe (three types), and plastic pipe. Republic Steel's production of plastic pipe augments Republic's 3-STEP SERVICE FOR STEEL USERS:

1. **to make more and better kinds of steel than any one else:**
2. **so that we can recommend the precisely exact steel for your job:**
3. **then to share with you our unexcelled knowledge of how to fabricate steel in order that you can get the best results for your product.**

We see steel as the world's most versatile material — but certainly not the be-all and end-all for every job. This realistic attitude toward our main product is one reason why you can depend upon our recommendations.

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REPUBLIC STEEL

WORLD'S WIDEST RANGE OF STEELS AND STEEL PRODUCTS

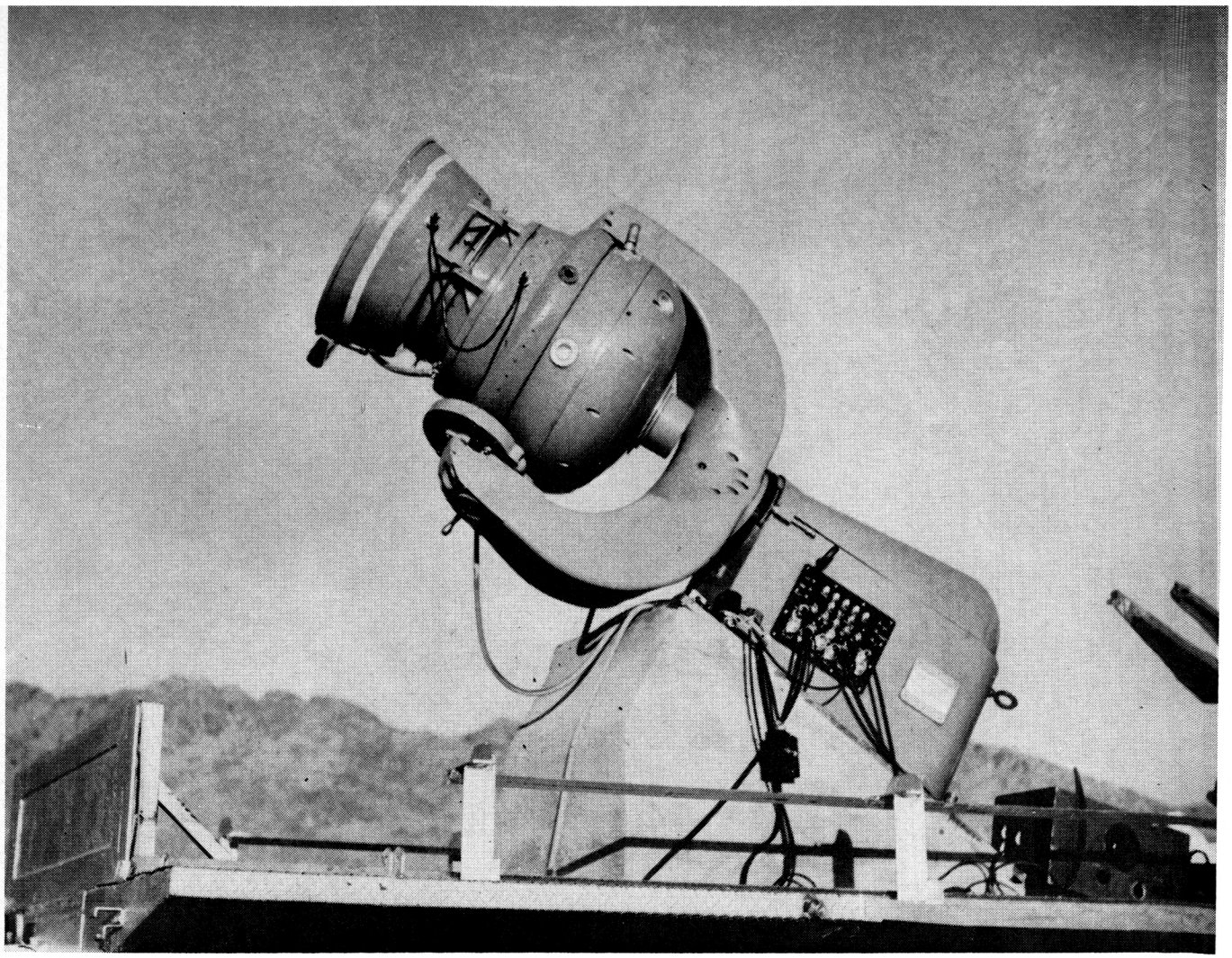


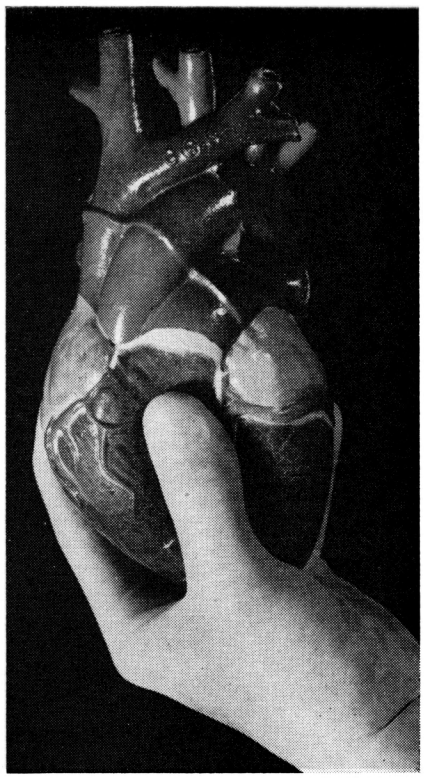
Photo Courtesy of Kodak

METEOR CAMERA. A new 5,000-pound camera of this type near Las Cruces, New Mexico, photographed 56 meteors in a period when an older camera caught only one. The meteors, mostly fragments of minor planets or comets, are being photographed by Harvard scientists on special molded Kodak film as part of a sky survey.

To You . . .

The time has come again when Christmas Spirits flow freely. The prevalent idea of Christmas Spirit is to wish well—in hopes that the world be a better world, a more unified, a happier world. Such spirits, though, seem to dwindle shortly after the Christmas holidays; but they should prevail throughout the year. Why don't they? You and I just seem to forget that this spirit is more than a Christmas Spirit, and we forget that we can live Christmas all year long. We of the SHAMROCK staff will do **our** best by working for, and wishing you a MERRY CHRISTMAS.

D.B.A.



Engineering and Medicine

What the close cooperation of MU's Schools of Engineering and Medicine means to Missouri

By Hugh E. Stephenson, Jr., M.D.

All of the schools in the university family might well look with welcome anticipation to the final realization of a four-year Medical School on the campus of the University of Missouri. This integral relationship with its mutual benefits must inevitably enlarge the potentialities of such a close unit of the allied sciences—be they sociology, genetics, biology, journalism, agriculture, veterinary medicine, engineering or otherwise. Out of more than 2500 colleges and universities in the United States or from 72 medical schools, such an ideal situation presents itself in no more than 20 instances. Missouri will have reason to be proud of her decision to build her four-year Medical School and hospital on the university campus.

One need look, for example, no further than engineering and its relationship to medicine. Here one can point to the close alliance necessary if progress in certain areas is to continue. Medical schools can no longer regard themselves as isolated trade schools. The accelerated pace of newer developments in the field of atomic by-products and electronics, for example, brings the problem into closer focus. A special conference sponsored by the American Institute of Electrical Engineers and the Committee on Electrical Techniques in Medicine and Biology was held on "Electronic Instrumentation and Nucleonics in Medicine." This featured such topics as ultrasonic mapping of cancerous and diseased tissue; position-emitting isotope techniques for tumor location; cinefluorography with brightness intensification; continuous respiratory CO_2 analysis; dynamic heart-body simulation; cineradiography and methods of determination of dispersion of ultrasonic velocity in liquids.

A dramatic illustration of medicine's close alliance with the electrical engineer and electronics is found in a discussion of the following problem:

Each year between 6000 and 8000 patients in apparently good health will die suddenly of acute arrest of the heart. The possibility of resuscitating a heart that has suddenly ceased beating has attracted the imagination of physicians for many years, and particularly since the advent of anesthesia with its increased incidence of sudden death upon the operating table. Since 1848 when anesthesia was first introduced, tremendous strides in increasing the safety of surgery have been made; but sudden cardiac arrest continues to plague the operating room. Through the lay press the average person has become familiar with recent years of such catastrophes.

No longer, however, does one need regard the sudden cessation of heart action as necessarily fatal. Through means of animal laboratory work which have been applied to patients, it is now possible to restore a stopped heart to its normal action providing certain limitations are realized. Of prime importance is the TIME FACTOR. Cardiac arrest is a four minute emergency as failure to pump blood to the brain will result in irreversible brain damage. Unless artificial methods of pumping blood are started within four minutes, death will be inevitable. The author has

recently conducted a world wide survey on such cases, and it can be revealed that from 1200 cases sent to him by doctors from all parts of this country and many foreign areas approximately 28% of those experiencing sudden cardiac arrest were successfully resuscitated. With improved methods of resuscitation and adequate instruction, however, this figure should at least be doubled.

One of the advances contributing to improved cardiac resuscitation has been the introduction of electric shock to the heart in certain types of these cases. This has been possible since 1947 when it was demonstrated that when the heart suddenly stops pumping blood it may be either completely at a standstill or it may be undergoing a peculiar quivering type of activity—sometimes described as resembling a "bag of worms." This latter condition is called cardiac ventricular fibrillation and is just as fatal as complete standstill unless effective measures are started at once.

In a normal heart the electrical activity of a heart can be measured by means of an electrocardiogram which shows regular rhythmical electrical activity arising from several localized areas of the heart. In ventricular fibrillation there are hundreds of scattered areas from which foci of excitation arise. By means of delivering several electric shocks directly to the heart, it was felt that these many foci could be converged into larger and larger foci until effective activity of the heart muscle would once again be able to pump blood to the vital centers of the body.



Photo Courtesy Steber Instrument Co.

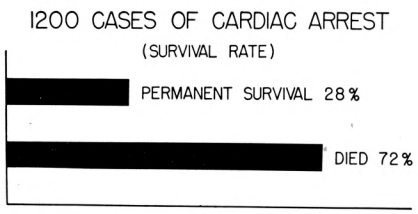
Fig. 1—The electric defibrillator is compact and light enough to be a portable instrument. It is only part of resuscitating a heart, as other methods must be used after the instrument is employed.

The problem of constructing an instrument capable of delivering an appropriate shocking current to the human heart is not difficult. One such unit is pictured in Figure 1. A satisfactory cardiac electrical defibrillator should satisfy several basic considerations. (1) It must be capable of delivering an adequate amount of current flow to be effective. (2) It must be safe. Precautions should be taken for protection against any injury to the patient or to the operator. (3) It must be reliable. (4) It should be constructed so that its cost will not be prohibitive to its widespread use in all hospitals.

Unfortunately it has not been possible to date, to adequately apply the current to the heart without opening the chest of the patient and applying the current direct to the heart muscle itself.

Since Ohm's law states that the current flow is dependent upon both the voltage and the resistance, it is helpful to know the resistance of the human heart. The resistance of the human heart has been estimated to approximate eighty to ninety ohms. The size of the electrodes, the composition of the electrodes as well as the surface area of the heart, and the content of the fluid in the chambers of the heart must all be taken into consideration. The current is delivered to the heart by means of electrodes that are shaped to fit the curvature of the heart. These electrodes are brass chrome-plated with insulated handles which can be detached and sterilized.

The leads are rubber covered. Depending upon the size of the heart, the size of the electrodes, as well as the amount of voltage and amperage used, will be determined by the size of the heart. There is no warm up period necessary, and the equipment is immediately ready for use when plugged in. In order to prevent shock to the surgeon or to personnel touching the patient, an isolating transformer is incorporated. The input voltage is 110 volts AC with an output voltage varying from 0 to 135 volts. The output current flow is adjustable from 0 to 2.5 amperes. A test button is mounted on the panel so that the current rate can be preset for treatment and the current switch can be regulated by means of a foot pedal or a push button on the panel.



Since it would be necessary to deliver a tremendous voltage to the patient to defibrillate the heart through the intact chest wall, it is necessary to open the chest and apply the electrodes directly upon the surface of the heart, in cases of cardiac arrest with the above described condition known as ventricular fibrillation. Before applying the electrodes, it is also necessary to massage the heart for several minutes in order to pump blood to the brain and to the vessels of the heart. Cardiac massage actually means compression of the heart by the hand, much like one would squeeze the water out of a sponge. The heart will best be compressed about 60-80 times a minute. As mentioned previously, the chest must be opened and massage started within four minutes. When the electrodes are finally applied, a shock is delivered for a fraction of a second and then is usually repeated several times before success is achieved. The heart is shocked into complete standstill and resuscitation is started again from this point by cardiac massage. In the 59 cases that the author has, himself, experienced, only three hearts have failed to return to their own spontaneous rhythm.

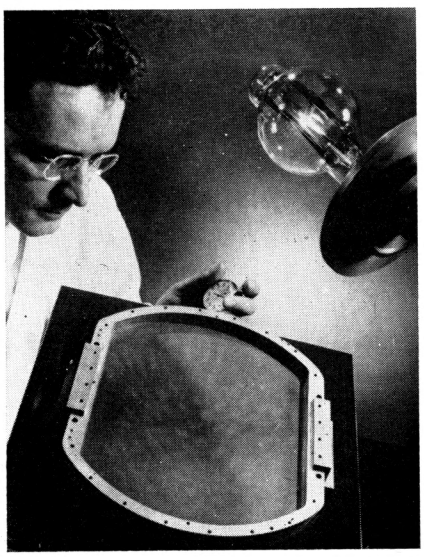
(*Continued on Page* 22)

NEWSTUFF

By Henn Liiv

Ol' SHAMROCK tried out some new products, attended meetings and anniversaries. Here is what he heard. Sylvania Electric Products, Inc., supplied a color television set for use at the Television industry's demonstration of compatible color sets requested by the Federal Communications Commission. E. Finley Carter, Sylvania vice-president and technical director, emphasized that the Sylvania set is an experimental model, and not production model. He added, however, that the company is actively engaged in the development of prototype production color models. The set was described by Mr. Carter as containing a 16-inch shadow mask picture tube mounted on a single chassis. The tube will produce a 14-inch picture. This particular set was designed basically for use in a console type of cabinet.

Pointing out that the Sylvania experimental set contains 50 radio receiving tubes, compared with about 20 in a conventional black and white set, Mr. Carter asserted that "engineering details such as this, a much greater number of components in the chassis, and a costlier picture tube means that early production models of color set will be quite expensive. During first months of production color sets with a 14-inch picture will cost about $1,000 each. No developments have occurred to alter the estimate".



—Photo Courtesy Sylvania Products

Light from a point source prepares a color television screen just as a color plate is prepared for printing.

Sylvania also demonstrated a photographic method of forming the complex screen: in a color television picture tube screen, three different phosphor materials may be placed in an interspersed dot pattern on a glass plate, a phosphor for each of three primary colors, red, blue, and green. Light from the point source zirconium lamp passes through an aperture plate containing more than 200,000 precisely spaced small holes. Rays of light fall in the desired dot pattern on a photographic emulsion containing the color phosphor. After controlled exposure and processing, only the phosphor remains in the pattern. The process is repeated for the other two phosphors with the screen and aperture plate moved slightly to permit the new dots to fall between those previously formed. A full color picture is preceded by each of three electron streams being made to fall on the appropriate set of color phosphor dots.

Progress abroad was reviewed by an American engineer. "West Germany's machine tool industry will be forced to seek world domination of the machine tool markets or to cut back its production below capacity", Athel F. Denham, President of Denham and Company of Detroit, said in reporting to the American Society of Tool Engineers on his trip to the Third International Machine Tool Exposition at Brussels as the ASTE Official Representative. With the total number of West German machine tool plants about equal to the combined total in both the United States and Europe, Denham listed four courses which may be followed by the West German industry. These are: an attempt to achieve world dominance, as evidenced by the major inroads already made in the South and Central American markets; *or* extensive trade with Soviet Russia, either direct or indirect; *or* cut-price dumping of machine tools in foreign markets with the loss being made up to the individual companies by government subsidy. This development is already being feared by British and French machine tool manufacturers; *or* a slackening off in production.

The Brussels exposition was cited by the delegate as revealing proof of the problem posed by the West German situation. Although there were 769 displays with a total of over 3,000 machine tools, he said West German exhibits dominated. Denham said that European machine tools excelled in rigidity; exterior finishes were superior to American standards: they employ-

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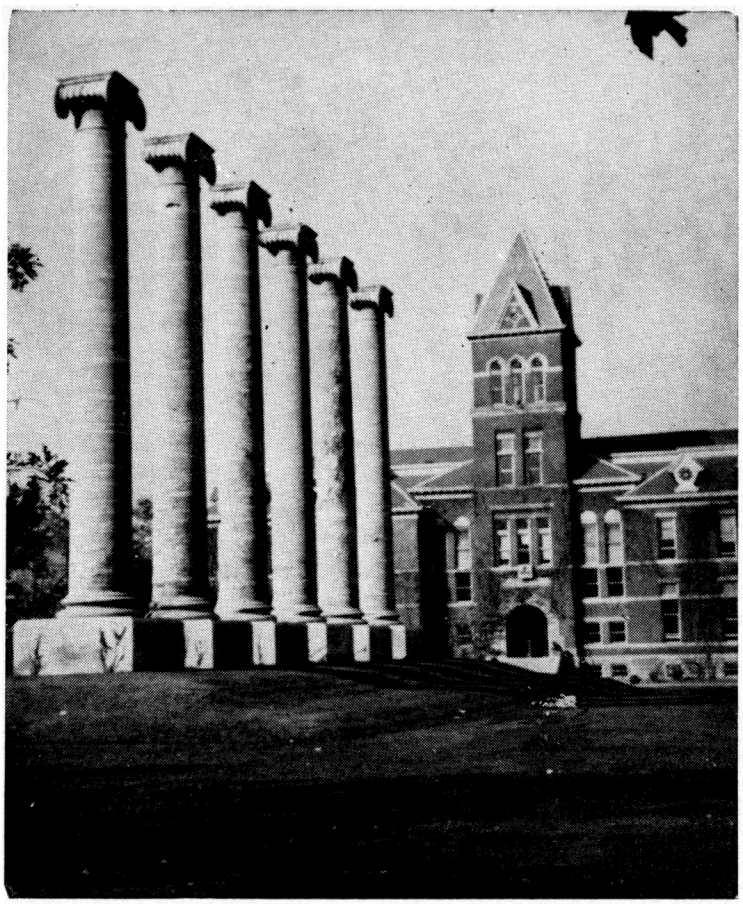


MIZZOU MEMOS

HOMER H. HAGGARD, C.E. '05, the first student who played St. Patrick, has put the old slide rule in the drawer and is taking his ease in retirement down in the sunny South, at Minden, Louisiana. To those who still uphold the old traditions of the Saint of Engineering, and look forward to that day when they can fish and sleep Mr. Haggard has a message: "*Life is unbearable.*"

Several of Ye Olde Grads hit the Homecoming Guest Book a light blow. Copying off the list these are:

L. E. LOCKWOOD, E.E. '23, 2314 Lawndale, Evanston, Illinois.

H. R. GORSUCH, E.E. '29, 5725 Horton, Mission, Kansas.

D. Q. JONES, M.E. '50, 322 E. 8th, Bartlesville, Oklahoma.

TOM MAGEE, E.E. '51, Box 7854, Dwight Patterson AFB, Ohio.

FRANK V. RAGSDALE, C.E. '12, Memphis, Tennessee.

J. EMMERSON FINNEY, C.E. '50, Jefferson City, Missouri.

JIM McCUBBIN, M.E. '46, and his wife were down for the K-State game. They have a year old daughter. Jim is doing Industrial Engineering work with the Marley Co. The address is 7176 Cherokee Drive, Prairie Village, Kansas.

WADE and WARNE HORNE, M.E. '43 and M.E. '43 are reported as follows, Wade is Maintenance Manager at the Sugar Creek, Mo., plant of the Standard Oil Co. Wayne is with the Austin-Bacon Co. in the Kansas City area.

LOUIS TEMPLE, M.S. in A.E., '51 and RICHARD CALLISON, M.E. '48 took in the Farm Forum on the Ag campus a few days ago. They are engineers in the Special Products Department at the Butler Mfg. Co. in Kansas City. Both of these gentlemen are old married people with sons. Louis has a boy called Lance (year and a half), and Dick's boy, Ricky, is four years old.

JACK G. COATES, C.E. '37 joined the Gulf Oil Company in September of this year, to be located in Houston, Texas. His immediate responsibilities are in connection with the Company's crude oil purchasing activities in Texas, Louisiana, Arkansas, Alabama, Mississippi, and New Mexico. He has been with Cities Service Oil Company since graduation except for four years in the Navy where he rose to the rank of Lieutenant Commander.



HOMER H. HAGGARD, M.E. '05

JON A. BAUER, M.E. '51 is with the Puget Sound Power and Light Company in Seattle, Washington. He is the Engineering Aide to the Superintendent of Power Supply, which handles the generating equipment for eight hydro stations and one steam plant. Jon is sure enthusiastic about his location and the Salmon fishing and big game hunting are no drawbacks as far as he is concerned.

BULLARNEY



By Gray

"Twin beds are well and good," said the blushing young bride to the salesman in the furniture store, "but there is no use buying them until we get twins."

♣

Through the smoke and ozone
fumes the student slowly rises;
His hair is singed, his face is black,
his partner he despises;
He shakes his head and says to him,
with words so softly spoken,
"the last thing that you said to me
was, 'Sure, the switch is open.'"

♣

Prof. Pietenpol: If, in going down this incline, I gain four feet per second, what will be my condition after 25 seconds?

Smart sophomore: Lou'll be a centipede.

♣

Little girl to her mother: "Will I walk to heaven on a golden bridge—The minister said so."

"He's wrong dear, there are no bridges in Heaven—it takes engineers to build bridges."

♣

Have you heard about the illegitimate Rice Krispy? Snap, crackle and no pop!

♣

Speaking of girls . . .

When one is mentioned here are some of the things the boys want to know:

Fine Arts student: "What play has she seen?"

Business student: "Is she the business type?"

Journalism student: "What did she ever write?"

The Engineer: "Where is she?"

Daffy Definitions

Bacteria: Rear of a cafeteria.
Bore: A chap with flat feats.
Charlatan: A medical quacktitioner.
Father: The kin you love to touch.
Garbage: Eatables smelled backwards.

♣

GEOMETRICAL LOVE

Given: I love you.
To Prove: You love me.
Proof: I love you (given).
Therefore, I am a lover.
All the world loves a lover. (Axiom)
You're all the world to me. (Constant.)
Therefore, you love me.

♣

The big day was here. The wonderful new bridge connecting the country's largest cities was being formally opened. At the height of the festivities, when thousands of people were massed at the middle of the bridge, the center span gave way, and it fell into the river with a thunderous roar. The chief engineer turned to his assistant and asked, "Where the hell did you put that decimal point?"

♣

"When the eyes are closed the hearing becomes more acute," says a medical authority. "We have noticed several people experimenting in church."

♣

Papa Robin returned to his nest and proudly announced that he had made a deposit on a new Buick.

♣

I call my gal a discontinuous function because she has no limits.

The draft board doctor was examining a prospective recruit.

"Read that chart," he commanded.

"What chart?" asked the draftee.

"That's right," said the Doc, "There is no chart, You're in, boy!"

♣

"If a drunk is Souse of the Border in Mexico, what is he in France?"

"Plaster of Paris."

♣

Rumor has it that one of our illustrious E. E. Professors is writing a new text on DC machinery. It deals primarily with hot circuits and is entitled *Forever Ampere.*

♣

Scotsman: (at riding academy) "I wish to rent a horse."

Groom: "How long?"

Scotsman: "The longest you've got, laddie. There are five of us going."

♣

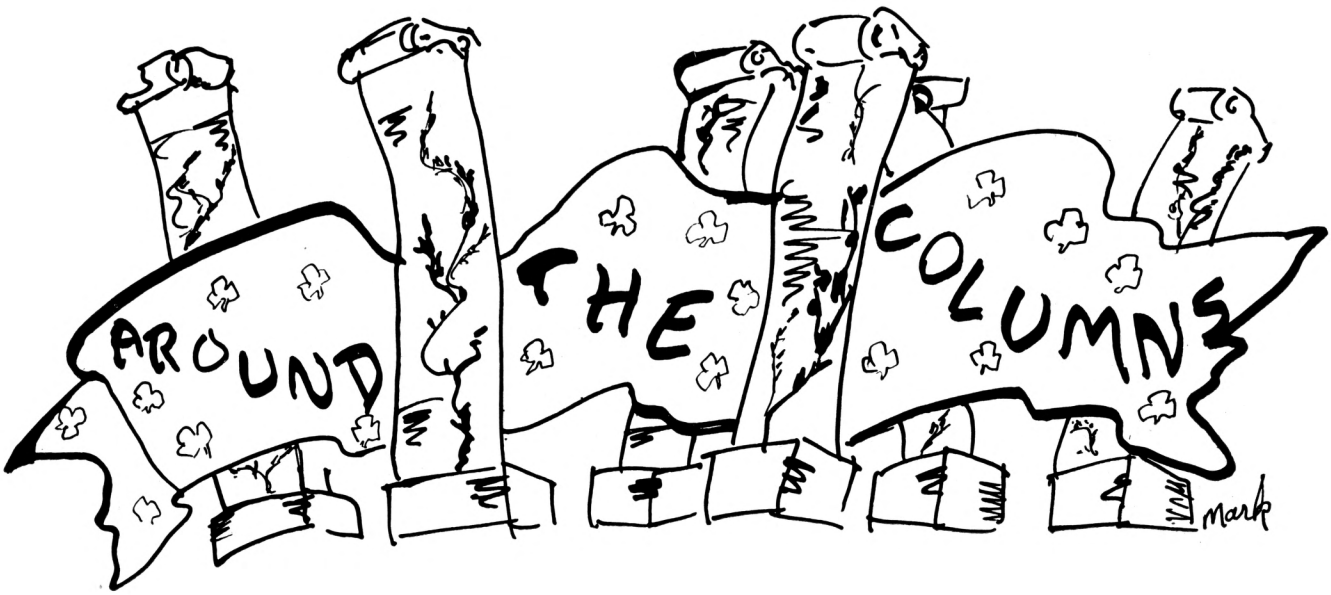
And then there was the Arts student who let his M.E. roommate fix him up for a date with Allis-Chalmers.

♣

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

♣

God made a machine, the machine made men,
Doctors, lawyers, priests, and then,
The devil got in and stripped the gears
And turned out the first batch of ENGINEERS.



with Slipstick Sam, '99

Dear Santa: I am Slip Stick Sam. I am a Student? I am enrolled in the University of Misery. I am studying engineering. Dum Da Dum Dum. My Job—Send you the facts. At 8:29 A.M. last Thursday morning, I was sitting in the Black and Gold drinking water. In pulled Prancer, Dancer, Cupid and Blitzen. I booked them on a 614 and turned them over to Dean Croft. Croft assigned me a new job; write Santa Claus. Dum Da Dum Dummm.

♣

Please Santa, do you have any more cute secretaries like the one that works for Dr. Burcham. It is an assumed fact that she is the reason that there is such a crowd in that section of the halls in between classes every day. The Shamrock office is for wanting one. Please Santa Please.

♣

It was a unique type of field trip that the M.E.'s took a while ago. It seems they made a pilgrimage to East St. Louis to see what the outside world looks like. They don't want to brag or anything but, WHO PUT THE G STRING ON THE M.E. BULLETIN BOARD. I think it would be a good idea if you asked them in person, Santa, what they want for Christmas.

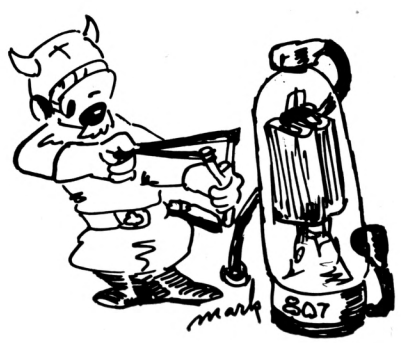
Santa, please give us a clue, who it was that stole part of our beloved sidewalk out in front of the Engine Building. The last time we heard, it was a band of wandering geologists who went that-a-way. Its not many students that go to class half-awake only to be confronted by a MEN at WORK sign looming up in a hole big enough to swaller the Engine Club.

♣

Pete Gale would be very happy, if all he could have for Christmas would be a big bunch of carrots. Tsk, Tsk, Tsk, just like a rabbit.

♣

Mr. Pringle, who teaches M.E. 220 gave a quiz about two weeks ago. On this quiz, he asked the definition of Allowance and Clearance. One of the students didn't know the true definition so he put: Allowance is the amount of money that you receive every month.



Clearance is the amount of money that you draw, tax free. This student has just been awarded the "Cool Head of the Month" prize, of a free trip to Stephens College, all expenses paid. I don't want to mention any names of course, but he is Editor of this Mag and his initials are D. A.

♣

Say Santa, if you have a couple extra, do you think you could bring the E.E. Labs a couple of 1000 amp fuses. It seems that they are having a hard time keeping them around. Usually only one of the fuses is blown during the year, but the other day both the AC and DC fuses were blown. Could be a pretty girl walked through the Lab?

Oh Santa, if you could only get more girls to enroll in Engine School, maybe we could talk some more Susies to switch. Their representative who takes M.E. 1 is a pleasant change from the grizzled males that we usually sit next to. This motion has already been seconded Santa, so, do your best.

♣

When you do come by our school, be careful when you slide down the chimney, Mr. Miller might be studying by firelight.

Yours Hopefully,
Slip Stick Sam.

My curriculum for EE degree

by Richard Beall, E.E. '54

There seems to be general agreement that some changes are indicated in the present curriculum required for a degree in Electrical Engineering. There is very little accord, however, on what these changes should be. Specifically, there are two arguments to be considered.

First, some educators feel that an engineering curriculum should not include any Humanities, since even the most basic engineering subjects cannot be presented adequately in a four-year course. Others propose that men who are trained in only the sciences are ill-equipped to lead productive and well-rounded lives in a diverse society such as ours. They suggest that an engineer be well-grounded in the traditional subjects of a liberal education.

Second, in-so-far as the technical education of the engineer is concerned, there are those who feel that a broad basis in general engineering subjects is preferable to a highly specialized training program in any particular branch of engineering.

In this paper I will adopt the point of view that a more adequate grounding in Humanities is indicated in the engineer's college program, while in the school of engineering itself, a high degree of specialization is desirable. No evidence will be presented in defense of this point of view, as there is an abundance in the literature. I would like, however, to suggest certain specific changes in the curriculum and develop my arguments for each change.

At present the Electrical Engineering curriculum is:

First Semester	*Hours*
Math. 9—Trigonometry	2
Math. 10—College Algebra	3
Chem. 1—Gen. Inorg. Chem.	5
Eng. 1—Comp. and Rhetoric	3
M. E. 1—Engineering Drawing	3
P. E. 1—Physical Education	1
M. S. 1—Military Science or A. S. 21—Air Science	1
Engr. 1—Freshman Orientation	0
	18

Second Semester	*Hours*
Math. 11—Anal. Geometry	5
Chem. 2—Gen. Inorg. Chemistry	3
Engl. 2—Comp. and Rhetoric	3
M. E. 10—Descript. Geomery	3
Humanistic-Social Study	3
P.E. 2—Physical Education	1
M. S. 2—Military Science or A. S. 22—Air Science	1
	19

Third Semester	*Hours*
Math. 175—Calculus I	5
Phys. 23—General Physics	5
C. E. 82—Eng. Materials	2
Econ. 41—Industrial Economics	3
M. E. 80—Machine Tool Lect.	1
M. E. 81—Machine Tool (Lab.)	2
P. E. 5—Physical Education	1
M.S. 3—Military Science or A. S. 23—Air Science	1
	20

Fourth Semester	*Hours*
Math. 201—Calculus II	5
Physics 24—General Physics	5
E. E. 150—Elem. of Elec. Engr.	5
Speech 75—Public Speaking	3
P. E. 6—Physical Education	1
M. S. 4—Military Science or A. S. 24—Air Science	1
	20

Fifth Semester	*Hours*
E. E. 210—A. C. Circuit Theory	4
E. E. 240—Elect. Machinery I	4
M. E. 90—Analytical Mechanics	4
Phys. 304—Elect. Measurements	3
Humanistic—Social Study	3
	18

Sixth Semester	*Hours*
E. E. 249—Elect. Machinery II	5
E. E. 275—Transmission Circuits	3
E. E. 280—Electronics	3
M. E. 99—Heat Engines	3
C. E. 101—Mech. of Materials	3
C. E. 102—Mech. of Materials (Lab).	1
	18

(*Continued on Page* 24)

Report from the annual Pi Tau Sigma

National Convention

By Tom Noel, M.E. '54

The annual National Convention of Pi Tau Sigma was held on the campus of the University of Michigan in Ann Arbor, Thursday and Friday, November 5 and 6, with the Michigan Pi Rho chapter as the host.

The highlight of the convention program was a tour on Thursday through the Ford Motor Company's River Rouge Plant which is just outside of Detroit and only 35 miles east of our convention site at Ann Arbor. We began our tour at the engine plant where the engines begin as empty engine blocks and leave as complete engines minus their ignition systems. Next was the rolling and stamping mill where we saw the ingots of steel rolled into thin sheets of desired thickness and then stamped into doors, fenders, hoods, and etc. We ended our tour at the final assembly plant, and after watching the chassis, engine, and body come together with near-perfect timing you begin to understand how the automobile companies are able to put out the tremendous volume of new cars each year.

Before returning to Ann Arbor, we went to see the Ford Museum which is not far from the River Rouge Plant. In one large "room" covering eight acres, Henry Ford has placed examples of all types of transportation, power generation, and industrial machines dating back over one hundred years. Of special interest to us was the collection of automobiles which include all makes from the earliest models in about 1900 up through about 1940. Several oddities drew considerable attention also. One was an old stationary steam engine whose flywheel was no less than forty feet in diameter. I imagine all of us had seen "a bicycle built for two." Well, the Ford Museum has "a bicycle built for ten." It has the customary two wheels and a 25 or 30 foot truss in between them. Ten seats and pedal cranks are evenly spaced along the truss.

The business session of the convention began on Friday morning in Rackham Auditorium on the Michigan campus. The main results of the business session are as follows:

1. A chapter-at-large was established so that worthy mechanical engineering students, at schools which do not have chapters, may become members of Pi Tau Sigma.

2. Mr. M. S. Cjesdahl, from the faculty of Penn State College, was elected President to fill the vacancy left by the resignation of Mr. Frank L. Schwartz, University of Michigan, who has been our President for the past three years. Mr. Goglia, from the faculty of Georgia Tech., was elected to fill the job of the Eastern Vice-President, a vacancy created by the resignation of Mr. Cjesdahl who was eastern Vice-President at the time of his election to the office of President.

3. A decision was made as to the location of the 1954 Convention. It will be held at Roanoke, Virginia with Virginia Tech, as the host chapter.

The business session was informal in nature and hence quite a few roaring laughs were the result. One of the best came as a result of some remarks by John Lescisin, the delegate from Carnegie Tech. During the portion of the session allotted for the reports of each delegate concerning his chapter's activities, John said that his chapter published a monthly news bulletin. Without even the slightest hint of a smile, he said they had named it "The Shaft" and gave it to all mechanical engineering students. Everyone howled at this little gem while John, still unknowing as to the cause of the laughter, stood looking puzzedly at us. After letting John in on the joke, we all agreed that "The Shaft" must have a very large circulation since we were getting it occasionally at our schools, too.

The 1953 Convention officially ended with a banquet on Friday evening at the Michigan Union. As each of us headed back for our home states on Saturday morning, I imagine that many as I did were taking home with them, besides the memories of a most enjoyable time, new friendships also.

NEWSTUFF

(*Continued from Page* 14)

ed standardized unit constructions on special beds, tables and columns, thus decreasing replacement and maintenance costs and the salvage losses; and many machines were equipped with selective programming controls for automatic performing of unrelated operations.

This year marks the 75th anniversary of the General Electric Company whose history begins with the formation of the Edison Electric Light Company in 1878. The G-E heritage in land transportation however, dates back to 1880. In that year Thomas Edison built and operated his first experimental electric locomotive. By 1887, F. J. Sprague was operating his famous street-car line in Richmond, Virginia . . . By 1900 a great network of city and interurban electric transit systems blanketed the country. For the next 30 years electrically-driven vehicles were the primary method of moving people on city street-car lines and in subways.

Even today, public transit still provides convenient transportation at low cost. Electricity also went to work on the railroads. In August, 1895, three General Electric 96-ton, 360 horsepower, straight-electric locomotives began hauling trains in the Baltimore Tunnel of the Baltimore and Ohio Railroad. . . . The first practical diesel-electric locomotive was placed in service December 17, 1924 by the Central Railroad of New Jersey at Bronx Terminal. . . . Today, straight-electric locomotives operate over electrified systems totaling 2600 route-miles on 17 Class I railroads in the United States.

During the 12 months ending November 1, 1952, the American railroads removed 5,742 steam locomotives from their inventory and replaced them with 2,425 diesel electrics. Electrical transportation also found its way into other industries. In 1887 the Lykens Valley Colliery of the Pennsylvania Railroad produced the first mine locomotive. . . . Modern G-E mine locomotives vary in size from 44 to 40 tons, with speeds ranging from 6 to 35 mph.

In the 20's, successful switching locomotives were built primarily for railroad work. They used diesel engines of the high continuous duty type operating in the 500 to 1000-rpm speed range. Such locomotives were heavy and expensive, and could only be economically justified in service where the loan factor was high. In the latter half of the 1930's engine builders achieved quantity production of low-cost, high-speed automotive diesels. These quickly proved successful in the automotive field. Simultaneously, low-cost, high-speed electric drives were developed for the larger sizes of these new engines. Here were the two components long awaited by locomotive designers. When the two were combined and applied to an industrial switching locomotive, the revolution began.

More than 2000 G-E industrial diesel-electric switchers have been placed in service since 1937 and have enabled industrial plants to do a better job at less cost. In 1948, G-E again harnessed electricity to a new prime mover . . . the gas turbine. Result was the first gas turbine electric locomotive in America. Although this type is still considered to be in the developmental stage, orders have been placed for 25 locomotives. Six are now in operation on the Union Pacific Railroad.

The past 75 years have seen electricity applied to most types of motive power and numerous other equipment for land transportation. Modern locomotives, whether they be diesel-electric, straight-electric, or gas turbine, differ principally in the manner by which electric power is furnished to the driving motors. Experts believe that even the application of atomic power to railroads will resolve itself into converting that power into electricity which can then be used to drive the locomotive.



—Cut Courtesy of General Electric

Hartmann Drug Co.

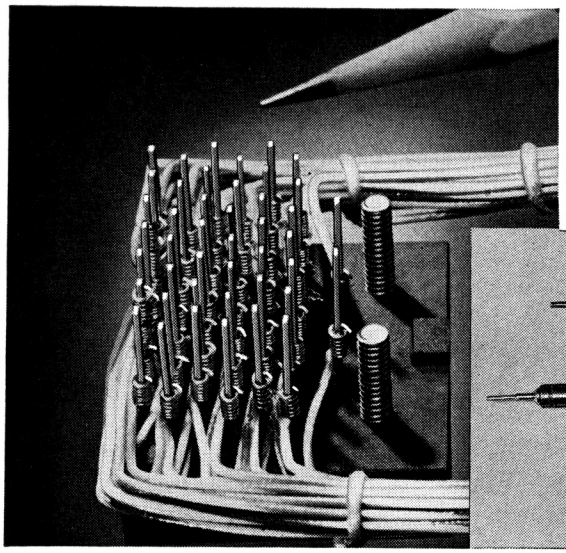
PRESCRIPTIONS

DRUGS — TOILETRIES

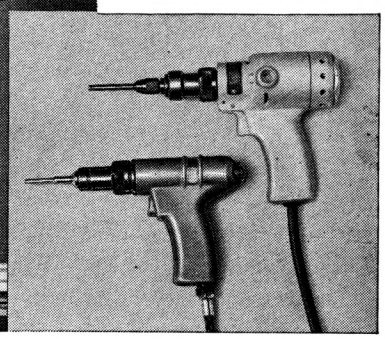
GIFTS

120 Strollway Phone 6603

Good Connections
...electrically speaking



New solderless method permits the making of very closely spaced connections, as shown on this experimental terminal block.



Electrically powered "wire wrap" tool (above) and compressed air tool (below) for making wrapped solderless connections.

GOOD CONNECTIONS are mighty important to us for, you see, we make more than a billion electrical connections each year. It takes that many to manufacture and install complex telephone equipment in the Bell System.

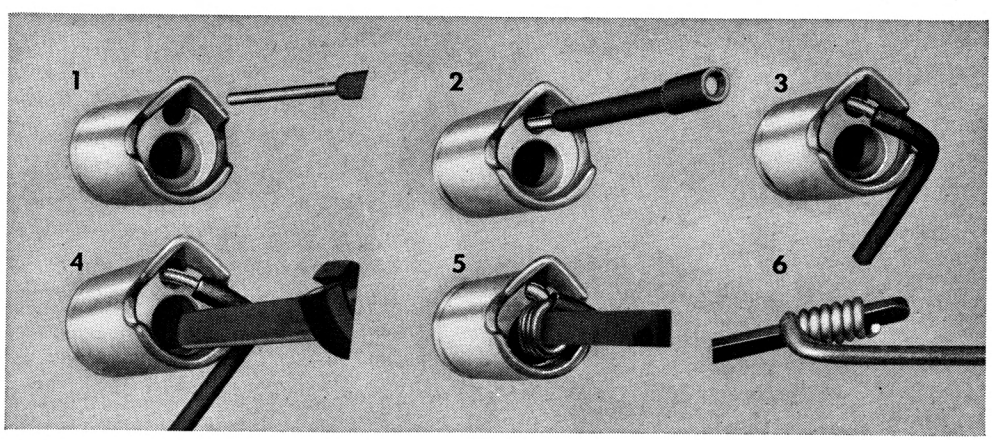
That's why the revolutionary new method of making electrical connections *without solder*—a method created by Western Electric engineers together with their teammates at Bell Telephone Laboratories—is indeed one of the significant engineering achievements of recent years.

Like most really creative engineering jobs, the development of a tool to make solderless connections grew out of a problem. We had to find a way to connect our newly designed wire spring relay to other components in giant bays of switching equipment. This new relay—something of an engineering achievement itself—can have as many as 36 terminals in an area only 1-3/8" by 11/16". Obviously, the conventional method of hand-wrapping and soldering wires onto the terminals is extremely difficult in such a small area.

After more than five years of research and experimentation, the engineers came up with a pistol-like power tool capable of making mechanically sound solderless connections. Shown above are two tools now used at Western Electric manufacturing locations. They literally shoot wire onto terminals . . . and do it surer, faster and less expensively than conventional methods using solder. That's not all. The new "wire wrap" tool keeps equipment free from solder splashes, wire clippings and reduces bent and distorted terminals. Electrically, the "wire wrap" tool gives a far better connection than can be made manually . . . the high pressure contacts are stronger, cleaner, more compact and more uniform.

In keeping with the Bell System policy of sharing technical know-how with all of industry, Western Electric will make this tool commercially available to electrical manufacturing companies, such as radio, television and communications producers, through licensed tool manufacturers.

You're right if you think we're more than a little pleased with our accomplishment. And as we have been many times before, we're proud of the engineers in all fields—electronics, mechanical, electrical, metallurgical, chemical, industrial—who uphold our reputation for leadership in fundamental manufacturing techniques.



How a solderless connection is made: (1) Skinned wire approaches the small flared opening in the tool tip. (2) Wire is inserted in hole. (3) Wire is bent and anchored by means of notch in side of gun tip. (4) Gun tip is slipped over rectangular wire terminal. (5) Spindle of gun tip rotates to wrap wire around terminal. (6) Six wire wraps around terminal complete electrically sound joint without soldering.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Manufacturing plants in Chicago, Ill. • Kearny, N. J. • Baltimore, Md. • Indianapolis, Ind. • Allentown, Pa. • Winston-Salem, N. C. Buffalo, N. Y. • Haverhill, Mass. • Lawrence, Mass. • Lincoln, Neb. • St. Paul, Minn. • Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City.

CARDIAC ARREST

(*Continued from Page* 13)

When cardiac arrest occurs outside the operating room, there is obviously a need to have all equipment available for resuscitation at a minute notice, due to the urgency of the situation. Therefore a Mobile Cardiac Resuscitation Unit, the first such unit in this country, was designed by the author, and has been in use for several years. Such a unit is equipped with an electrical cardiac defibrillator, a positive-negative pulmonary resuscitator, and an electrocardiograph machine, an electrophrenic stimulator for stimulating the phrenic nerve to artificially control respirations, interval time clocks, transfusion units, surgical instruments, and the various drugs used in resuscitation. This first Mobile Cardiac Resuscitation Unit has been used extensively throughout New York City's sprawling Bellevue Hospital.

When cardiac arrest occurs in which ventricular fibrillation is not present but at which time the heart is completely in standstill, an electrical pacemaker has been developed for external control of the heart rate by means of pulsed voltages applied to hypodermic needle electrodes placed in the side of the chest under the skin. The electrical pacemaker operates on an input voltage of 110 volts 60 cycles AC; the output voltage is monophasic rectangular pulses continuously variable from 30 to 100 volts of 5 milliseconds duration. An automatic heart rate can be produced varying from 50 to 150 beats per minute. The output current rating is 100 milliamps or more of heart pulse current. The electrical pacemaker, as is the electrical defibrillator, is used only in especially indicated situation. In the majority of cardiac arrests, resuscitation can be accomplished solely by means of heart massage and the addition of various drugs injected into the heart.

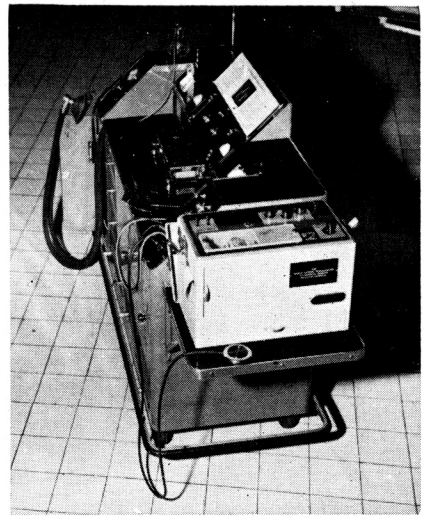


Photo Courtesy Bellevue Hospital

The Mobile Resuscitation Unit designed by the author has received use throughout all of Bellevue Hospital. It contains all drugs and instruments necessary for the correction of cardiac arrest.

These are but a few of the examples illustrating the degree of interchange necessary between the medical and engineering sciences. In order to give the maximal exploitation of the knowledge of the two sciences on any one particular point, it is quite obvious that a physician cannot be schooled in all of the various aspects of electrical engineering, etc., nor can the engineer find time for a complete coverage of the fundamentals of medicine. Some of the stumbling blocks in medicine may be quite simply removed by those in the Engineering field, if only they were aware of the problem. It is possible through an understanding of the mutual problems at hand, however, to attack these problems through a concerted joint effort. Let us all look forward to a period of closer cooperation and mutual assistance between the School of Engineering and the School of Medicine. The engineering student interested in placing himself on the frontier of a new career might well consider the relationship between Medicine and Engineering.

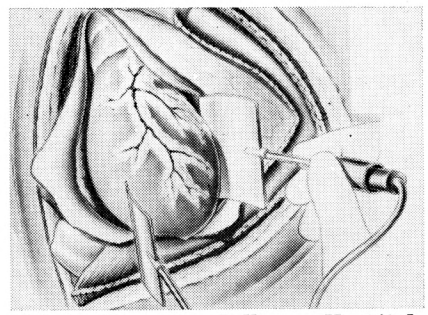


Photo Courtesy Bellevue Hospital

Placing the electrodes around the heart.

Barnstead

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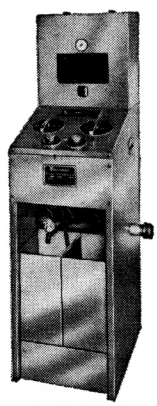

Barnstead Demineralizers increase production, reduce rejects, and insure better product control. Barnstead Demineralizers produce high-test, mineral-free water for as little as 5c per 1000 gallons, with a minimum of supervision and maintenance.

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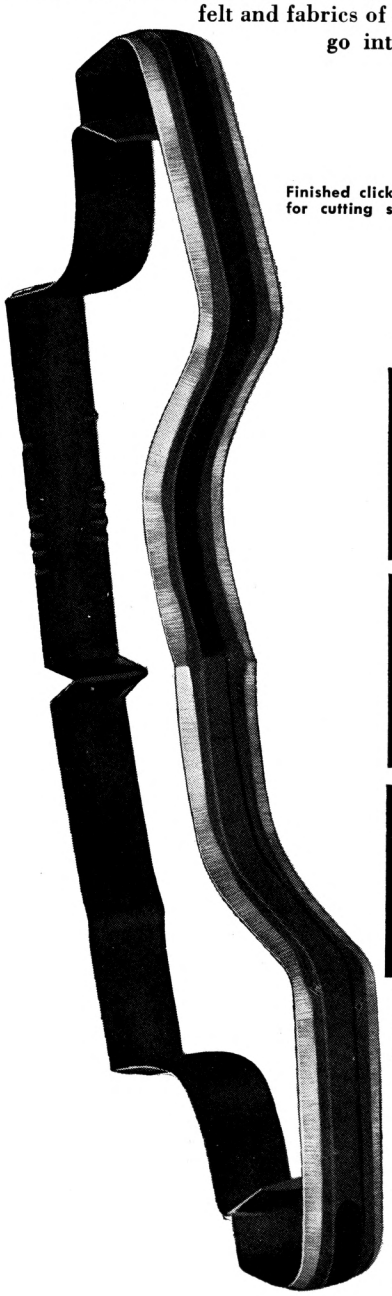
What's Happening at CRUCIBLE

about clicker die steel

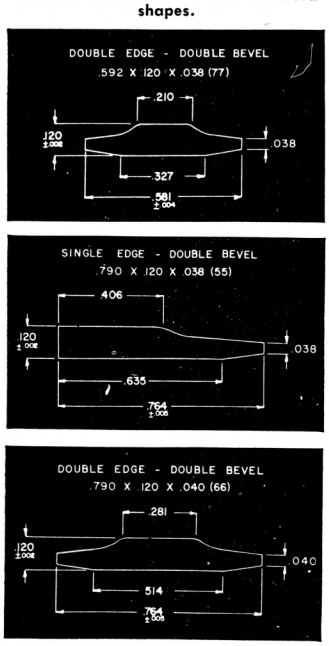
what it is

Clicker die steel is a special cold rolled alloy steel. It is used in making clicker dies for cutting leather, rubber, plastic, felt and fabrics of other compositions that go into the making of shoes and similar products.



Finished clicker die ready for cutting shoe leather.

Some of the clicker die steel standard shapes.



Wider shapes are used when dies are sized by surface grinding after forming and welding. Standard widths are provided when the dies are not to be surface ground.

how it is used

Clicker die steel is furnished to the die maker in either single or double edged form in one of several standard shapes. The die maker first shapes the die by bending the die steel to a pattern that provides the desired configuration, and then welds the two ends at a corner. He finishes the die by grinding a bevel on the outside of the cutting edge and filing the inside edge. Before the finished die is hardened and tempered, the die maker forms identification marks — combinations of circles and squares — in the cutting edge so that the material cut from it may be easily identified as to its size and style.

In the cutting operation, the leather or other material is placed on an oak block in the bed of the clicker machine. Then the die is placed by hand on the material which is cut as the aluminum faced head of the machine presses the die through it. The clicking sound which the head makes as it strikes the die is where the term "clicker machine" derived its name.

what it is composed of

Clicker die steel as produced by the Crucible Steel Company of America is a controlled electric steel in which the combination of carbon and alloy is designed for maximum toughness and proper hardness after heat treatment.

Experience has proved that cold finished clicker die steel is superior to hot rolled material for sizes approximately ¾ inch and narrower because of its lower degree of surface decarburization which permits the use of slightly thinner sections. Cold finished material also has a better surface finish with closer width and thickness tolerances and thinner edges that require less grinding and filing to complete the die.

CRUCIBLE'S engineering service

As with clicker die steel, the Crucible Steel Company of America is the leading producer of special purpose steels. If you have a problem in specialty steels, our staff of field metallurgists with over 50 years experience in fine steel making is available to help you solve it. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

CURRICULUM

(*Continued from Page* 18)

Seventh Semester	*Hours*
C. E. 240—Fluid Mechanics	3
E. E. 315—Transients	3
E. E. 320—Vacuum Tube Circuits	4
Technical Elective	3
Humanistic-Social Study	3
	16

Eighth Semester	*Hours*
M. E. 230—Thermodynamics	3
M. E. 241—Mech. Laboratory	2
Free Elective	3
Technical Elective	6
Humanistic-Social Study	3
	17

The curriculum which I propose is:

First Semester	*Hours*
Engineering Mathematics	5
Humanities (History)	3
Chemistry I	5
Engineering Drawing	4
	17

Second Semester	*Hours*
Engineering Mathematics	5
Humanities (Literature, Art Music)	4
Chemistry II	3
Structures I (Analytical Mechanics and Mechanics of Materials)	3
Structures II (Engineering Materials Mold shop and Testing Lab)	3
	18

Third Semester	*Hours*
Engineering Mathematics	5
Humanities (Natural Sciences)	3
Physics	5
Structures III (Continuation of Structures II)	3
Slide Rule	1
	17

Fourth Semester	*Hours*
Engineering Mathematics	5
Humanities (Psychology)	2
Physics	5
Technical Report Writing	2
E. E. 150	5
	19

Fifth Semester	*Hours*
Humanities (Philosophy)	5
E. E. 210	5
E. E. 240	4
Electrical Measurements	3
Technical Report Writing	1
	18

Sixth Semester	*Hours*
E. E. 275	3
E. E. 280	3
E. E. 315	3
Contemporary Problems	3
E. E. 249	5
	17

Seventh Semester	*Hours*
Machine Tool	2
Servo-mechanisms	3
Problem Solving	4
Maintenance and Repair	3
E. E. 320	4
Heat Engines	3
	19

(*Continued on Page* 26)



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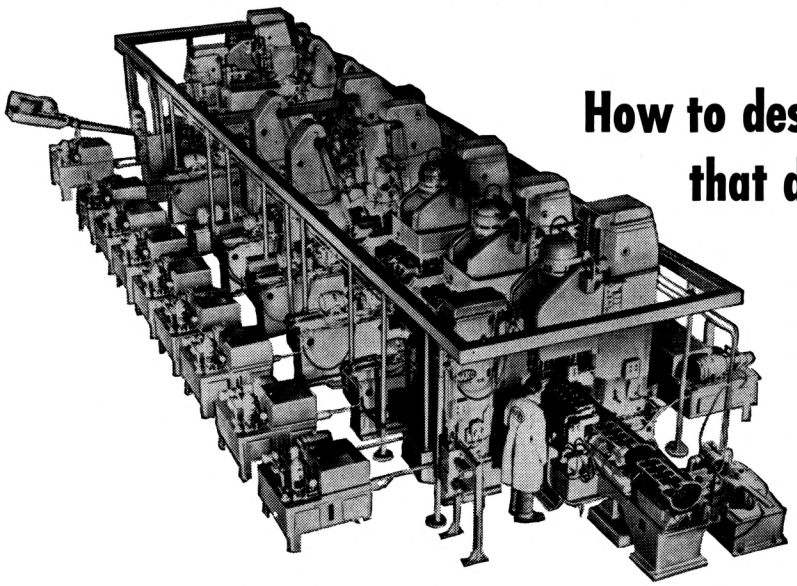
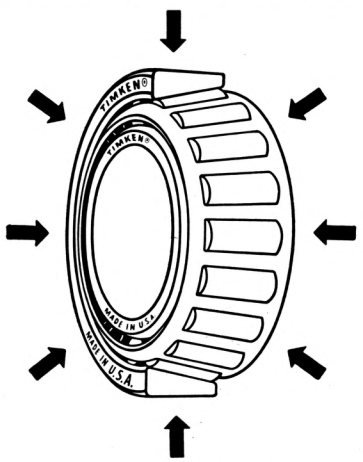


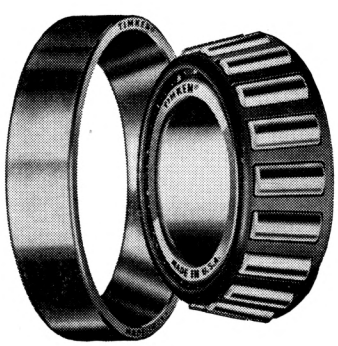
How to design precision into machine that does 98 operations a minute

In designing a machine that performs 98 facing operations every 1.1 minutes, machine tool engineers had to be sure of extreme precision in spindle shafts. Spindles had to be held rigid to eliminate vibration and chatter. Engineers solved this problem by mounting all spindle shafts on Timken® tapered roller bearings.

How TIMKEN® bearings hold spindle rigid

The line contact between rollers and races of Timken bearings gives spindles wide, rigid support. Deflection is minimized and end-play eliminated because the tapered construction of Timken bearings enables them to take radial and thrust loads in any combination. Spindles are held rigid for long-lasting accuracy.





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NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

CURRICULUM

(*Continued from Page 24*)

Eighth Semester	*Hours*
Speech	3
Problem Solving	3
Technical Elective	6
Humanities (elective)	3
Survey of Engineering Procedures	3
Inspection Trip	0
	18

I would like now to justify some of the changes which I have made.

A sound background in trigonometry, solid geometry, and algebra should be a requirement for admission to the College of Engineering. These courses should be offered in college only to fulfill the entrance requirements, and no credit would be given. Many high schools today do offer a science major which requires of the student that he have at least four semesters of algebra, one of plane geometry, one of solid geometry, and one semester of trigonometry. It might be well that all high schools would follow this policy if the entrance requirements were so changed.

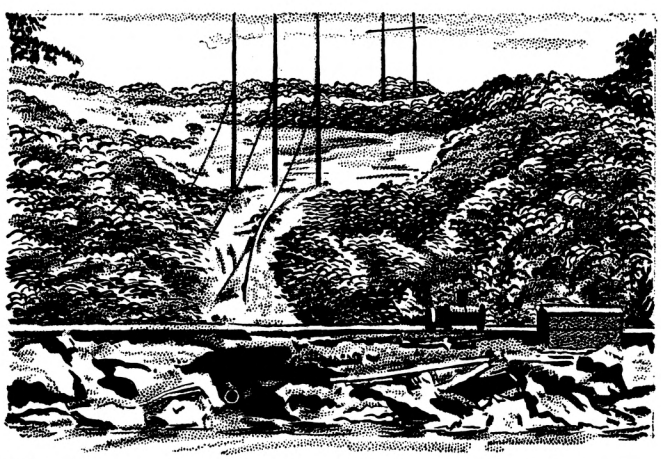
Engineering Mathematics is the title to that sequence of courses which would cover analytical geometry, calculus, introduction to vector analysis, differential equations, and differential equations of applied mathematics. I feel that these courses should be taught by analysts rather than geometricians or algebraists, or, if possible by the E. E. staff, itself. By making differential equations a requirement, as do many schools today, time can be allowed in later E.E. courses, such as Transients, for a more thorough treatment of the subject without the necessity of teaching the required attendant mathematics as a part of the electrical course.

Such differential equations of applied mathematics is a course designed for engineers, a number of important subjects are left to this course, and it should therefore become a part of the mathematics sequence. Subjects of such general interest as the mathematics of mechanical and electrical analogues are a part of this course, and fourier's theory is given a more thorough treatment.

Composition and rhetoric are taught at present in most high schools, and it needs only for the quality of these courses to be improved to prepare the student for his course in Technical Report Writing. The inclusion of this latter course seems justified, since it would be at least as valuable as speech, which is now, and will continue to be on the list of required courses. Technical Report Writing is offered in the Fourth semester so that the student will have had enough technical training to supply him with subjest matter, and will still be offered early enough so that he is able to apply the training to reports which are required in later courses.

In the engineering field today, the engineering draftsman is being replaced by the technician-draftsman. I believe, therefore, that Engineering

(*Continued on Page 28*)



The first submarine installation of a pipe-type cable system was recently installed under the Hudson River at Poughkeepsie, N.Y. Three cables, each nearly ¾-miles long, were simultaneously pulled into a six-inch welded steel pipe laid across the river bottom. The pipe was then filled with oil maintained at 200 lbs. pressure, enabling a 110,000-volt power circuit to cross the river safely.

This kind of system is called Oilostatic — a design which has long been first choice among utilities for handling large blocks of power by means of a high-pressure pipe-type cable system. Increased circuit reliability and savings on installation and maintenance costs are realized.

Oilostatic's new role as a submarine cable is typical of the significant contributions to better electrical service made by Okonite engineers.

● ● ●

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

OKONITE insulated wires and cables

8789



Here's another new aid to precision production from Brown & Sharpe — enables you to specify closer tolerances and know they're practical. This new No. 955 Electronic Caliper permits production gaging in units from .0001" to .00001", often without removing work from machine or fixture . . . or without lifting work from the bench. Readings are taken on the No. 950 Electronic Amplifier. Four interchangeable jaws provide a measuring range from 0" to 4" . . . only one master needed for each setting. Aligning attachment also available to facilitate measuring long work pieces. Write for the new illustrated Bulletin. Brown & Sharpe Mfg. Co., Providence 1, Rhode Island, U. S. A.

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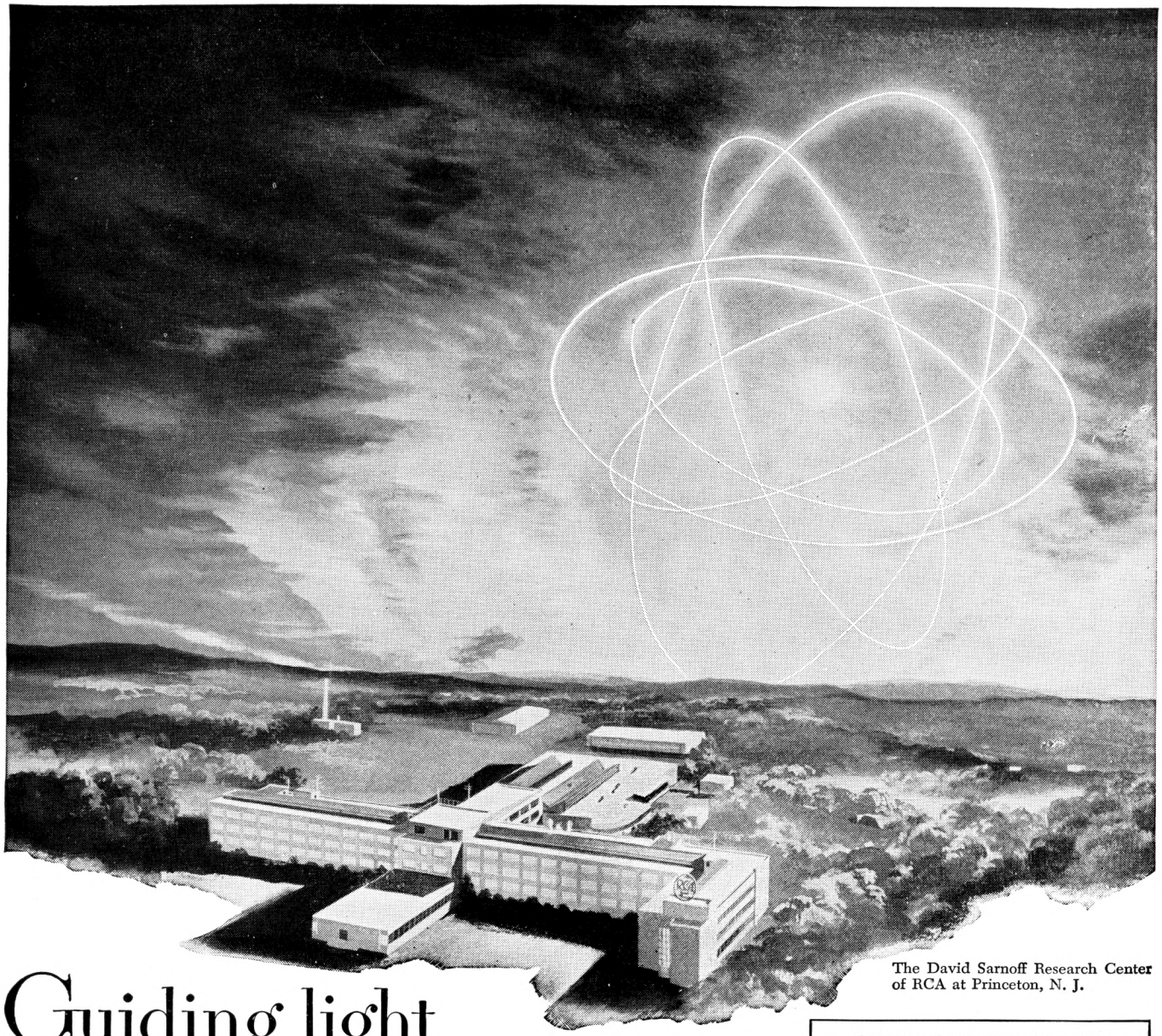

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How useful it can be is seen in the advances already made by RCA scientists—such as the *picture tube* of your television set... the *image orthicon* television camera, used by every studio in the nation . . . the amazing *electron microscope,* which magnifies as much as 200,000 times. RCA scientists now work toward new advances—more powerful television sets . . . all-electronic color television . . . UHF television . . . new electronic systems for industry and our Armed Forces.

To RCA scientists, the challenge of *tomorrow* is more interesting than *yesterday's* success. This pioneering spirit assures you finer quality in every product and service of RCA and RCA Victor.

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***See the latest in radio, television, and electronics at** RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, RCA Building, New York 20, N. Y.*

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CURRICULUM

(*Continued from Page* 26)

Drawing could be combined and condensed with Descriptive geometry in a four hour course. Some blueprint reading should be covered, beyond this, the drawing taught would be that which is necessary for the preparation of precise plates in Descriptive Geometry. Some freehand sketching would be taught, but no inking would be required, as indeed, little is required in industry today.

The first course in chemistry would be unchanged. The second course, however, should be set-up specifically for electrical students, placing emphasis on those subjects known or foreseen value to electrical engineers. The course should be predominantly mathematical and would include study of gas laws, insofar as they apply to turbine operation, heat balance in a boiler, and gas activity in vacuum tubes. Some time should be spent on solid state chemistry of cathode metals and transistor materials.

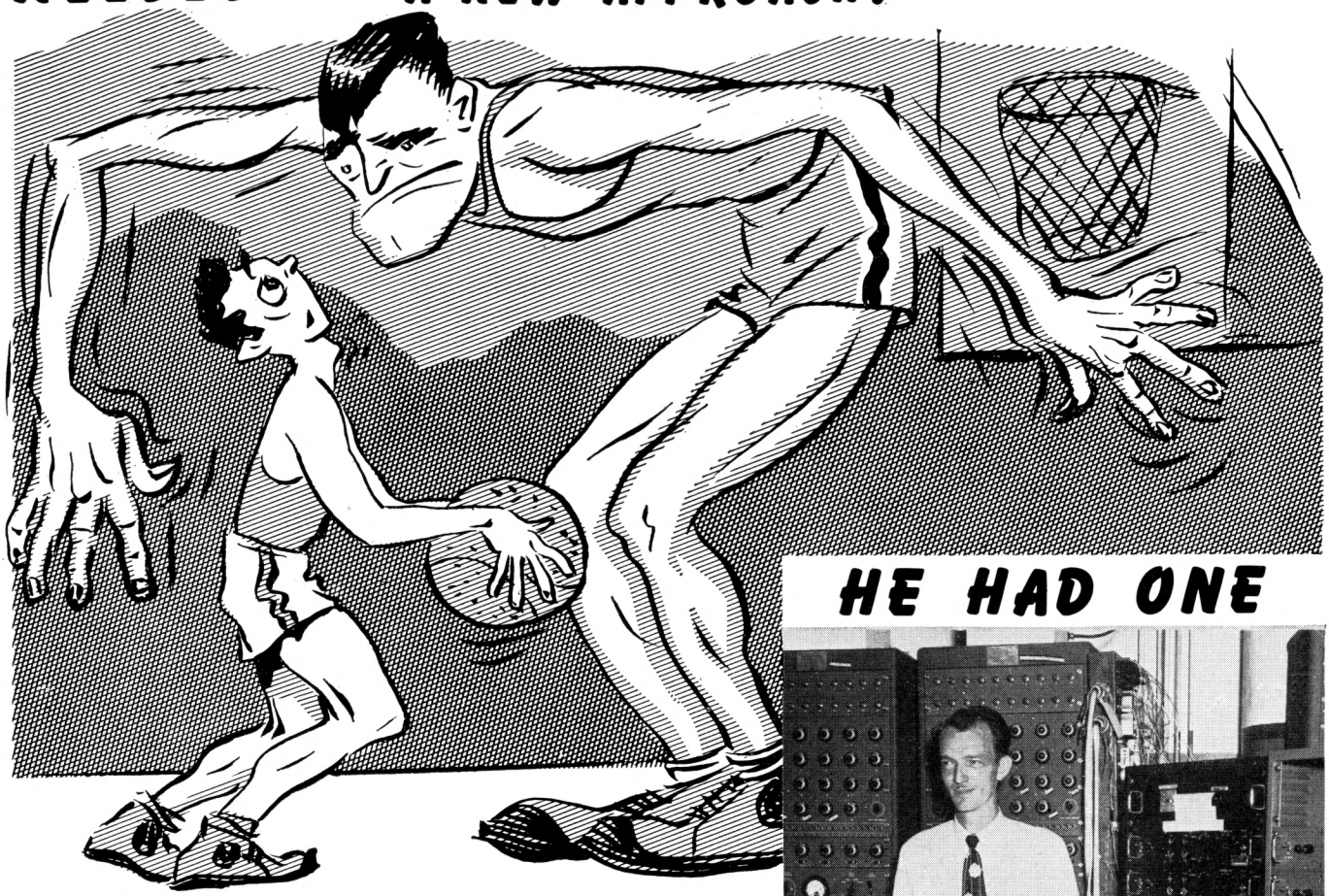
The series of courses which is called Structures will be integrated into one department to include a second semester three hour course which will be comprised of one hour lecture covering the material now in C.E. 82, and two one hour labs, one a materials testing lab, and the other a demonstration lecture lab in heat treating and metal processing.

A one hour slide rule class is offered in the third semester so the proficiency in vector manipulation may be achieved before taking E.E. 210, but it is not offered so early that use of hyperbolic and logarithmic scales will be forgotten before reaching E. E. 275.

The E.E. series of courses, 150, 210, 240, 280, 249, 275, 315, and 330 is left unchanged. Due to the increase in the application of servo-mechanisms in both communications and power field, this course is to be required and is to replace M.E. 230, thermodynamics, which I believe to be a highly specialized study of phenomena of interest more to mechanical engineers than to electricals.

Industrial Economics has been omitted entirely, as I feel it is of little value to the electrical engineer. (*Continued on Page* 30)

NEEDED--- A NEW APPROACH!



HE HAD ONE

BOBBIE S. SHARRAH
Assistant Chief Dynamics Engineer — Missile Engineering Division
B.S.A.E. Iowa State College '45
M.S. Applied Mechanics Washington University '52

Pictured in front of our REAC installation, Bob Sharrah exemplifies the type of pioneering spirit essential in missile engineering. He developed a new and useful approach to the problems of stability of guided missile control systems as influenced by aeroelastic effects. At twenty-eight, Bob also points up the youthfulness of M.A.C.'s engineering management.

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McDonnell engineering planners are constantly alert to new materials, new equipment and new techniques. A Flight Test Hanger, Propulsion Laboratory, Altitude Test Chamber and Wind Tunnel are recent additions to our engineering facilities. We are also interested in new engineering talent—men who can contribute original thinking—*engineers with a new approach.*

If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when the McDonnell representative will visit your school. Ask him about the McDonnell Graduate Study Plan. You may also write to:

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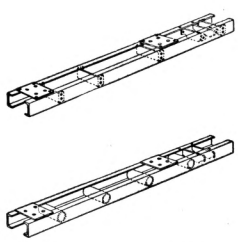
For a successful engineering career, thorough background in welded steel construction is vital since:

GOOD ENGINEERING DESIGNS DEPEND ON COST

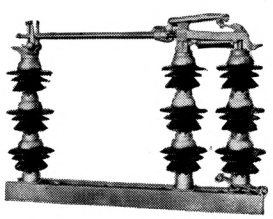
With more and more emphasis being placed on cost of manufacture to meet competition, industry's management today looks to its engineers to initiate money-saving ideas in product designs. As a result, the alert engineering student who can come up with unique money-saving suggestions in his designs will find greater acceptance for his suggestions and a promising future in personal advancement and income.

Often too little attention is devoted to how a product design can be simplified to eliminate costly manufacturing manhours once a basic design is established. To achieve this end, where designers reappraise product details for welded steel construction, production costs are being cut an average of 50% compared with manufacture using castings.

The reasons for the lower cost with welded design are basic . . . lower cost of steel per pound, fewer pounds of steel needed and simpler shop procedures. In addition, steel designs are stronger . . . resist fracture from shock . . . are more modern in appearance.



FORMER BOLTED DESIGN *of base for electric switch. Bases range from 6 to 10 feet long. Are subject to severe cantilever stresses from opening and closing of switch.*



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THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

CURRICULUM

(*Continued from Page* 28)

Electrical Measurements will be taught in the engineering departments laboratories with equipment which the electrical engineer is expected to know. A knowledge of such instruments as the C.R.O., the signal generator and the impedance bridge will be required, and the student will be expected to combine a faculty in operating these instruments with a basic understanding of their circuitry. Later, in a course called Maintenance and Repair, the use of these instruments as trouble shooting devices will be taken up in a one hour lecture and a two hour lab. Demonstrations in this lab will include such important phases of the technicians work as brush-seating. trouble-shooting, and commutator repair. This work will give the student an appreciation of some of the techniques of repair.

The course of Machine Tool will include one lecture and one lecture demonstration in the laboratory. The lab will include at least one each of the machines found in modern machine shops, and stresses will be placed on the limitations of machines, which, in turn, impose limitations on design.

The Humanities course is designed to encompass as much study in the liberal arts field as possible. Because of the necessarily specialized work required to today's engineering student, a course of this sort is valuable if the graduate expects to fit himself into contemporary society. The survey, as outlined, will be a two year program of lecture courses conducted by the various departments in the liberal arts college. History will be offered in the first semester, literature, music, and art, the second semester, the natural sciences, the third semester, psychology, the fourth semester, and the philosophy of sciences in the fifth semester. The student will be offered a three hour elective in humanities his senior year. Such a survey would be broad but admittedly rather shallow. However, it would be no more shallow than the system now in practice which offers several free, with no effort at integration or organization.

I would like now to discuss the inclusion of three new courses in my proposed curriculum of study. They are: Engineering Problem-solving, Contemporary Engineering Problems, and Survey of Engineering Procedure.

The first is to be a course in the practical solution of problems which will give the student facility in answering such question as, What accuracy is necessary? Can this accuracy be maintained with the instruments available? How much of the available data can be disregarded as superfluous? What source material is available in the way of charts and table which bear on the problem?

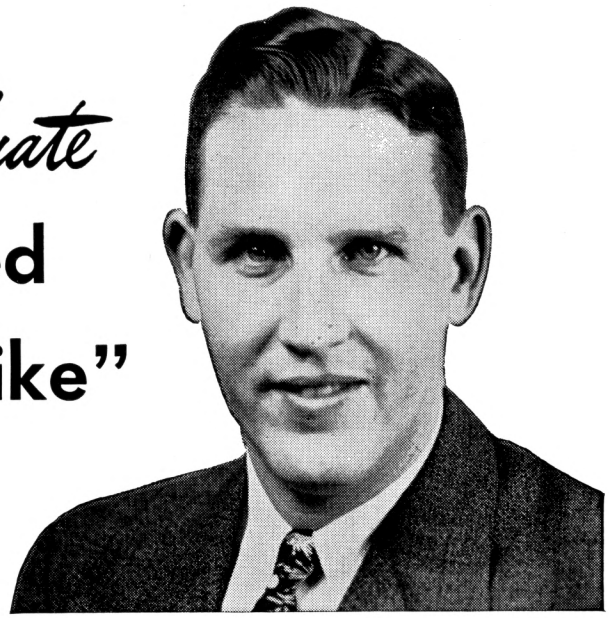
There is a real need in the curriculum for such a course is evidenced by the fact that such industries as General Electric build a three-year advanced engineering course around the kind of problem-solving mentioned above.

The course in contemporary problems is planned as a lecture course where current work in various areas of Electrical engineering will be discussed. Information which would be disclosed in a course of this sort might include the answer to a question such as, "On what particular work is Bell Laboratories spending most of their research appropriations, at present?" This knowledge of the work being done invaluable to the student when representatives of these same companies are here to interview.

Lastly, the course entitled, Survey of Engineering Procedures will be a lecture course and will cover such subjects as, the relationship of one branch of engineering to another, the various engineering societies and their functions, the relationship between the engineer and management, between the engineer and the unions, etc. Whenever possible, the lectures for this course would be delivered by men from industry who would be expected to explain their organization's function.

I readily admit that the proposed program probably is not the best which could be offered, but I believe it contains improvements over the one now in existence, and I predict that it is a fair sample of the electrical engineering curriculum of the future.

"Allis-Chalmers Graduate Training Course Helped Me Find the Work I Like"



says HUGH C. SELLS,
Syracuse University, BS—1942
and now Manager, Knoxville District Office

"I guess I was like many graduating engineers. I didn't really know what I wanted to do. When the Allis-Chalmers representative visited the campus, and described their Graduate Training Course, it sounded like the type of postgraduate training I really needed.

"What appealed to me then—and still does—is the broadness of the program. Here is a company filling a unique spot in industry. It makes important, specialized equipment for almost any industry you can name."

Wide Choice of Activity

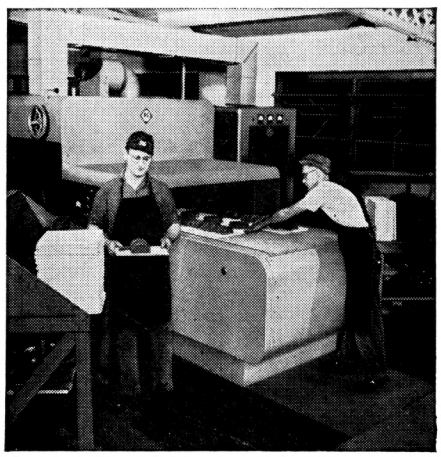
"It's like a big department store for industry. But that isn't all! In addition, it offers a wide choice of activity within each of these many product groups . . . whether it be sales, design, research or production.

"After getting the broad look at industry the program offers, my interest began centering on Service and Erection of large equipment. This led me into many departments of the company, and I learned about everything from steam turbines to sifters for flour mills."

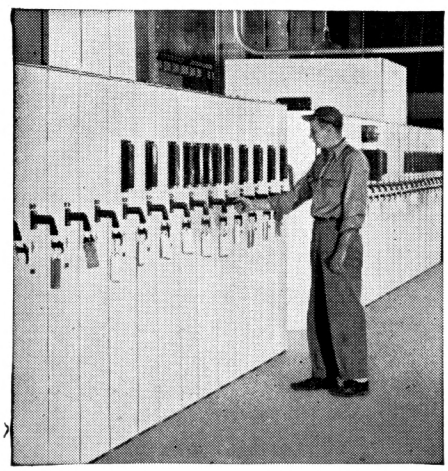
Valuable Background

"The transition from service to sales was natural. The background of service and erection work proved very valuable.

"So you see, whether you think you know what you want to do or not, the Allis-Chalmers Graduate Training Course is so flexible, so broad in its scope, you have a real chance to find yourself. Best of all, you don't have to waste time doing it."



ELECTRONICS—Modern way to dry sand cores is with Allis-Chalmers *Foundromatic* Sand Core dryer. Revolutionary new process dries cores in minutes instead of hours.



POWER—Neat, compact and safe switchgear installation is big improvement over open framework and knife switches in older installations.

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

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YE ED

SHAMROCK SEZ:

Last year YE ED of SHAMROCK pulled the financial status of the magazine into the black, and since SHAMROCK is to be non-profit, YE ED felt that something useful should be done with part of this money. Mike (last year's Editor), Dean Croft, the faculty advisors, and member of the Engine Club Exec Council held a few meetings last year to decide what should be done with this and any other profits the SHAMROCK ever made. It was felt that this money should be made useful to someone who well needed the money, and this was done by proposing that those moneys be invested and part of the principal be immediately used for Scholarships for students in a tight spot. At the first meeting of Engine Club, the proposed revisions to the By-Laws were read; and at the second meeting, they were approved. Much more informal than the University Loan Service, it is more easily accessible to the needy student. And yet, none of this money can be transferred to any other part of the SHAMROCK or Engine Club without the approval of the Dean, the Shamrock Scholarship Board, and the Faculty Advisors of the Engine Club. Ol' SHAMROCK is quite tickled about the Dean's praise, too: about the unselfishness of the Engine students who help their financially restricted friends, rather than spend the money on liquid entertainment.

INSPECTION TRIP season has opened. One of the requirements for graduating seniors is that they go on at least one inspection tour during their last year, either as a group, or singly. Of course, going in a group has many advantages over the lonesome tour: most company representatives are friendlier and much more obliging. Information concerning operations is given more readily, travel expenses are less per groups— and after inspection, there is always a chance for a party at some of the nitespots in a particular town. After the first M.E. and Ch.E. trips there were a few sleepy but also shiny faces mulling around Engine Building. Commented one of these faces, that he got more out of actually looking at a particular machine for a few minutes, than he got out of a month's lectures on the same. So SHAMROCK is grateful to the companies visited and for the free meals provided, and is already getting Dean's excuses for the next trip.

TRIPOD THE DOG is a tradition known to many years' graduates of Mizzou. However, that is almost all one knows about him—and even the mystery of the "fourth pod" is no common knowledge. Seems that the animal, as it now stands on its three legs, has captured the affection of many of our alumni, who keep on writing Ol' SHAMROCK for information on his health and wellbeing. So an article is forthcoming about Tripod, and anyone possessing any fond or bitter memories about him is invited to write to the editor.

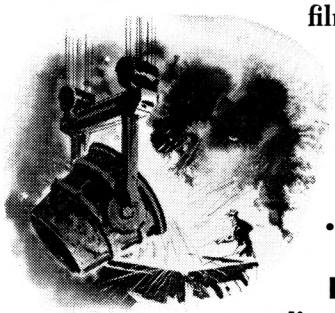
VISITING ALUMNI are always welcomed by Ol' SHAMROCK. It would be great fun to see an old grad at the SHAMROCK office, 233 Engine Building, and find out about the ol' troops, what's new at the company, and just talk about old times. After all, this mag serves the alumni as well as the students here, and it's always a great feeling to see a familiar name in print—especially when it is your own.

Correction!

Well, we did it again. This time, though, it is a big error. If you will look on page 5 of the November issue of the SHAMROCK, you will notice that Dr.'s Luebbers and Wetterstrom are mentioned twice under "Faculty Advisors ." It was worse than this, for they were mentioned under "Secretarial" in the first proof. We apologize to Dr. M. M. Bolstad, our other faculty advisor, because we mentioned his name only once; and we apologize to Professor Henriksen, who called the error to our attention.

Photography helps a New Steel Mill roll into action

Fairless Works, U. S. Steel's new Eastern Seaboard mill, is now starting operations—and growing—at the same time. And camera and film play their parts in both.



. . . to help locate ore, plot transportation, lay out plants, control quality, improve production, U. S. Steel puts Photography to work.

From ore through research and production, Photography is one of Steel's important operation tools. It helped locate and appraise the new Venezuelan Cerro Bolivar deposits which sparked this great new seaboard mill. It helped chart the ore's course to the sea—helped plan the plant and keeps a running record of its growth. And day after day it's at work in the research lab improving steel metallurgy, and on the production line controlling quality.

Countless numbers of America's varied industries, large and small, use photography in many ways to save time, speed accomplishment, increase production, and cut costs.

In fact, so many new applications of photography are being found, that many well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. Returning servicemen, too, have found new opportunity here.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

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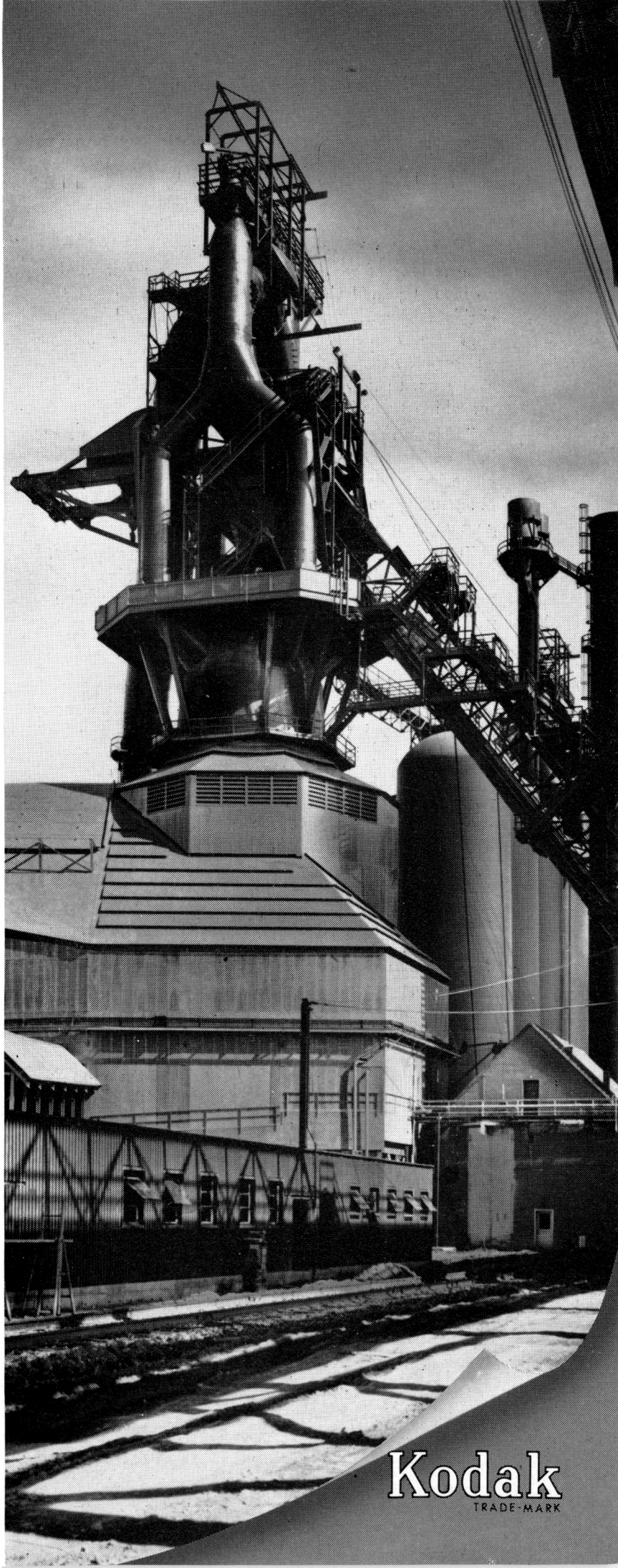

WE ASKED THESE RECENT COLLEGE GRADUATES:

"WHY DID YOU JOIN GENERAL ELECTRIC?"

"When I graduated from college I didn't have a definite idea of what field of engineering I wanted to go into. I joined General Electric because I felt that G.E.'s engineering training program offered the best opportunity to move about freely in an organization whose activities include almost every branch of engineering. In this way I found the particular specialty for which I was best suited and most interested.

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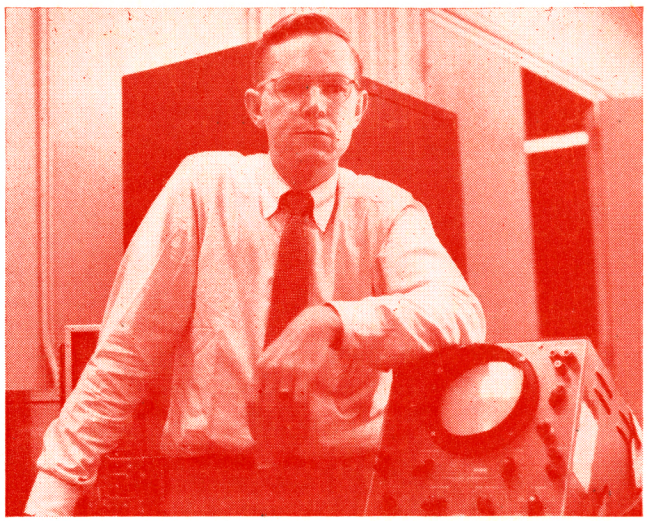
"On the basis of the experience thus acquired, I have been able to make an intelligent choice of the particular field of engineering for which my talents, interests, and abilities are best suited."



GERALD R. PETERSON, U. of Calif., BS, electrical engineering.

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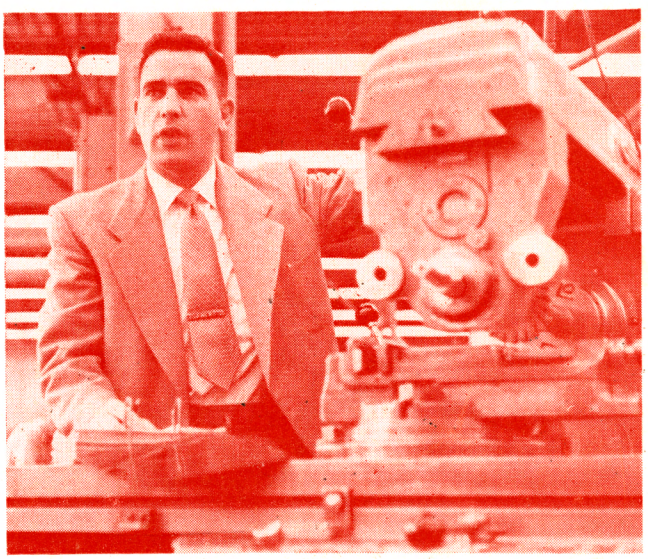
"Through assignments in these areas a logical decision can be made on final job placement. To me this seems extremely valuable in putting the right man and the right job together, and thereby greatly enhancing the possibility for success."



DAVID J. DILLON, U. of Ill., BS, management.

These are but two of the many reasons why hundreds of college graduates come with General Electric each year. These men are part of the large group of young people who are getting ahead *fast*—in an industry where there is broader scope for your ability . . . where your future is not chained . . . where you work in an atmosphere of vigorous, progressive thinking.

If you are interested in building a career with General Electric see your college placement director for the next visit of the G-E representative on your campus. Meanwhile, for further information on opportunities with G.E. write to College Editor, Dept. 2-123, General Electric Co., Schenectady 5, N. Y.

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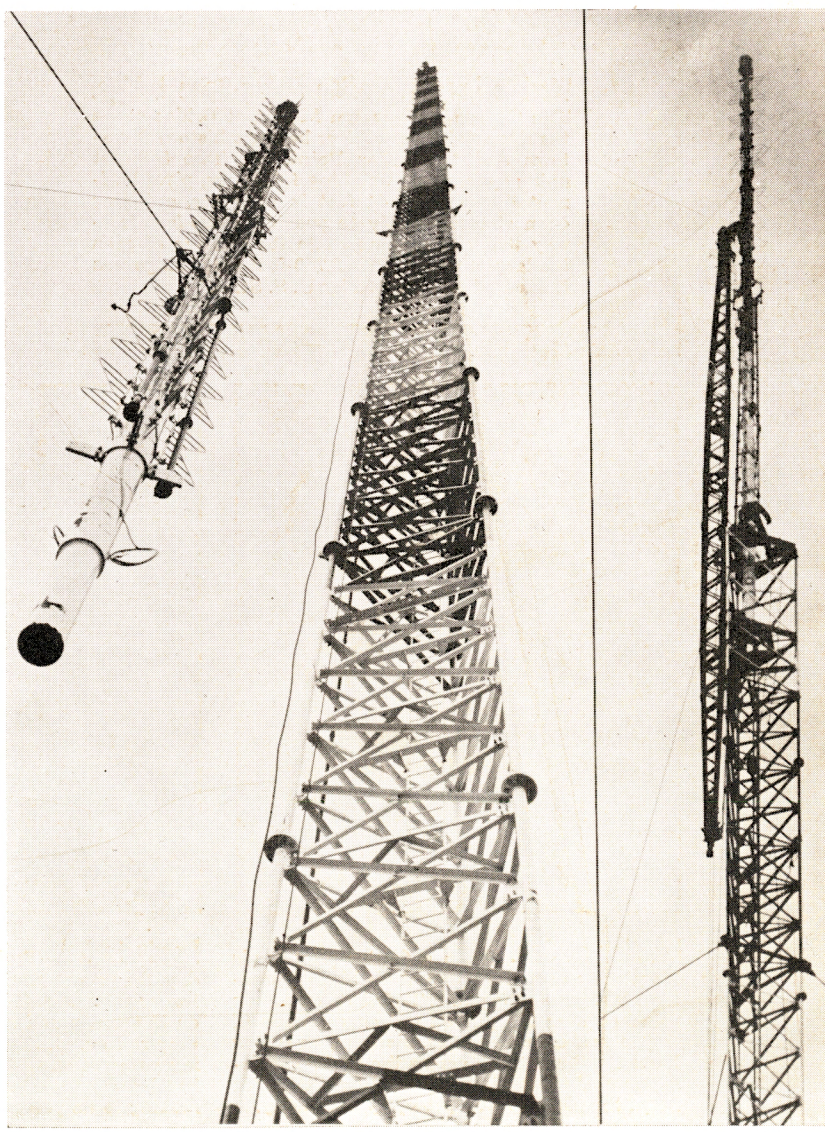

January 1954

25c

Features: THE NUCLEAR REACTOR
KOMU-TV

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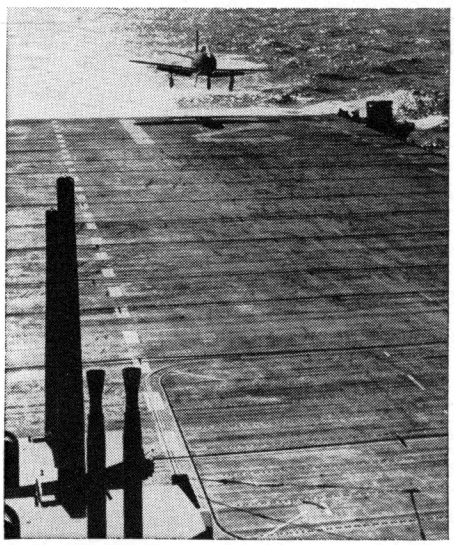
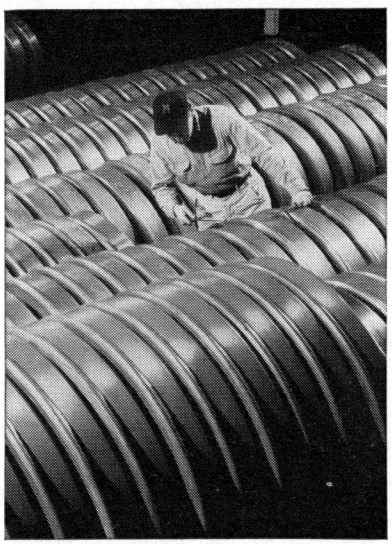


Landing at Sea. When a fighter pilot lands his plane on a flattop, one of his biggest problems is *stopping* the plane. To help him, a hook attached near the plane's tail engages one of the galvanized wire cables, mounted on spring brackets, that stretch across the deck. The resiliency of the cable, plus the bracket action, helps the plane to stop promptly and safely.



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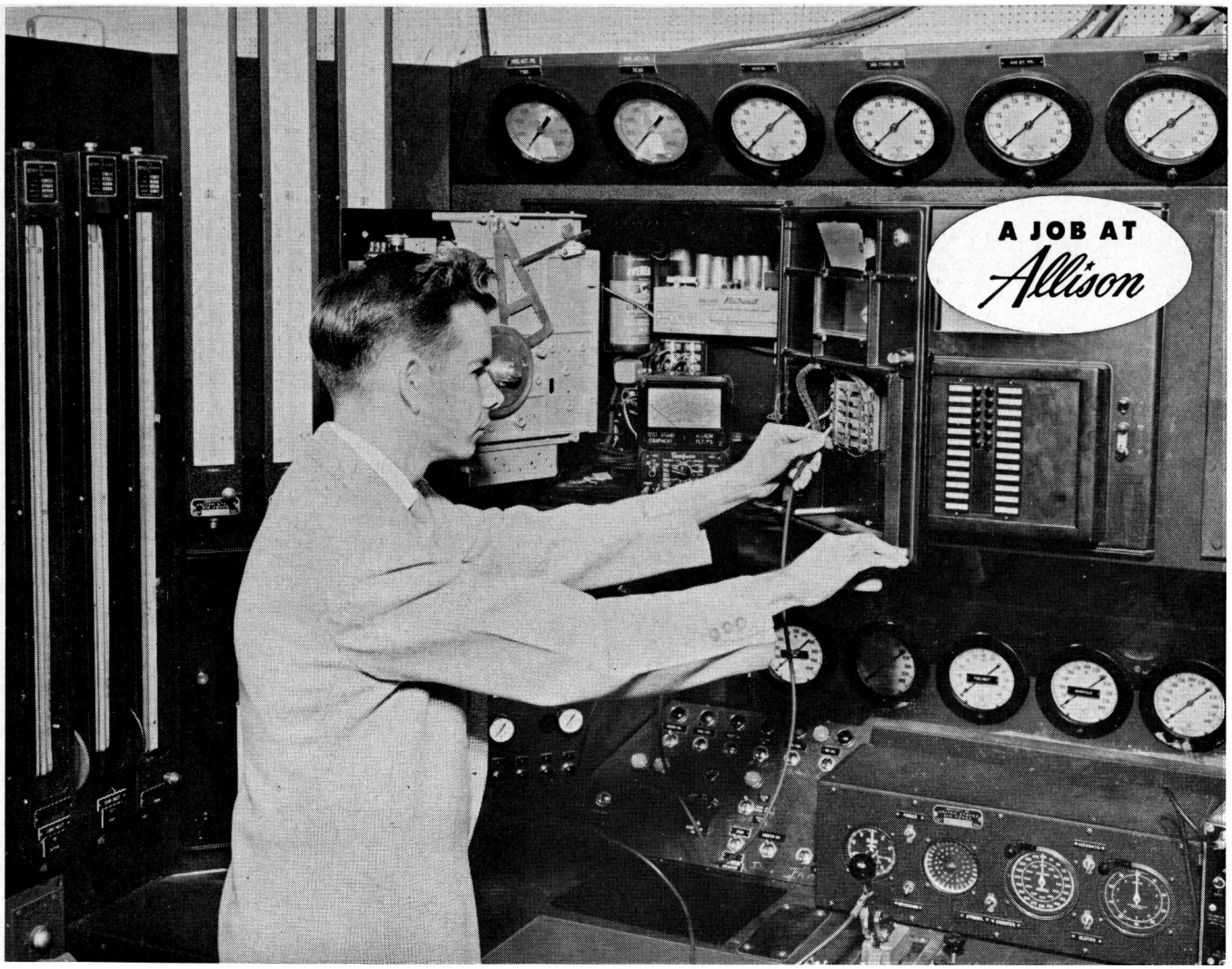

● Wallace L. Carr was graduated from the University of Illinois with a B.S. degree in Electrical Engineering in 1951. After a short time with a large electric utility—where he was Junior Engineer in substation design—he came to Allison where he is presently Electrical Engineer in the plant engineering department, Aircraft Engine Operations.

Wally's job in this department varies from designing plant, lighting, and power layouts, and machinery electrical diagrams to electrical and instrumentation layouts of turbo-jet and prop-jet test cells. With a multimeter, he is shown above checking the thermocouple circuits on the control panel in one of the Allison test cells.

In jet cells, it is necessary to simulate all engine controls that appear in a jet plane, plus other controls which are necessary to check and evaluate engine performance . . . operating temperature . . . acceleration . . . speed . . . fuel consumption . . . oil flow, etc.

Electronic control of important functions of jet engine operation has made the electrical portion of test cell operation a complex and fascinating problem for the Electrical Engineer.

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For further information about YOUR engineering career at ALLISON, discuss it with your Placement Counselor and arrange for an early interview with the ALLISON representative the next time he visits your campus. Or, write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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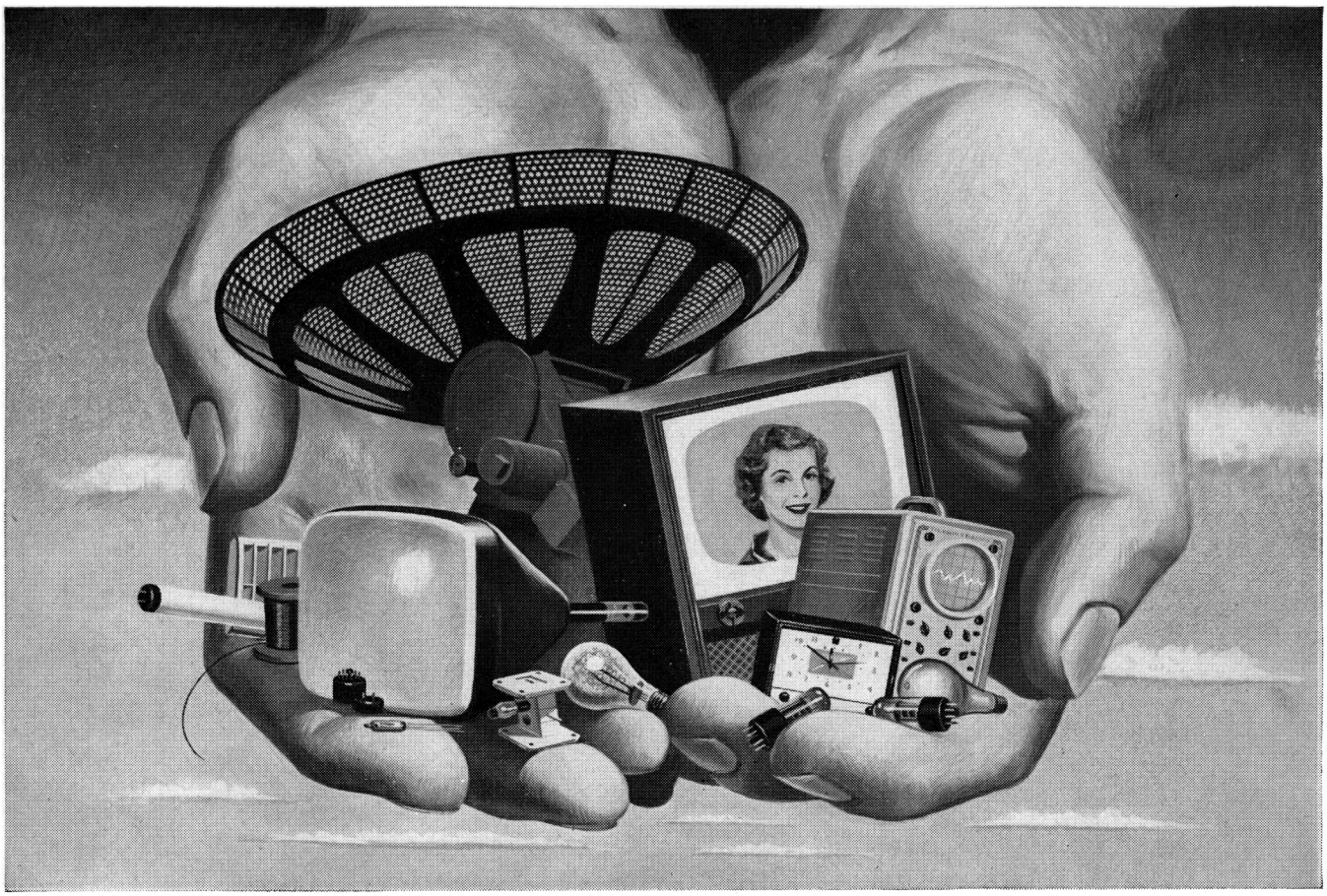

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Take Bill's word for it!

William Carpenter was originally a sales representative for Columbia-Southern, working out of the St. Louis district sales office, and is now Acting District Sales Manager. His job is an interesting one and a vital one in the fast-growing Columbia-Southern chemical business.

Bill studied engineering with the thought in mind of becoming a salesman. He has some sound reasoning to offer to the graduate. But let's start at the beginning of his story.

Bill entered Carnegie Tech, Pittsburgh, Pa., in 1942 but the war interrupted his college education for two years. He graduated as a chemical engineer in 1948.

He wanted to get into sales rather than production or engineering. He felt then, as he does now, that an engineering background is becoming an increasingly important one for the man who wants to move ahead in the field of selling. He believes that the vast amount of initiative and imagination in specialized sales work is based on a foundation of technical knowledge.

Bill looked around for quite a bit after graduation to find the right spot for his talents. He had many interviews but finally settled on Columbia-Southern. He was impressed with the caliber of people at Columbia-Southern . . . the type with whom he liked to work. He found Columbia-Southern a progressive, rapidly expanding company. He realized that the sound sales training program, supervised by the Technical Service Department, guaranteed complete understanding of his products. The program called for actual plant work in production, engineering, research and shipping—providing him with the thorough background which would be demanded by his customers.

Bill is glad he decided on Columbia-Southern. He now has full responsibility for all accounts as Acting District Sales Manager in the corporation's St. Louis office.

Bill has this to say to the graduate: "Look for a company that is growing. Look for a company that will give you the opportunity to do the work you are best suited to do. Look for the organization which offers real opportunity for advancement."

Columbia-Southern has opportunities for graduates in all business and technical fields including engineering, research & development, sales, plant design, mining, construction, maintenance, production, accounting, transportation and related fields.

You are invited to write now for further information to our Pittsburgh address or any of the plants.

William Carpenter of Columbia-Southern, *left*, is shown in a sales interview with W. F. Schierholz, Jr., Vice President and General Manager of St. Louis Solvents & Chemical Division, Fuel Oil Company of St. Louis.



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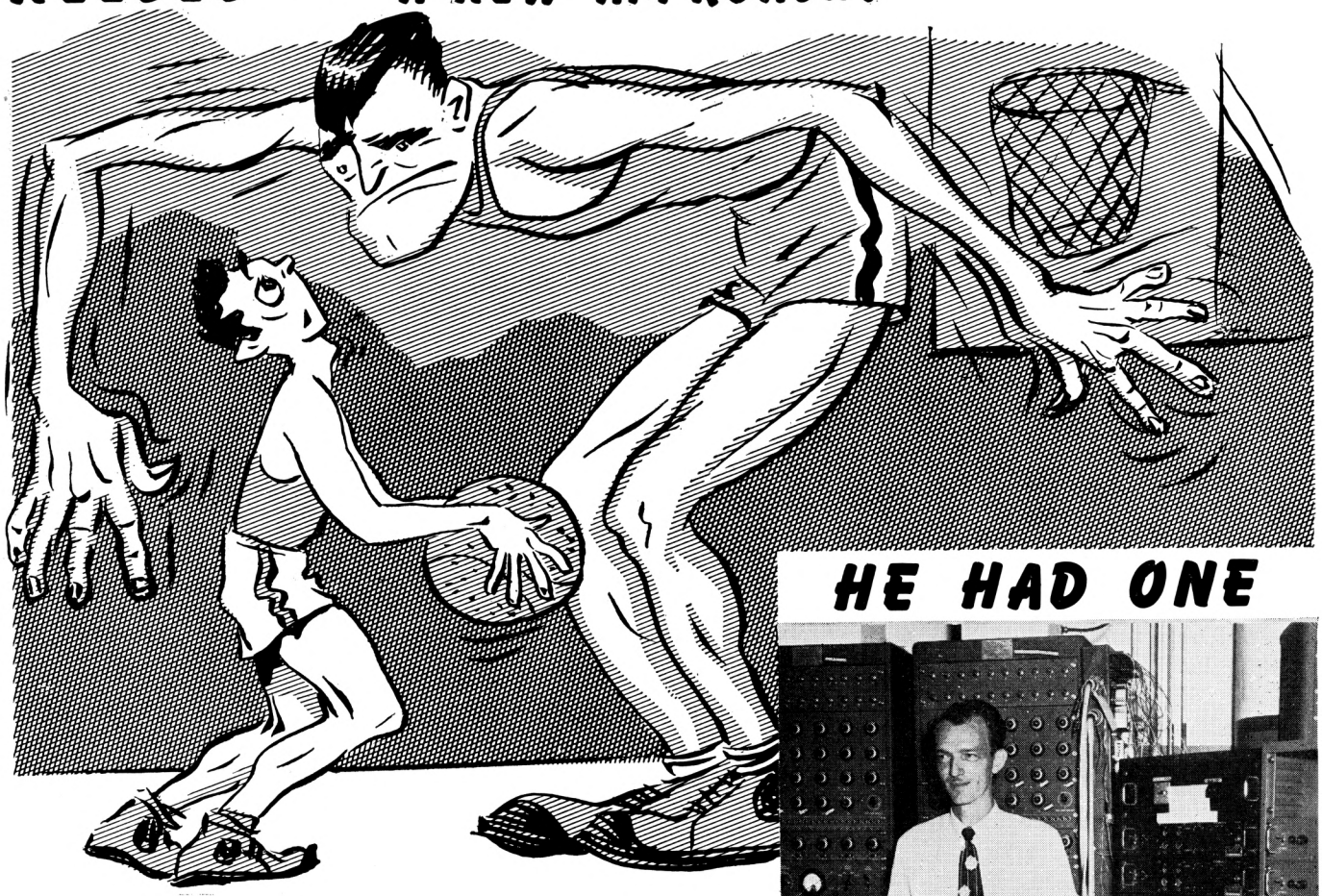
NEEDED--- A NEW APPROACH!



HE HAD ONE

Prime contractors to our Armed Forces—M. A. C. is engaged in the design, development and production of airplanes, helicopters and guided missiles. One of the newer products of McDonnell ingenuity, the F101 Voodoo, will soon join the arsenal of the U. S. Air Force.

McDonnell engineering planners are constantly alert to new materials, new equipment and new techniques. A Flight Test Hanger, Propulsion Laboratory, Altitude Test Chamber and Wind Tunnel are recent additions to our engineering facilities. We are also interested in new engineering talent—men who can contribute original thinking—*engineers with a new approach.*

If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when the McDonnell representative will visit your school. Ask him about the McDonnell Graduate Study Plan. You may also write to:

Technical Placement Supervisor
Box 516, St. Louis 3, Missouri

BOBBIE S. SHARRAH
Assistant Chief Dynamics Engineer — Missile Engineering Division
B.S.A.E. Iowa State College '45
M.S. Applied Mechanics Washington University '52

Pictured in front of our REAC installation, Bob Sharrah exemplifies the type of pioneering spirit essential in missile engineering. He developed a new and useful approach to the problems of stability of guided missile control systems as influenced by aeroelastic effects. At twenty-eight, Bob also points up the youthfulness of M.A.C.'s engineering management.

If your interests lie in the field of missile development, a challenging career awaits you at McDonnell. We need more young engineers like Bob Sharrah—*engineers with a new approach.*

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COVER

—Photo Courtesy KOMU-TV

We have a feature article on the new KOMU-TV, and we deduced that a cover shot of the tower under construction would be one of our best. The workers are raising and setting the TV mast at a height of greater than 700 feet.

MISSOURI SHAMROCK

VOL. XV 20 NO. 4

JANUARY, 1954

♣

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A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from J. M. Wallace, Manager, Meter Div.,
Westinghouse Electric Corporation
University of Pittsburgh, 1935



To the man who wants more than a job

You and I know that getting a job is not a problem these days. Industry needs thousands of young engineers.

But the man who wants more than a job might well pause and consider just how he is going to find his special opportunity. It cannot be found everywhere.

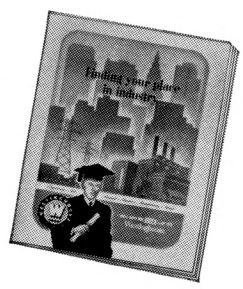
The man I'm talking about wants interesting work with a future, yes—but also something more. He is determined to help make the world a better place in which to live—and wants a job that will enable him to do this. He is co-operative in his work, but demands the dignity of being treated as an individual. This man had high purpose when he elected a career as an engineer.

I know this man. He's many men at Westinghouse. He's an engineer's engineer.

You, who want more than a job, are this man, too. You will be among your own at Westinghouse. G-10273

YOU CAN BE SURE...IF IT'S
Westinghouse

For information on career opportunities with Westinghouse, consult Placement Officer of your University, or send for our 44-page book, *Finding Your Place in Industry.*
Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 N. Seventh Street, St. Louis 1, Missouri.





THE PERCENTAGE of hydrogen in liquid hydrocarbons can be determined by making two simultaneous measurements on the sample to give (1) density and (2) the absorption rate for beta rays. The weight percentage of hydrogen in the sample is computed from these measurements and a calibration curve. The new instrument shown here, a Standard Oil development, measures the beta ray absorption rate.

BETA RAY

used to speed hydrogen measurement

The problem: How to measure the percentage of hydrogen in organic compounds in a short time.

The established process was combustion. It took about four hours, and so discouraged the use of hydrogen determinations. But such analyses are increasingly important. Processes in the petroleum and chemical industries often involve hydrogenation or dehydrogenation. In addition, the percentage of hydrogen is an index to the performance of critical fuels such as those used in jet planes.

A rapid method for measuring hydrogen content would therefore be a great help in both research work and plant control. Standard Oil's Engineering Research Department, specialists in solving technical problems, took on this challenging assignment.

A new machine—a beta ray hydrogen analyzer—was invented and constructed. It gives results in five minutes, and is twice as accurate as the old combustion method. It is so easy to operate that a laboratory technician can use it.

Problems such as this are met continually in Standard Oil laboratories. They offer an opportunity for young men with training in chemistry and engineering to test their knowledge, skill and ingenuity.

Standard Oil Company

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The promotion of increased sales by helping the consumer make the best use of the energy he buys, and by showing him how to let electricity do more of his jobs.



- **Research**

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- **Business Management**

The coordination of problems related to Company finance, materials, property and personnel for the efficient operation of the electric business.

These are the five principal channels through which graduates may advance at The Detroit Edison Company. Under these broad headings are hundreds of different positions—all working together for the best interests of customer, employe, and investor.

When a graduate joins The Detroit Edison Company, he is assured every opportunity to fit into the job he likes best—and, once there, he knows he will be encouraged to advance as rapidly as his ability and energy will carry him.

Detroit Edison is a fast-growing electric utility company. It is foresighted, too. For example, Detroit Edison engineers are working with Dow Chemical Company as one of the nation's industrial atomic research teams investigating the use of nuclear heat in thermal electric generating plants, to produce electric power even more efficiently.

There's a future for graduates at The Detroit Edison Company—a career opportunity best described by the fact that many of the executives in the organization at this time began their climb to success in positions similar to those offered graduates today.

The DETROIT EDISON Company

2000 SECOND AVENUE
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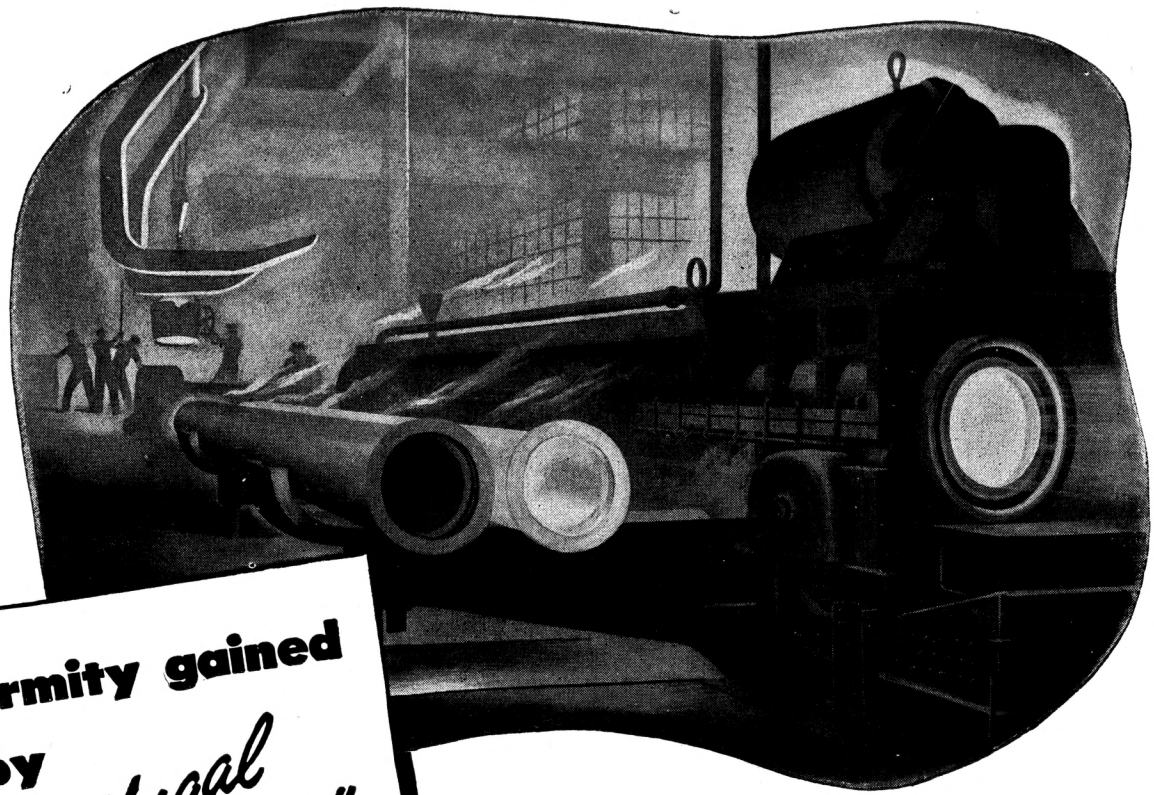


Uniformity gained by "Centrifugal Casting"

The great majority of cast iron pressure pipe produced today is cast centrifugally, in metal or sand-lined molds.

When this mechanized process was introduced 27 years ago, its potentialities for improved production controls were evident. For human fallibility was largely replaced by machine accuracy based on scientific principles.

The improved production controls made possible by the centrifugal casting process have long since been realized. Hundreds of millions of feet of centrifugally-cast-iron pressure pipe are now in service. All of this pipe is more uniform in metal structure, in wall thickness, and in concentricity, than pipe not centrifugally cast.

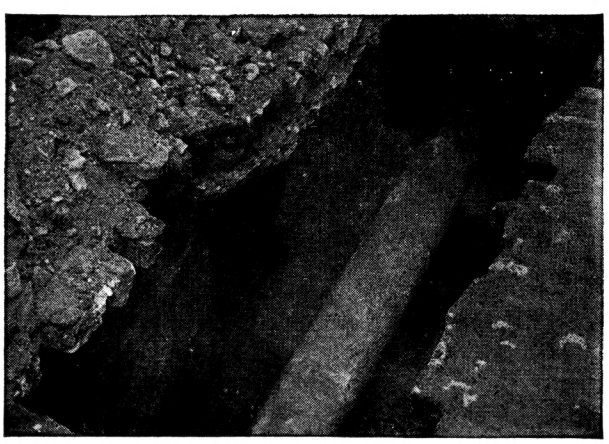
Better production control means better pipe; it results in greater uniformity of quality.

Production controls in cast iron pipe foundries start almost literally from the ground up with inspection, analysis and testing of raw materials; continue with constant control of cupola operation by metal analysis; and end with rigid tests of the finished product.

By metallurgical controls and tests of materials, our members are able to produce cast iron pipe with exact knowledge of the physical characteristics of the iron before it is poured into the mold of a centrifugal casting machine.

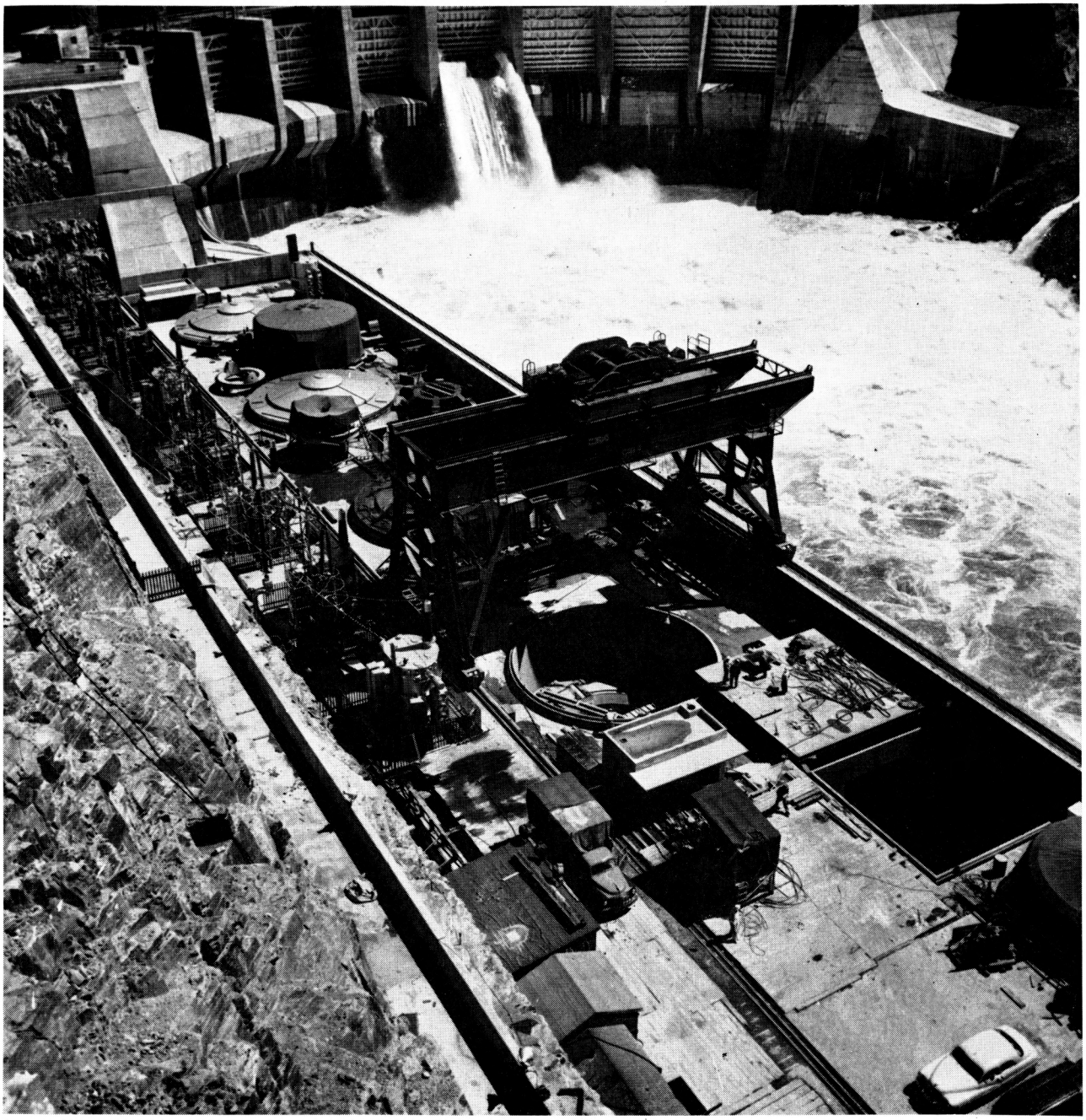
Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction.

Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Avenue, Chicago, 3, Illinois.



Section of 114-year-old cast iron gas main still in service in Baltimore, Md.

CAST IRON PIPE SERVES FOR CENTURIES



—Cut Courtesy Westinghouse

The Cabinet Gorge hydroelectric development on the Clark Fork River in northern Idaho was completed last year by the Washington Water Power Company. The first of four Westinghouse 50,000-kw generating units was on the line just 21 months after start of construction. Despite unusually severe conditions of weather, terrain, and the wild nature of the river, the task of diverting the river and pouring concrete for the 208-foot high, 600-foot long dam was accomplished in a single season between river flood stages.

Your Editor . . .

February is coming soon, when we will find ourselves again electing a new SHAMROCK Editor. Perhaps it is best not to designate the man I would choose for the job, but rather I will note what seems to be the necessary abilities of an Editor of our magazine. Remember first, that the Editor of SHAMROCK receives very little monetary payment for his struggles. Yet, he finds it necessary to spend more time than he can afford while gathering material each month. Perhaps he does realize a certain amount of satisfaction knowing he is performing a service for you and the College of Engineering. Otherwise, he is compensated by gaining a certain amount of prestige, which might help him in obtaining a job after finishing school. By the nature of the advantages and disadvantages of the Editorship, you can guess the qualities the Editor must have. He must know how to write and edit. He must have the ability to work with people. He must have a sense of value and time. He must have an imagination, yet be a cool-headed businessman. And he must have a persistent nature.

Consider well these things when choosing the next Editor of the SHAMROCK. And remember, the Editor always needs and appreciates your whole-hearted support, your articles, and your ideas.

DBA

THE NUCLEAR REACTOR

AS A SOURCE OF ELECTRICAL ENERGY

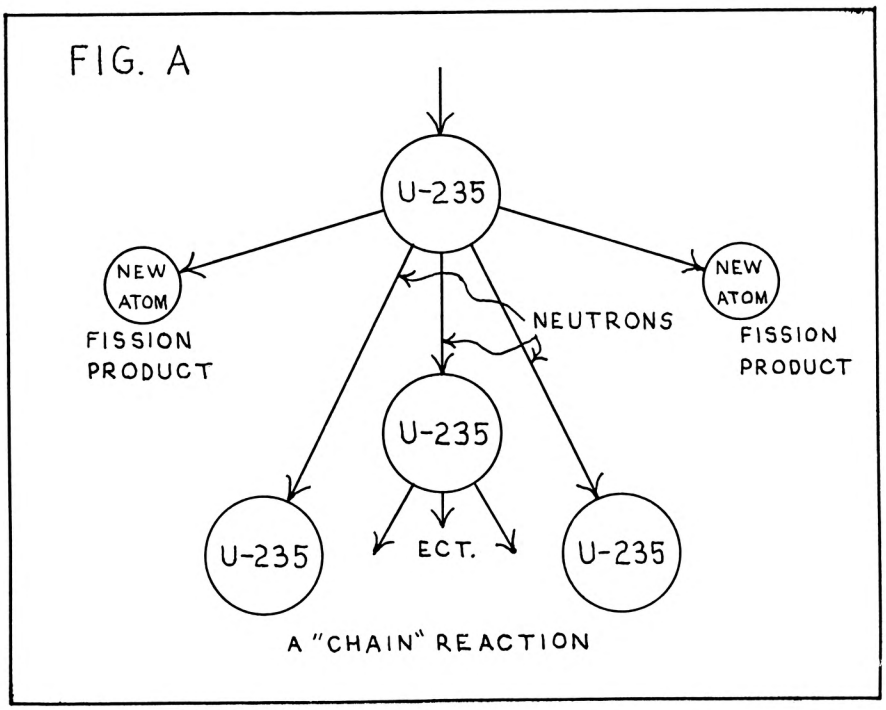
By James Fithian, E.E. '54

INTRODUCTION

There has been much discussion lately about the possibility of obtaining electrical power for civilian commercial use from nuclear reactors. The opponents of this use of nuclear reactors have three major arguments. First, the development would have to be made security tight. Second, the cost of such a program would be enormous. Third, it would be some time before nuclear power could compete with conventional power. Those favoring the development program agree that the cost will be high, but point out that the energy stored in undeveloped uranium far exceeds that of undeveloped coal and petroleum together. Since society will have to use atomic energy some day, it may as well begin now. However, keeping ahead in the field of nuclear development is probably the most important reason for nuclear power development since the undeveloped coal supply will last for many years.

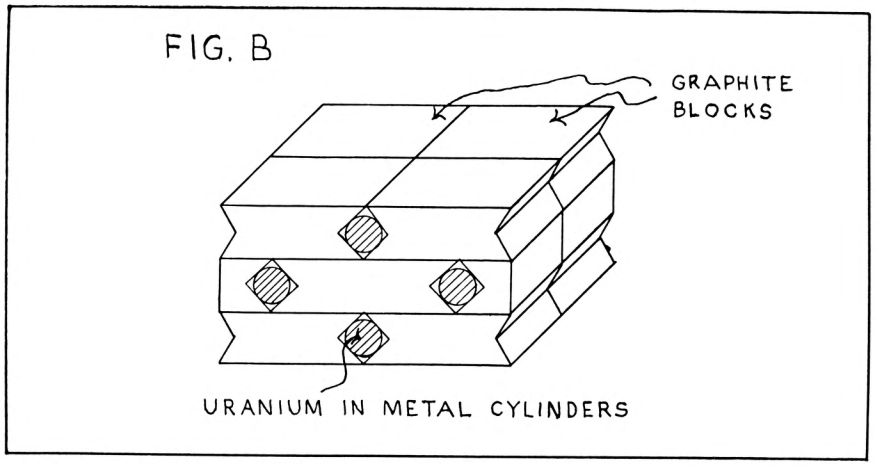
Leadership in the field of nuclear power can only be kept by constantly forging ahead on the development. The nuclear reactor is the heart of a nuclear power plant. Much research will have to be made before the nuclear reactor can take its place along with steam plants and power dams as a source of electrical power.

FIG. A



HOW DOES A NUCLEAR REACTOR WORK?

The nuclear reactor is nothing more than a "slowed down" atomic bomb. The action of the reactor is to an atomic explosion as the burning of black powder is to a powder explosion. Unlike the powder explosion, which occurs throughout the material instantaneously, the atomic blast goes from one atom to another. The blast can be compared to the burning of a piece of wood. One part burns and heats parts adjacent to the burning part and then the adjacent parts begin to burn. This combustion of adjacent parts of a burning piece of wood is a simple example of a "chain" reaction. The much talked about "chain" reaction is the basis of both the reactor and the bomb. If a neutron is sent into a uranium 235 atom, the atom will undergo fission (splitting). The uranium 235 atom will split into two or more atoms of atomic mass less than that of the uranium atom. Along with the new elements made by the fission, two or three neu-



trons are given off, which can go to other uranium 235 atoms and cause fission in them. The process is known as an atomic "chain" reaction. If the atomic masses of the neutrons given off are added to the atomic mass of the fission products (new atoms), the total mass will be slightly less than the original mass of the uranium 235 atom. The difference between the original mass and the final mass is the mass lost in the fission process and appears as energy. This amount of energy can be calculated by the Einstein equation, $E = Mc^2$, in which E is the energy, M is the mass lost in the fission, and c is the speed of light. A diagram of the "chain" reaction is given in figure A.

"Slow" neutrons (neutrons of relatively low energy), which have been employed in nearly all reactors tested thus far, can cause fission in uranium 235 but not in uranium 238. Uranium 238 is by far the most abundant in nature, and since "slow" neutrons are being used, the uranium 238 is not fissionable. Nature's uranium, after removal from its ore, consists of about 99.3% uranium 238 and about .7% uranium 235. Consequently, a refinement of the uranium must be made before the uranium can be used in the reactor. In actual practice the uranium is refined until about 35% of it is uranium 235. Although uranium 238 is not fissionable by "slow" neutrons, it can absorb one neutron and become a new element, Plutonium. Plutonium is a highly fissionable element not found in nature. It can be used to make atomic bombs.

The neutrons which come from the fission process are of the "fast" type and must be slowed by a moderator, which is a material that does not absorb neutrons. The slowing down occurs because of collisions between the neutron and the atoms of the moderator. The process can be compared with the collisions of billiard balls. Among the better moderators are graphite and "heavy" water.

Any material in the reactor which has a high affinity (absorbing power) for neutrons will slow the reaction. If enough of the material is present in the reactor, the reaction will cease. Cadmium has a very high affinity for neutrons and is used to control the reactors.

A person seeing a nuclear reactor for the first time would probably be disappointed. A nuclear reactor is nothing more than a large, concrete cube with several pipes projecting from it. The concrete is about six feet thick and each side of the reactor is about twenty five feet long. On the inside of the reactor is a lattice-like structure of uranium and graphite. The metal cylinders of uranium are about one inch in diameter and three inches in length. The graphite blocks are about the size of standard building blocks. One possible arrangement is shown in figure B. Cadmium bars which control the reaction by controlling the amount of neutrons, project from the sides of the cube. To slow the reaction the rods are slid into the center of the reactor where they can absorb many neutrons.

Many problems confront the builders of the first nuclear reactors which will produce electrical power. The problem of shielding the reactor is not a difficult one since a concrete wall acts as a very solid shield. The main problem is the extraction of the heat from the center of the reactor. A liquid must somehow be passed through the reactor to extract its heat. This liquid which carries the heat from the reactor is known as a coolant. Passing through the reactor, this coolant becomes radioactive and thus must be shielded. The pipes which carry the coolant are exposed to the tremendous radioactivity. The pipes must be able to withstand not only the intense heat but also the intense radioactivity which causes the physical properties of materials to undergo serious change. There are

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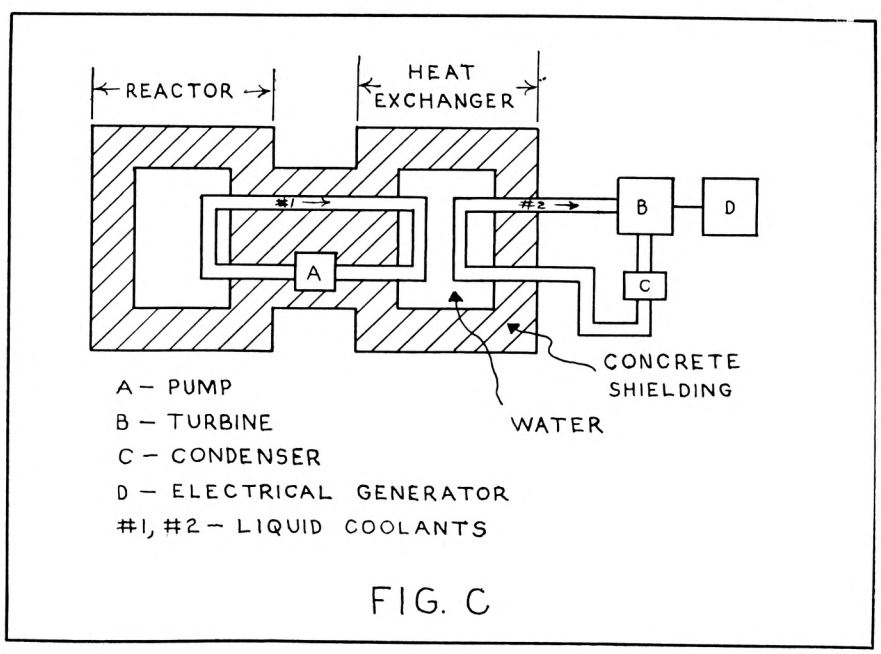


FIG. C

KOMU-TV

THE MOST MODERN TELEVISION STATION IS OPERATED BY THE UNIVERSITY OF MISSOURI

By John Renken, E.E. '55

—Photos Courtesy KOMU-TV

About six miles outside of Columbia on Highway 63 South is located KOMU-TV, the television station of the University of Missouri. The facilities of this station will be used to train students in a variety of fields associated with the television industry, and also to provide good TV reception for the homes of central Missouri.

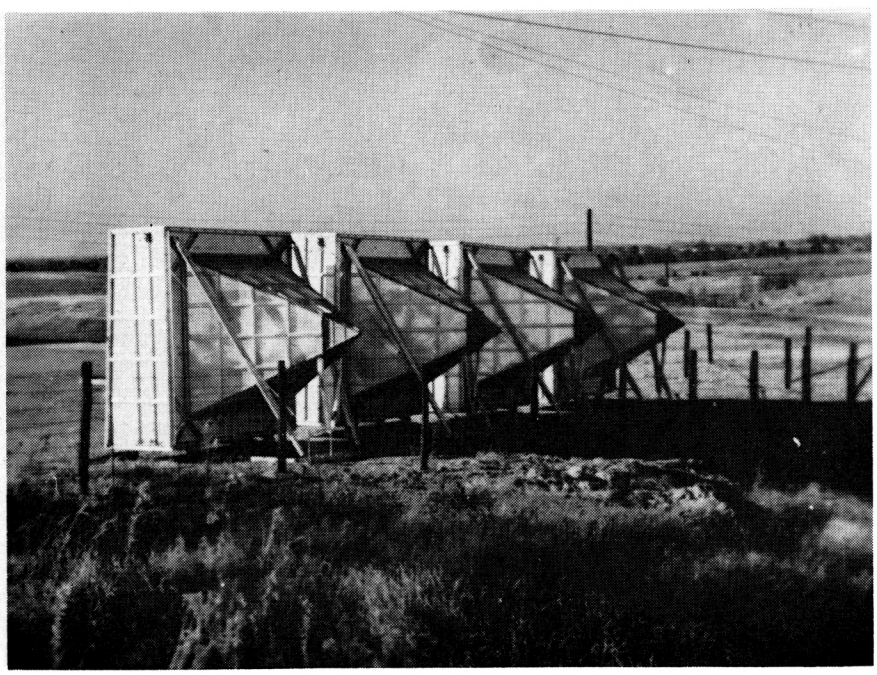
BUILDING CONSTRUCTION

The building is very functional in design and appearance. It is constructed of Haydite block painted white and contains staff offices, control room, studio, announcers' booths, viewing room, darkroom, workshop, broadcasting equipment rooms, scene shop, and two kitchens, which will be used as props for TV shows. The building is air-conditioned by three units: a thirty ton unit which air-conditions the office, a twenty-five ton unit which air-conditions the studio, and a fifteen ton unit which air-conditions the operating rooms. Next to the studio is a large room from which the whole studio can be seen through a glass wall. It will be opened at certain times to the public, and it will also be used as a classroom.

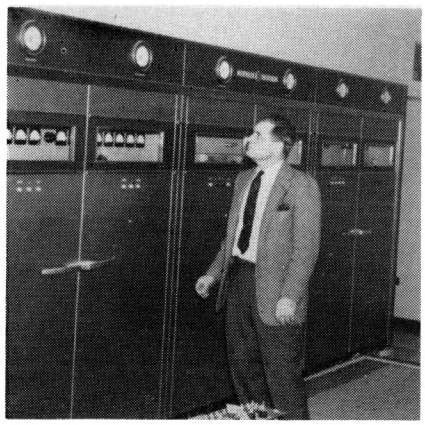
STUDIO

The studio, which is located in the center portion of the building, has a suspended ceiling twenty-two feet from the floor which is constructed of two feet by four feet blocks of spun glass supported by aluminum brackets. The studio is completely sound proofed, including the doors. Lighting is by a heavy duty, electrified, overhead trolley system. The lights hang from these rails and are movable to any place in the studio.

This system is rather new, and only a few stations in the country use it. All around the studio are fifty ampere power outlets and connections for microphones set in the walls. The wall between the control room and studio is one solid sheet of tinted glass. This glass keeps the light dim in the control room, and still makes



These microwave reflectors, 10 feet square, collect signals from four networks for channeling into KOMU-TV.



The transmitter board.

it possible to see from control room to studio.

CONTROL ROOM EQUIPMENT

It is necessary to have the lights dim in the control room because of the eight twenty-one inch jeep receivers. These jeep receivers do not function as normal TV receivers. The electrical signal is cabled to the jeep receiver, and only its amplifier and video tube are used. Each receiver can carry a different image. For example, one might be hooked to the studio camera, one to a remote camera, and the rest to the various projectors. The program director can glance at these receivers and see how the image will look on the TV receiver before it is put on the air. Few television stations are this well equipped with jeep receivers.

The control room is equipped with all the devices which manufacture the special effects used on TV: wipes, montages, insertions, laps, dissolves, and fades. This equipment is comparable to that of the largest stations in the country.

KOMU-TV is equipped with one studio-type camera mounted on a pedestal-type dolly, and two remote cameras supported by a tripod and dolly, which may be used for basketball, football, and news events. All three cameras are made by General Electric.

The studio is also equipped with two sixteen millimeter Eastman Synchro-Light projectors. These projectors have been especially adapted for television use by changing their speed from the normal twenty-four frames per second used in movie houses to the thirty frames per second used in television. This speed is used throughout the country since it is exactly one half of the 60 cycle power line frequency. This scanning speed of 30 frames per second keeps the 60 cycle leakage in the power supplies of studio equipment and home receivers from causing trouble.

The movie projectors are used when anything filmed on motion picture film is shown on television. The slide projectors are used when transparencies are to be shown. For instance, the call letters of the station can be put on a transparency and projected into the film camera and from there to the transmitter during station breaks. The opaque projector is used when it is wished to project any opaque object, for example, a watch into the film camera.

NETWORK FACILITIES

KOMU-TV will have available the facilities of four networks: ABC, NBC, Dumont, and CBS. The network programs come by micro-wave relay towers from Kansas City. Present plans are to broadcast from 4:15 to 10:30 p.m. and to run a test pattern sometime during the day.

POWER SUPPLY

Power for the station comes from the lines of the Boone County REA. At the station, a wye bank of 3-75 KVA transformers steps down the voltage for the building lights, studio lights, and air-conditioning equipment. A delta bank of 3-25 KVA transformers supplies the 220 volt three phase for the studio equipment.

TRANSMITTER

The transmitter is a General Electric Type TT-16-E Oral and Visual Transmitter with a peak visual power of five kilowatts, and an average power input of two and seven tenths kilowatts to the final of the oral section.

The final amplifier tubes in both sections are push-pull Eimac 3-2500's with 4500 volts on the plates. The transmitter uses two types of air cooling: anode cooling, in which the air cools the plates of final tubes, and cubical cooling, in which the air cools the cubes of the transmitter. Cooling ducts were set in the concrete floor as it was being poured. They emerge underneath the transmitter. This is a rather new idea, and is not found in any but the most modern stations. The transmitter operates on channel eight, 180 to 186 megacycles. The visual frequency is 181.25 megacycles. Coverage will extend over a sixty mile radius.

There is space for a fifty kilowatt amplifier which would use the pres-

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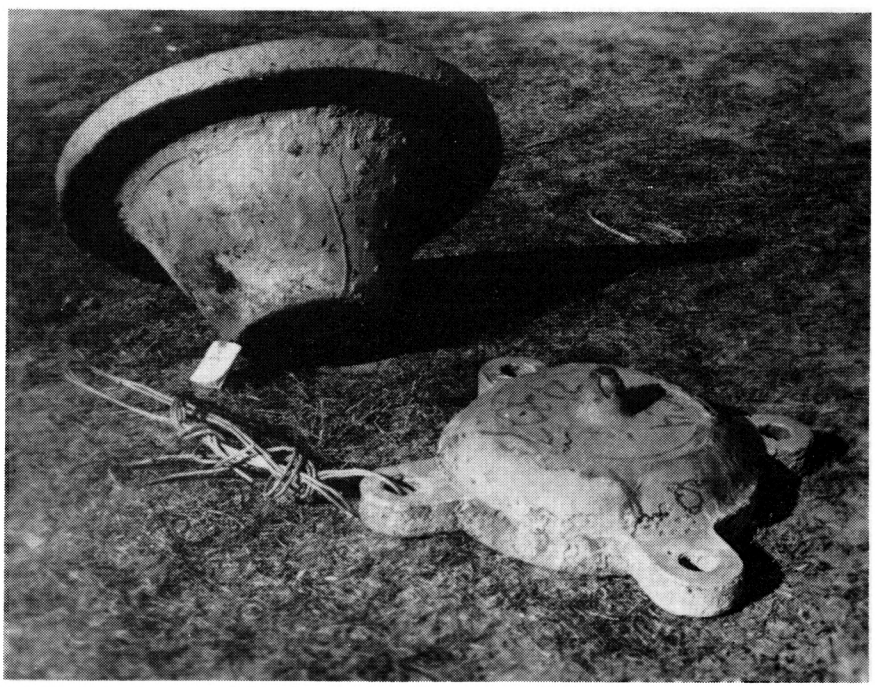
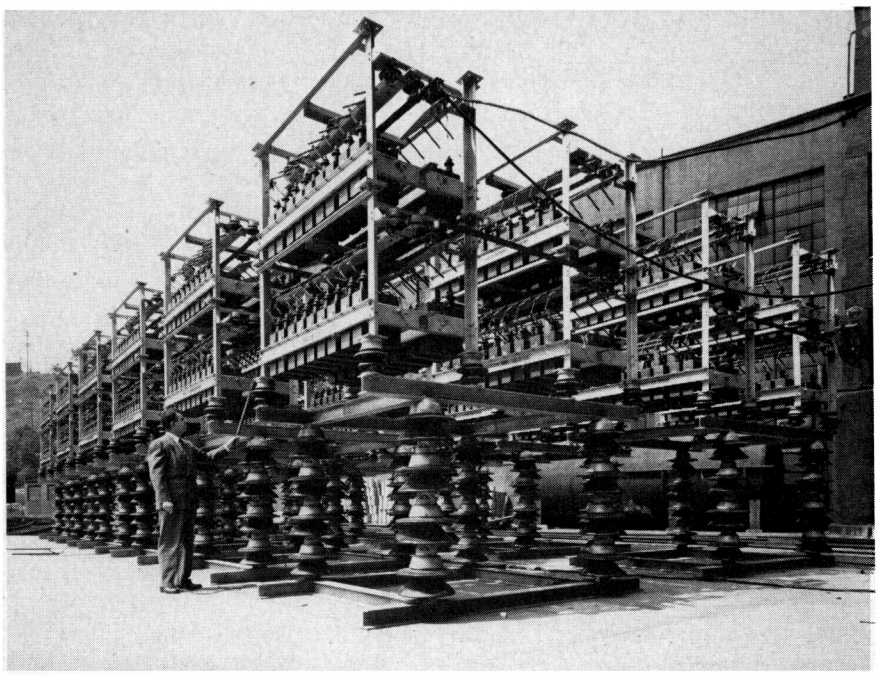


Above is a picture of the pedestal for the 386,000 pound tower. Note the pack of cigarettes for size comparison.



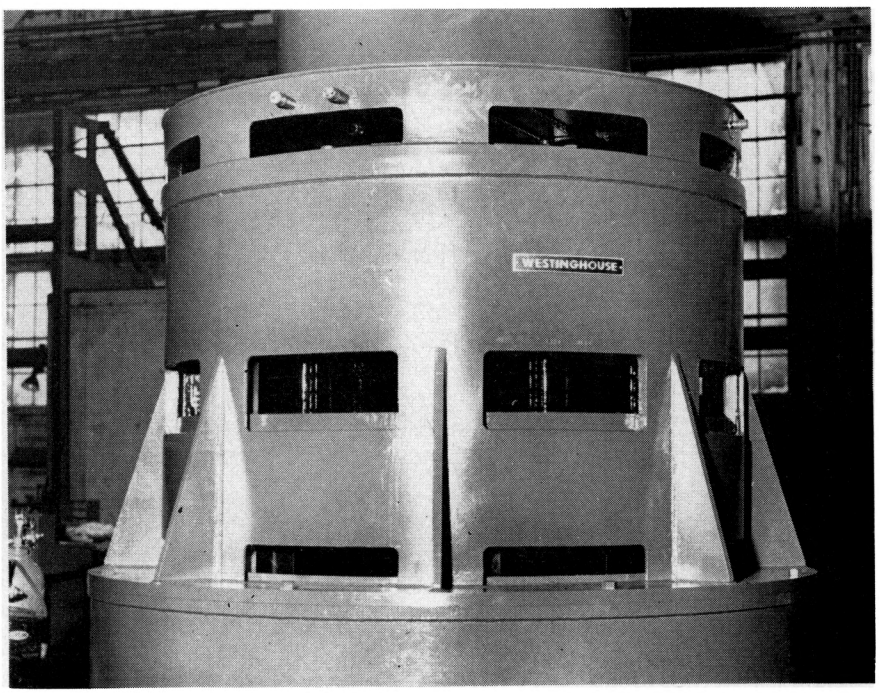
This 21,600-kva, 60-cycle bank of capacitors at the Westinghouse Electric Corporation's high-power laboratory at East Pittsburgh can be operated at 1.7 times normal voltage to give it 65,000 kvar, the largest amount of reactive kva for test purposes at any industrial laboratory. This can be used to simulate the capacitance of long transmission lines or cables for circuit-breaker evaluation or for tests on switching of shunt or series capacitor banks. The bank is insulated for operation at voltages as high as 198 kv, line-to-ground (345 kv line-to-line).

KW

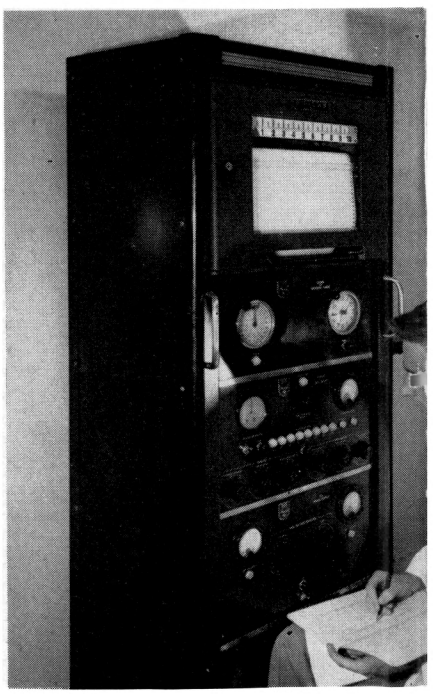
PI

SINGLE SHO

OF ENGINEER



To power pumps which must continue to run even through momentary interruption of power, Westinghouse Electric Corporation produced 12 specially-designed, vertical squirrel-cage induction motors such as the one shown here. Each motor is rated 900 hp, at 585 rpm, and has a built-in seven-foot diameter flywheel. The flywheel has an energy storage of 4,260,000 pounds feet, which will maintain the pump above half speed for a 15-second power interruption.



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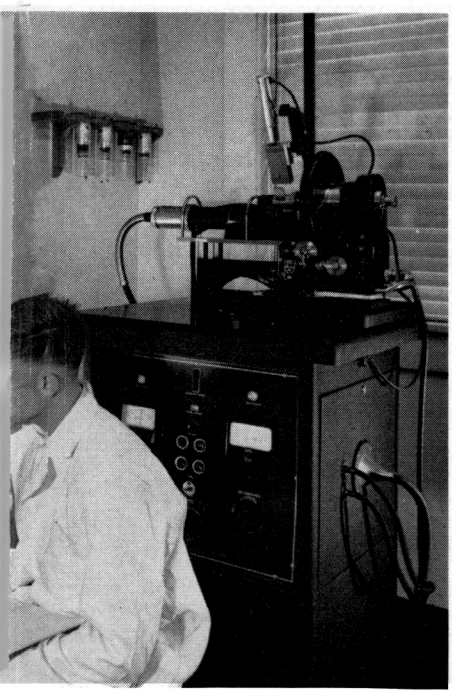
—Cuts Courtesy Westinghouse



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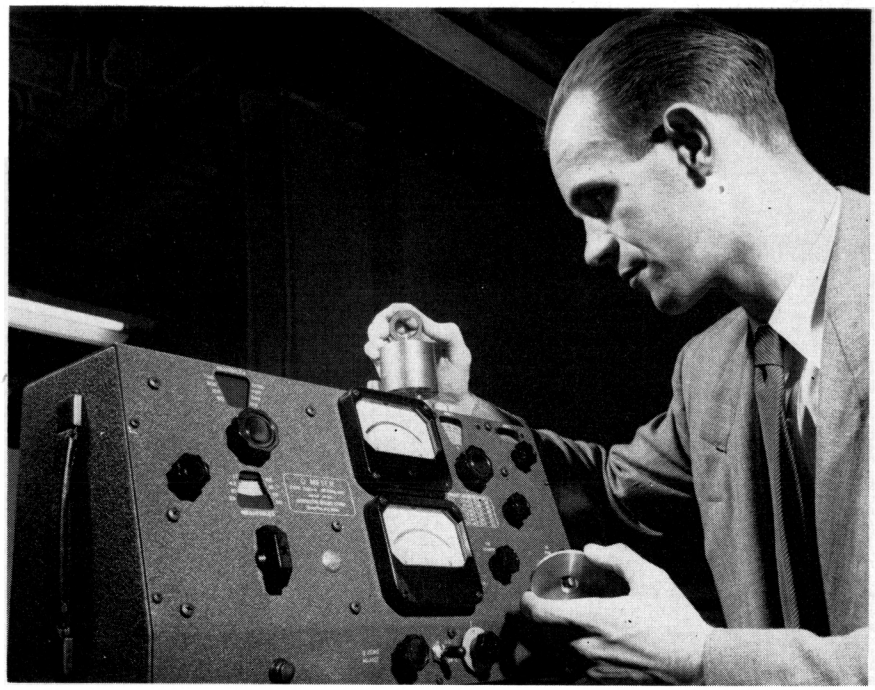
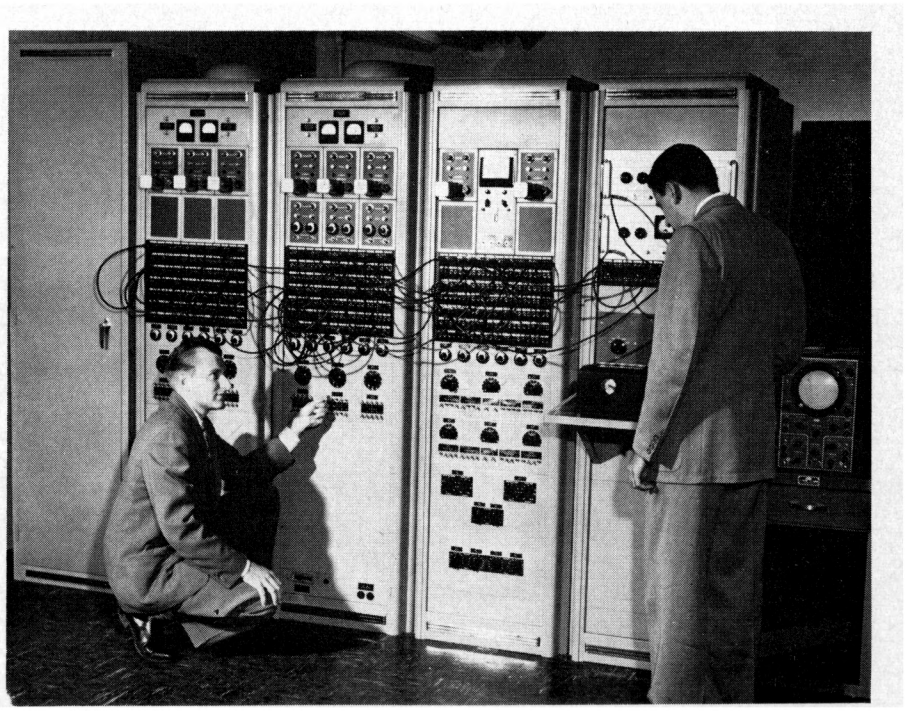
y. Read Newstuff for Complete details.

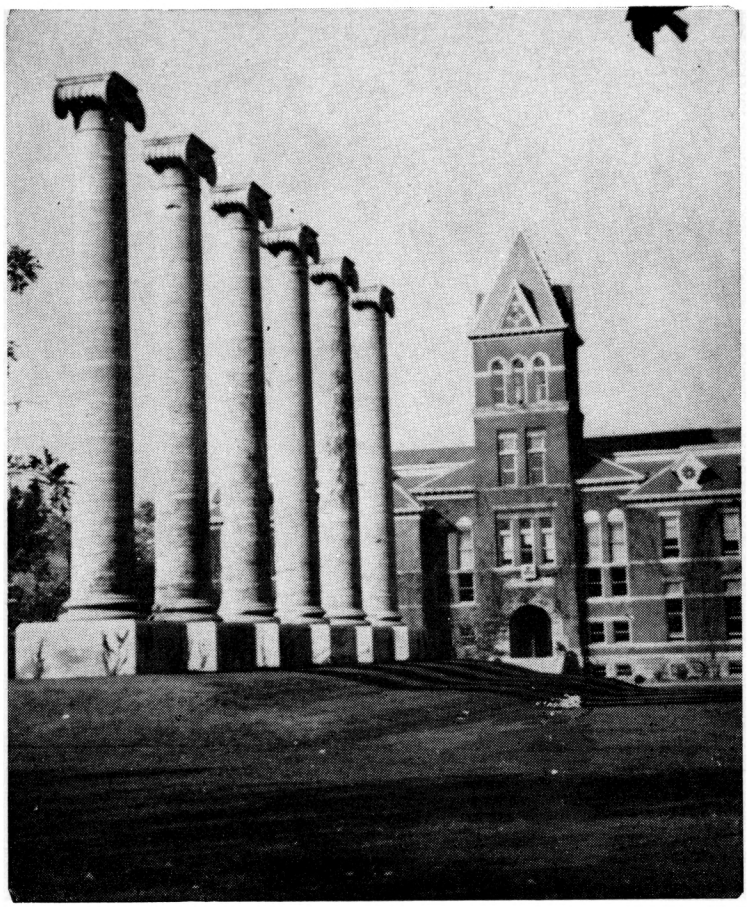


Measurement of hysteresis loops at high frequencies has been another extremely difficult task. A laboratory device now displays these loops on an oscilloscope where they can be photographed or measured. It is good for frequencies up to one megacycle.



The multi-drive systems for many process lines—steel, aluminum, paper-have become too complex for complete analysis by conventional methods. This new analog-type computer at the Westinghouse Motor and Control Division in Buffalo is constantly busy solving problems of tension regulators, tandem-mill controls, and pickle-line drives to mention but a few. The computer solves the problem ten times faster and, even more important, makes possible consideration of all possible variables. Thus there is assurance that the optimum combination is chosen and that no unsuspected mismatch of operating characteristics results in the final design of the controls.

MIZZOU MEMOS



By Don Brooker

C. E. HENSON, JR., A.E. '53, sends word that he is a proud pop as of October 28. She is called Vickie Lynn. C. E. is with the David Bradley Manufacturing Co. in Kankakee, Illinois. Everything is fine up there but the fishing, he says.

KENNETH JR. HOLLOWAY, M. E. '40 who is with the Civil Aeronautics Authority in Kansas has taken in every Tiger home game. He was impressed with the new additions to the M.E. Laboratory.

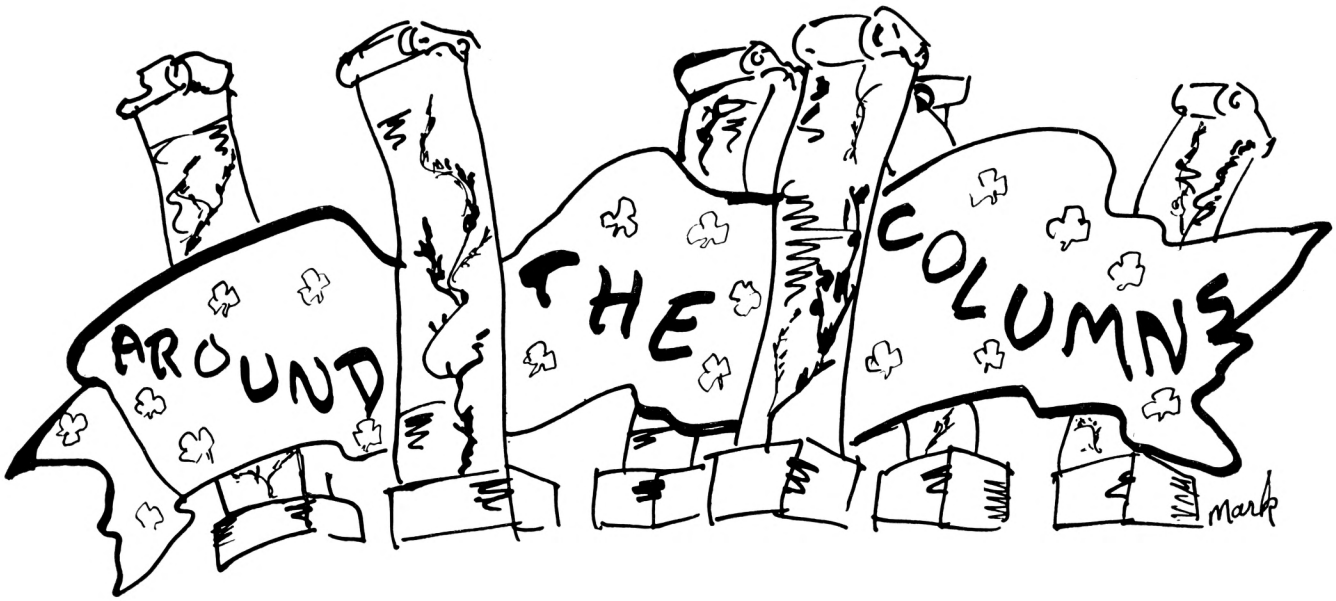
KEN REICHERT, E.E. '52, also of Sperry Gyroscope, is rapidly learning all the new arts associated with microwave, high vacuum systems, electron dynamics, klystrons, and baby toys. Ken never gives the old dodge about running into a door—he claims his baby bops him with playthings.

J. E. SHEPARD, M.S. in E.E. '33 spoke at a recent engineering seminar on *Recent Technical Development in High Power Microwave Amplifiers.* He is Director, Electronic Tube Engineering, Sperry Gyroscope Company, Great Neck, L. I., New York. The Shepard family includes Jeanine, 13, and Shirley, 15, who are reported to be interested in science.

ROBERT H. SMITH, E.E. '49, has been transferred from the New York Engineering Division of the American Machine and Foundry Company to the Washington, D. C. office of the Contract Division of the same company. His new address is 7204 Fourteenth Avenue, Takoma Park, Maryland.

VEJDI DIKER, C.E. '36, in far off Turkey, who has been Director General of Public Roads Construction in the Ministry of Public Works, is now in the engineering business. This bit of information is taken from a new list of distinguished alumni of Robert College of Istanbul, Turkey.

THOMAS H. MAGEE, E.E. '51, writes from Wright-Patterson AFB, Ohio that he is lending engineering support to the contracting officer. He is having an opportunity to see the importance of small details in aircraft design.



with Slipstick Sam, '99

Gee, isn't it great to be back in school again after being forced to lounge around the Xmas Holidays. It sure feels good to be studying again instead of having hell of a good time at home.

Speaking of Good Times, Old Sam has seen some of the fellows walking around as if they are still hung over. I don't know about you, but my head feels just about as small as the stadium football field.

♣

As we all try to be just a little bit better each year, here is a list of those ever-present New Year's Resolutions:

1) That the guys in C.E. 82, Engineering Materials promise not to lock Mr. Crabtree out of his classroom any more.

2) We promise not to put glue in the M.E. 1 pencil sharpeners from now on.

3) We promise not to set any big rocks in front of Mr. Utz's big toes if he will trade in his golf hat for a beret.

4) We promise to make it a ritual to celebrate TGIF, also TGIS, TGIM, TGIT, TGIW, TGIT, and drink a toast to Mizzou every now and then.

5) We solemnly promise not to throw eggs or damage another University building this Spring at the Hamburg Show.

6) When we have our study sessions at the Den, we promise not to drink draught beer. From now on it will be pitchers as we should conserve the energy we use to make the many trips, for the quiz.

♣

For you who remember Ken Walton, he was finally snagged by his gal, Barbara Miller. They were engaged this fall, and will be married sometime in March. He is an E.E. and will graduate in June '55.



♣

It looks as if the editor of this mag has made big time. Dave Aldag was elected to the Who's Who of American Colleges last month. Besides all of his activities, he has maintained an 2.57 average in Engine School. Dave is an M.E. and just a few of his societies that he belongs to are: Phi Eta Sigma, Omicron Delta Kappa and Pi Tau Sigma. Dave is a pretty good boy, and he smokes too.

♣

Art Briephol was selected for who's who also. Sam wishes you the best, Art; and don't burn the midnight oil.

♣

And then there was the Ch.E. in P. Chem. Lab who wanted a smoke, but had no match, so he threw one cigarette away and that made the pack a cigarette lighter!

♣

For all you Gung Ho space cadets who hope to make advanced A. F. R. O. T. C., here is a tip. Sgt. Claudi is tending bar at the Black and Gold, a good chance to chit chat over a cool brew.

Well, gang, its moving on dusk, so I hope this has been cool in the bitter.

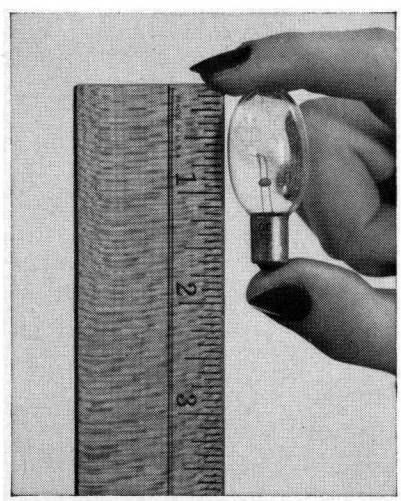
See you all next month.

Slipstick Sam

NEWSTUFF

By Mike McDaniel

SHAMROCK has some more news of the fast moving Engineering World. Here is the info.



—Cut Courtesy GE

General Electric Company recently introduced a tiny flashbulb which is expected to revolutionize the picture taking industry. It is known as the M-2 and is described as the world's smallest, least expensive, most convenient, and most reliable flashbulb yet. Rated at 4000 lumen-seconds, it provides sufficient light for good black and white picture results at distances up to 15 feet when used with existing reflectors, fast film, and box-type cameras. Owners of better cameras will obtain good results at considerably greater distances. As compared with the No. 5 bulb, by far the most popular flashbulb today, the M-2 has the same effectiveness at half the distance.

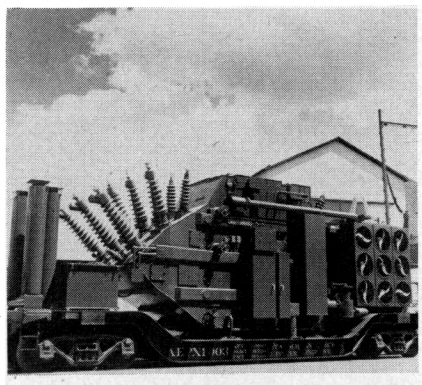
Besides being the smallest flashbulb yet introduced, the M-2 differs in appearance from all previous types in that it has a smaller base. Similar in size to that of the smallest Christmas tree bulb, the base is of the miniature type, smooth and without either pins or screw threads. It is pushed straight into the socket and needs no positioning or turning.

The M-2 will perform adequately with present reflectors with the aid of adapters. Much better results are possible with reflectors designed especially for use with the tiny bulb. To stimulate the introduction of such reflectors, G.E. has developed new designs and is showing them to manufacturers of cameras and flash attachments for their guidance. These new reflectors are expected to be considerably smaller (from three to four inches in diameter) and more nearly parabolic in shape, than the units currently on the market.

The M-2 bulb is three quarters of an inch in diameter, or slightly more than half the diameter of the No. 5 bulb, and is nearly an inch shorter. The base of the M-2 is only three-eighths of an inch in diameter, or about three-fifths the size of a No. 5 base.

Like other flashbulbs, the M-2 is clear, and is filled with shredded aluminum foil. It incorporates construction improvements recently introduced by G. E. in its line of midget flashbulbs.

The retail price of the M-2 is 10 cents per bulb or a savings of about 5 cents over the No. 5 or its equivalent.



—Cut Courtesy Westinghouse

The American Gas and Electric System has a new 50,000-kva mobile transformer in service. It is of the same dimensions and weight that would have been required for a 17,000-kva rail car mounted unit 10 years ago. This increased space and weight efficiency has been made possible through the use of forced oil, forced air cooling with directed flow, by simplification of connections, by turning the core and coil assembly on its side to save height, and using a vertical terminal board for changing connections. The new unit is a three-phase unit and is moved from place to place filled with oil and with its coolers and bushings in place. Only the arrestors have to be taken down in transit. The complete transformer weight is 90 tons and it can step down from 132, 88, or 66 kv to 44, 33, or 22 kv.

One of the newest tools which materials engineers at the Westinghouse Electric Corporation are employing to speed measurements is the fluorescent x-ray spectograph (see kwik pic) which is used to determine within close limits the constituents of a given alloy. While standard chemical methods are slow, the new method allows a test to be made in about 30

(*Continued on Page* 24)



Awards that foretell your gain

Chemicals from coal hydrogenation...

...acclaimed the 1953 Chemical Engineering Achievement!

IN 1933 Carbide received the first Chemical Engineering Achievement Award. This recognized the beginning of commercial production of much-needed chemicals from petroleum and natural gas—which proved to be the beginning of the American petrochemical industry.

HISTORY REPEATS—Now, just twenty years later, Carbide has received the 1953 Chemical Engineering Achievement Award for "the first successful production of chemicals from coal by a high pressure hydrogenation process."

In minutes, coal becomes gases and liquids rich in needed chemicals—"one of the major contributions in this century to the well-being of us all."

Some of these chemicals are used in making plastics, synthetic rubber, pharmaceuticals, vitamins, and many other things. Others are completely new and hold great promise.

FOURTH RECOGNITION—Carbide is the first two-time individual recipient of this award. It also is the fourth time the people of Carbide have been recognized, for they shared in two previous group awards—in 1943 for synthetic rubber, and in 1946 for atomic energy.

TRUE SIGNIFICANCE—As in all Chemical Engineering Achievement Awards, coal hydrogenation was recognized not as the accomplishment of any one individual but as the result of the cooperative efforts of many.

The people of Union Carbide appreciate the recognition of their achievement by the distinguished Committee of Award, composed of senior chemical engineering educators.

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

UCC's Trade-marked Products include

SYNTHETIC ORGANIC CHEMICALS
EVEREADY Flashlights and Batteries
BAKELITE, VINYLITE, and KRENE Plastics
ELECTROMET Alloys and Metals
PYROFAX Gas
HAYNES STELLITE Alloys
DYNEL Textile Fibers
UNION Carbide
PREST-O-LITE Acetylene
PRESTONE Anti-Freeze
LINDE Oxygen
NATIONAL Carbons
ACHESON Electrodes

BULLARNEY



By Gray

A philosopher is a man who doesn't care whether a thing is right or wrong, as long as he can prove it.

♣

March 15—the day when income becomes a collector's item.

♣

A pessimist is a fellow who always looks both ways before crossing a one-way street.

♣

A demagogue is a man who can rock the boat himself and persuade everybody there is a terrible storm at sea.

♣

Loaded Dice—poison ivory.

♣

A budget is a method of worrying before you spend it instead of afterwards.

♣

High Finances—paying your bills with borrowed money.

♣

War paint may be defined as a lipstick smear on a married man's collar.

♣

The old hillbilly was sentenced to five years in the penitentiary. When the judge asked if he had anything to say, the old man inquired mildly, "Ain't you bein' a bit liberal with my time?"

♣

Betty: "I don't like that boy you're seeing."

Sue: "Why?"

Betty: "He whistles dirty songs."

♣

Poultry is up two cents, but pigeons continue to drop a little.

♣

Watt You Think of This One?

"Have you," asked the electrician, "any four-volt, two-watt bulbs?"

"For what?" asked his assistant.

"No, two."

"Two what?"

"Yes."

"No!"

♣

Sven got into the mine elevator, chuckling out loud.

"What's the joke, Sven?" asked the mine foreman.

"Ay ban have a good joke on Ole," he replied. "Ay just find out that Ole pay my wife five dollars to kiss her and I do it for nothing."

♣

Two drunks wandered onto a railroad trestle one dark night.

First drunk: "Boy! This ish a long flight of stairs."

Second drunk: "I don't mind that so much, but I'm having a hell-of-a-time getting used to thish low hand rail."

♣

The reason for the amber light on the traffic signal has finally been revealed: It gives the Scotchmen a chance to start their engines.

♣

A woman calling the music shop was given the wrong number by the operator. A man answered and the woman thinking it was the music shop asked, "Do you have 'Eyes of Blue' and 'Love Me' too?"

"Why, no Ma'am," answered the man. "I have a wife and twelve children and four sets of twins."

"Is that a record?" the woman asked.

"I'm not sure, but I think so," said the man.

♣

"The Sunday school lesson will be on Ruth. Willy, what do you know about the story of Ruth?"

"Sixty home runs in one season, Ma'am."

♣

"Keep on firing boys," said the Italian general. "Never say die. Never give up until your last shot is fired. When it is fired, run. I'm a little lame, so I'm starting now."

♣

The scene is a train compartment in Romania. The characters: A Russian officer, a Romanian, an old lady and an attractive girl.

The train enters a tunnel. The passengers hear first a kiss, then a vigorous slap.

The old lady thinks: "What a good girl she is, such good manners, such fine moral character!"

The girl thinks: "Isn't it odd that the Russian tried to kiss the old lady and not me."

The Russian thinks: "That Romanian is a smart fellow! He steals a kiss and I get slapped!"

The Romanian thinks: "Am I a smart fellow! I kiss the back of my hand, hit a Russian officer, and get away with it."

♣

Freshman German Student: "What is castor oil known as in Holland?"

Senior: "Old Dutch Cleanser."

♣

Have you heard the new radio program about the girl who wanted two bathrooms? It's called "The Wife's Other John."

♣

Signs Along The Highway

"Soft Shoulders"

"Dangerous Curves"

"Five gals. for a dollar"

"Try Ethyl"

and as a final warning,

"Watch out for children."

THEY STARTED OUT EVEN AT GRADUATION:

Why is one doing better now?



You may not see it in their outward appearances – but there's a big difference between these young men. One has held three jobs in the five years since graduation. He's still looking for a job that offers him a lifetime career. The other has been with a Bell Telephone Company during that time. He's on his way up!

Seventy-five per cent of college men hired by the Bell Telephone Companies since World War II are still with these telephone companies after *five years!* Here's why:

Telephone Work Is Interesting—As an engineer, you'll be planning telephone facilities or supervising construction, installation and maintenance. You'll work with the newest developments in electronics and communications as you help expand and improve the world's best telephone service.

There Are Places to Go—Each year the number of college people hired is related to estimates of the number of future management positions expected to be available. We are looking to the future—yours and ours.

You Grow with a Growing Business—The Bell System is one of the fastest growing businesses in the world. Since the end of World War II, it has spent about nine billion dollars for new construction. The past five years have seen the introduction of network TV transmission, dialing of Long Distance calls and the development of the remarkable transistor.

You'll Be Happy—Not only because of the interesting and rewarding work, but for many other reasons. For instance, Bell Telephone Companies are located in all parts of the country. So you may be able to start where you want to live. And what about salaries? It is the basic policy of the telephone companies to pay salaries that compare favorably with those positions of similar responsibility in other fields.

No matter what your military status, it's worth inquiring about Bell System employment opportunities. Your Placement Officer has the details. And be sure to talk to our employment representatives when they visit the campus. The time to plan your future is now!

BELL TELEPHONE SYSTEM

NEWSTUFF

(*Continued from Page* 20)

minutes. A beam of x-rays is shot obliquely at a small wafer of the alloy. This produces secondary rays, each combination of wave lengths being characteristic of a particular element. Thus the secondary-ray output is first separated by a grating crystal and then scanned through an 180 degree arc with a Geiger counter. The angle of the secondary ray identifies the element; the intensity—its amount. The method is accurate to about 0.3 per cent for components existing in quantities of more than five per cent in an alloy. This method of analysis supplements the emission spectrograph, which is suitable for identification of small or trace amounts of alloy elements.

The Navy now has a transmitter which makes it possible for them to communicate instantly with any of their ships over the globe. In the first test message dictated by Admiral Robert Carney and transmitted in code by RCA's David Sarnoff, answers were received from a battleship off Japan, a carrier in the West Pacific, and a submarine in the far off Atlantic.

The giant transmitter, located 55 miles from Seattle in the Jim Creek Valley of Washington Cascade mountains, is a fourteen million dollar wonder which took six years to complete and changed the face of the surrounding wilderness. Engineers cleared 2000 acres of heavily wooded slope, built 12 miles of access roads and erected permanent housing for 48 navy men and their families.

The massive electronic equipment, designed and built by RCA, uses as much power as a city of 25,000 population. Its output of 1.2 million watts makes it 22 times more powerful than any commercial station in the United States.

Jet pilots soon will have a means for keeping a continuous, more precise check on how much fuel their aircraft consumes in flight as the result of a new device called a mass flowmeter. This device measures the actual fuel being gulped down by thirsty jet engines in terms of pounds per hour and indicates it on the aircraft instrument panel.

According to GE engineers, the flowmeter will aid pilots or flight engineers by making it simpler for them to compute remaining flying time. It will also give them a quick method of evaluating engine operating efficiency through comparison with data gathered from past experience.

Since specific gravity varies with the type of fuel and its temperature, measurement of the mass of the fuel at the time of its use is essential in determining the efficiency of fuel consumption.

The Atomic Energy Commission has announced the completion of a large steel sphere at the Knolls Atomic Power Laboratory's West Milton, New York site. Here scientists will test-operate a prototype atomic power plant for submarines.

Closing of the last openings—at the top and bottom—marked the end of ten months work. A total of 682 steel plates were joined together to make the structure which, together with its supporting columns, weighs 3850 tons. Two welds skirting its equator are each 706 feet in length. The sphere, which is 225 feet in diameter, rises higher than an 18 story building.

The purpose of the housing is to provide insurance against the escape of radioactive material in the remote chance that numerous safety devices fail simultaneously. Scientists say that there is no chance of a bomb-type explosion, however.

The atomic reactor is being built at the Knolls Atomic Power Laboratory. It will be installed in a land based submarine hull section. Water will surround part of this hull inside the sphere to simulate actual seagoing operations.

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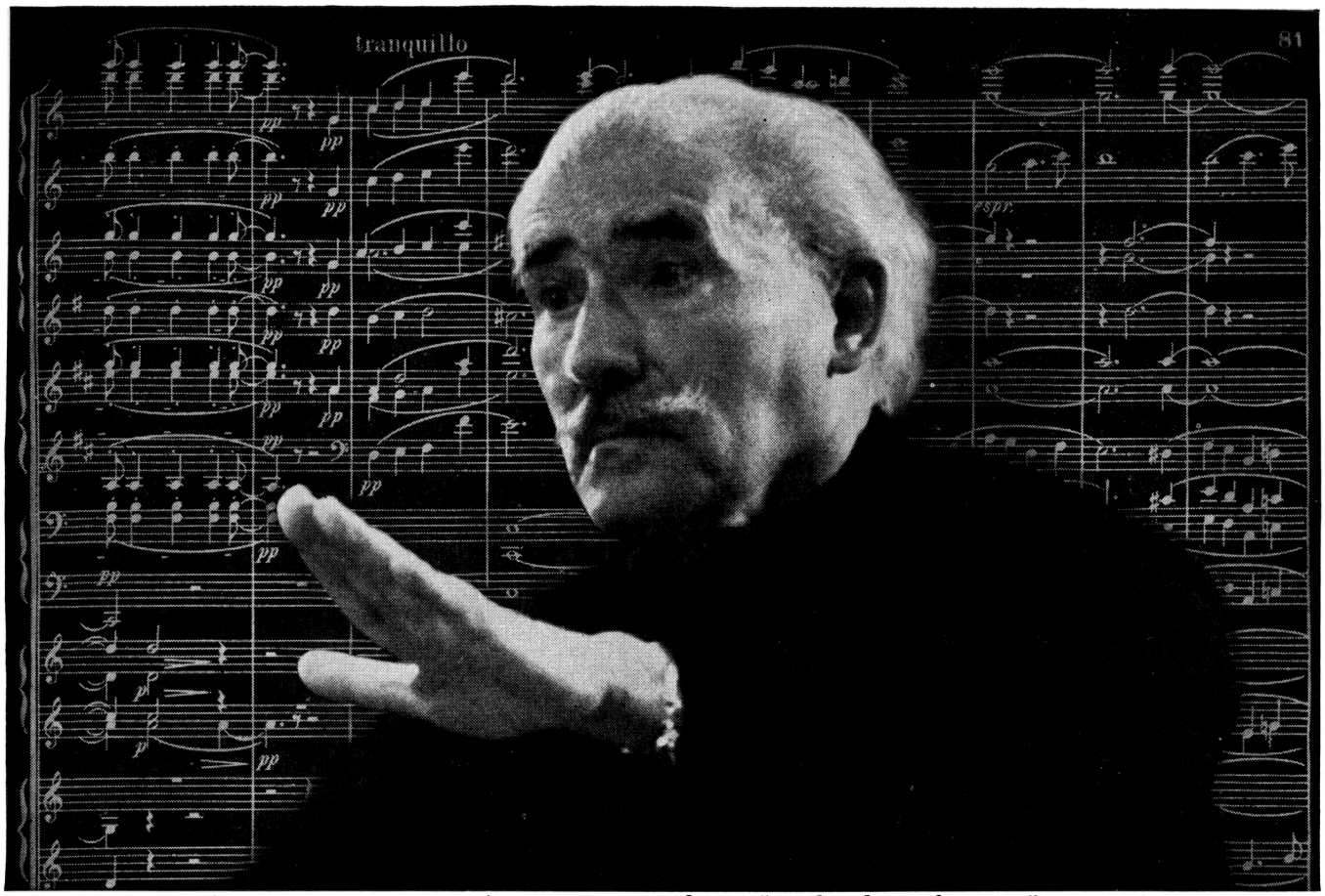


Arturo Toscanini conducting "Death and Transfiguration," Opus 24, by Richard Strauss

RCA High Fidelity brings you every musical note!

RCA Victor High Fidelity is the result of 50 years of leadership in recorded music, phonograph research and development of radio and motion picture sound. It is a new dimension in sound created by the perfect union of recorded music and the phonograph.

A genuine high fidelity instrument re-creates the full range of tones and overtones of the original composition—exactly as the composer intended. The precise balance of sounds from the highest to the lowest must be maintained if perfection is to be achieved.

"Victrola"® phonographs, Victor records, and "intermatched" high fidelity equipments for those who want to assemble their own units—all are designed to work together to bring the brilliance of the original performance into the home. Now, with RCA High Fidelity instruments, you can hear the full gamut of the orchestra—from the shimmer of the cymbals to the beat of the tom-tom. Your favorite music sounds just as if you were in the presence of the recording orchestra and artists.

True Hi-Fi—as in RCA Victor instruments and components—embraces the entire scale of tones from the rich lows to the colorful highs. Nothing is missing . . . the sounds reach the ear in their proper proportion and relation.

The nation-wide interest in high fidelity reflects a growing taste for the highest quality music. Developments by RCA scientists and engineers now let you enjoy this new musical experience. Visit your RCA Victor dealer and hear the new Hi-Fi models of "Victrola" phonographs, Victor records and "intermatched" components.

RADIO CORPORATION OF AMERICA

World leader in radio—first in television

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to College Relations Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

KOMU-TV

(*Continued from Page* 15)

ent transmitter as a driver. Station officials hope that some day the station will be able to increase power up to fifty kilowatts input to the transmitter final.

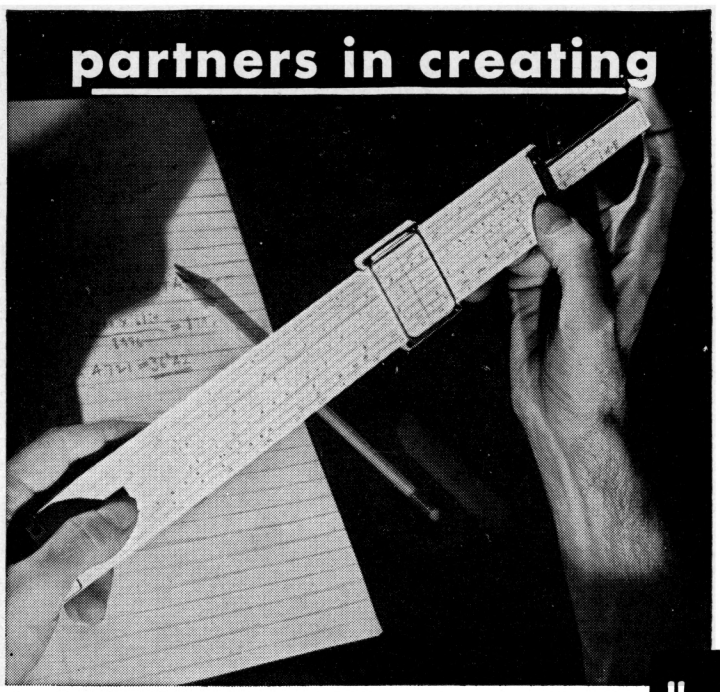
ANTENNA AND TOWER

The tower is seven hundred feet tall, triangular, and six feet on a side. It is guyed with nine wires: three are one third of the way up, three are two thirds of the way up, and three are at the top level. The tower is made by Blaw-Knox and is being put up by Beasley Construction Co. of Muskogee, Oklahoma. The tower and antenna together weigh 386,000 lbs.

Mounted on top of the tower is the twelve bay, seventy-four foot antenna, which weighs 8850 pounds. The antenna gain is 10.86 decibels, which is equivalent to a power ratio of twelve to one. The five kilowatt peak power of the visual transmitter, minus the transmission line losses, multiplied by twelve, equals 48.8 kilowatts, effective visual power. Effective oral power is 25.1 kilowatts. The fifty kilowatt amplifier, if added later, will make the effective visual power 316 kilowatts, the maximum allowed by the FCC on this channel.

The transmission lines have an impedence of fifty ohms. The outside diameter is three and one eighth inches, and the inner conductor has a diameter of about one and one quarter inches. Both the transmission lines and antenna will safely handle the output of the fifty kilowatt amplifier when it is added.

The University of Missouri's new television station is as modern and well designed as any television station in the country. Central Missourians can now have good television reception any evening they wish to turn on their television receivers.



● There's a K&E slide rule for every purpose. Whether designed to meet the modest needs of the beginner or the exacting requirements of professionals, all K&E rules feature "built in" accuracy and reflect the skill and craftsmanship of America's most experienced slide rule manufacturer.

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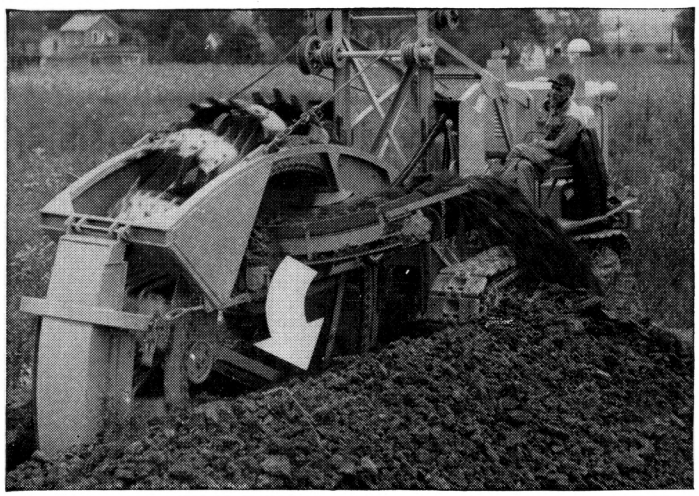
Another page for **YOUR BEARING NOTEBOOK**

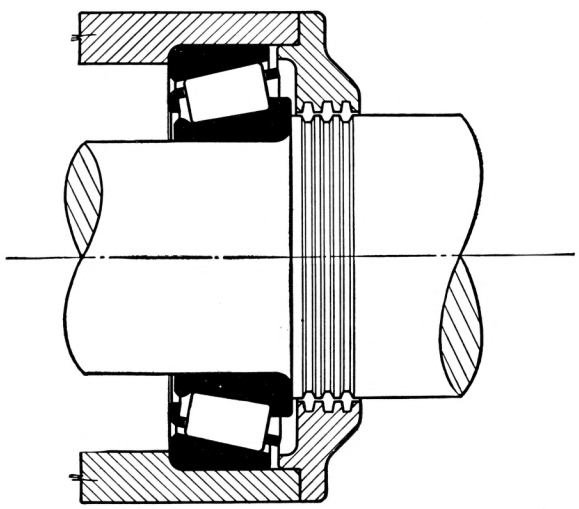


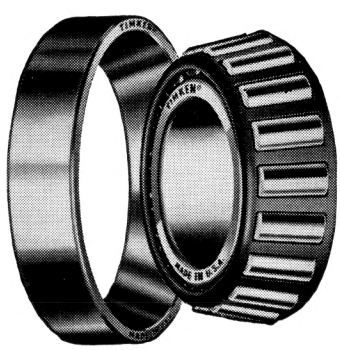
How to keep buried wheels turning smoothly

Hidden under the pile of dirt (see arrow) is a 4-wheel truck that backs up this ditch digger's whirling buckets. To prevent breakdowns, the wheel bearings had to be able to absorb the shocks of boulders and the digging action itself. And they had to be protected from the dirt. The engineers who designed this application licked both problems by mounting the truck's wheels on Timken® tapered roller bearings. Timken bearings absorb the shocks because they have tough, shock-resistant cores under hard, wear-resistant surfaces. And Timken bearings make closures more effective.

How TIMKEN® bearings help keep dirt out—lubricant in

Timken bearings make closures more effective because they hold the housings and shafts concentric. As a result, dirt can't get in—lubricant can't get out. Maintenance is minimized. Continuous, trouble-free operation is assured.

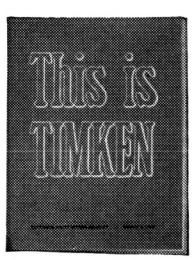




TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⬭ AND THRUST →⬭← LOADS OR ANY COMBINATION ✳

NUCLEAR REACTOR

(*Continued from Page* 13)

two metals which can stand both the heat and the radioactivity. The metals are stainless steel and zirconium. However, stainless steel has a high affinity for neutrons and would thus impede the action of the reactor. Zirconium has a low affinity for neutrons. This characteristic would seem to make it the ideal metal; however, zirconium is a metal which is very difficult to obtain in pure form. The impurities in zirconium have a high affinity for neutrons.

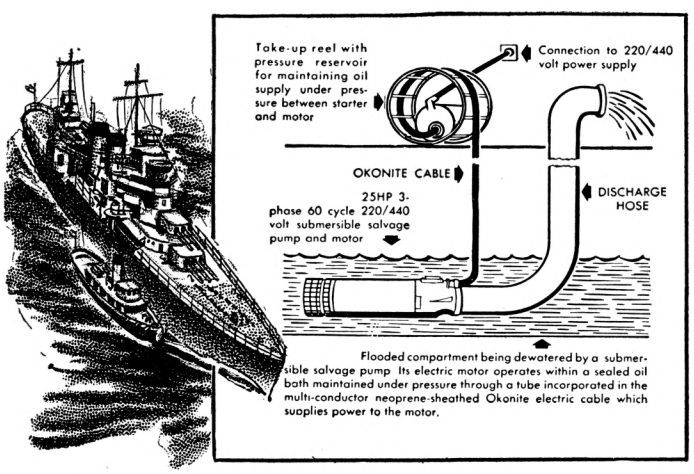
Another major problem will be the choice of the coolant. Among the requirements for the coolant are a low affinity for neutrons and an ability to withstand high temperatures. Several coolants are available which seem to meet these requirements. Among these are helium, water, "heavy" water, and sodium. Helium and "heavy" water have the least affinity for neutrons. However, helium would have to be used at a high pressure, and "heavy" water is hard to obtain. Although water has a relatively high affinity for neutrons, it may be used because of its abundance. The problem of the best coolant hasn't been solved by the government, which is constructing two nuclear reactor powered submarines. One will use water for a coolant and the other will use liquid sodium as the coolant.

The nuclear reactor will be the heart of the nuclear power system and will be essentially the same as the experimental models. The reactor will use concrete as the shielding. Water will probably be used as the coolant. The internal piping will be made of either stainless steel or zirconium. The moderator will be "heavy" water or graphite.

The process (to produce electrical power) which will probably be used is shown in figure C. Liquid #1 passes through the reactor extracting its heat, and then the liquid passes through the heat exchanger, giving up the heat obtained from the reactor. Liquid #1 takes the heat from the exchanger and proceeds through a conventional steam cycle driving a turbine, which, in turn, drives an electrical generator. Liquid #1 would be radioactive but Liquid #2 would not be.

A Boston spinster was shocked at the language used by workmen repairing telephone wires near her home, so she wrote to the Telephone Company. The manager immediately asked the foreman on the job to make a report and here's what the foreman said:

"Me and Spike Williams were on this job. I was up the pole and accidentally let the hot lead fall on Spike—and it went down his neck. Then Spike looked up at me and said: 'Really, Harry, you must be more careful'."



Seriously crippled by an aerial torpedo during World War II, the cruiser USS Honolulu struggled home 12,000 miles under her own power.

This historic trip was made possible by the vessel's salvage pumps which were served by unusual "double-duty" Okonite cables. These specially made cables not only supplied power to the electric motors in the pumps, but also maintained a constant oil supply to the pumps through a tube *in the same cable.* Despite many weeks of submersion in oily sea water, the Okonite cables retained their original properties.

● ● ●

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

OKONITE SINCE 1878 *insulated wires and cables*

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DIALS

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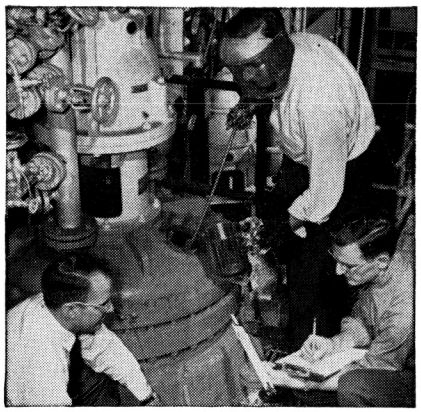

Robert Thomson (*left*), B.S. in Ch.E., Univ. of Va. '50, **David S. Rumsey** (*center*), M.S. in Ch., Univ. of Mich. '48, and **Rene M. LeClair** (*right*), M.S. in Ch. E., M.I.T. '51, test samples on an experimental batch unit.

Plant Development

Offers Training and Opportunity



John Purdom, M.S. in Ch.E., Ohio State '48 (*right*), confers with other engineers on the progress of a new plant.

A young chemical engineer recently had his first assignment in a *Plant Development* group at Du Pont. He was part of a team assigned to improve recovery of adipic acid, a nylon intermediate, from plant-waste streams.

First, he made a literature survey for possible leads. Three recovery methods came under consideration: *solvent extraction*, *crystallization*, and a combination *distillation-crystallization* process. He helped to set up a laboratory program to compare and evaluate them.

Preliminary results were somewhat inconclusive. It was decided to go ahead with semi-works tests, while an organic chemist completed the laboratory work.

Next, the young chemical engineer joined forces with a mechanical engineer to design a semi-works plant to evaluate each method. In this plant, all vital points were checked and rechecked: materials of construction, steam and water requirements, heat-transfer coefficients, yields, product quality, and pollution problems.

The semi-works data revealed that the *distillation-crystallization* process was the most economical, and also gave the best product quality. Usually, the next step would be construction and operation of a pilot plant. But this time, engineers from the *Production Division* arranged for a limited-scale plant test, using a spare batch still and a crystallizer on a part-time basis. Two months of testing confirmed the previous data—the new *distillation-crystallization* process recovered adipic acid efficiently, and would reduce costs considerably. The plant is now using this process successfully.

That's how one young chemical engineer started his career in a typical Du Pont *Plant Development* group. The job of such groups is to make processes and equipment more efficient, to adapt products to new uses, and to improve product quality.

Plant Development work not only offers opportunity in itself but valuable training for other fields.

ASK FOR "Chemical Engineers at DuPont." This new illustrated booklet describes initial assignments, training, and paths of promotion. Just send a post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware. Also available: "Du Pont Company and the College Graduate" and "Mechanical Engineers at Du Pont."

DU PONT
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BETTER THINGS FOR BETTER LIVING
. . . *THROUGH CHEMISTRY*

Watch "Cavalcade of America," on Television

SHAMROCK

SEZ:

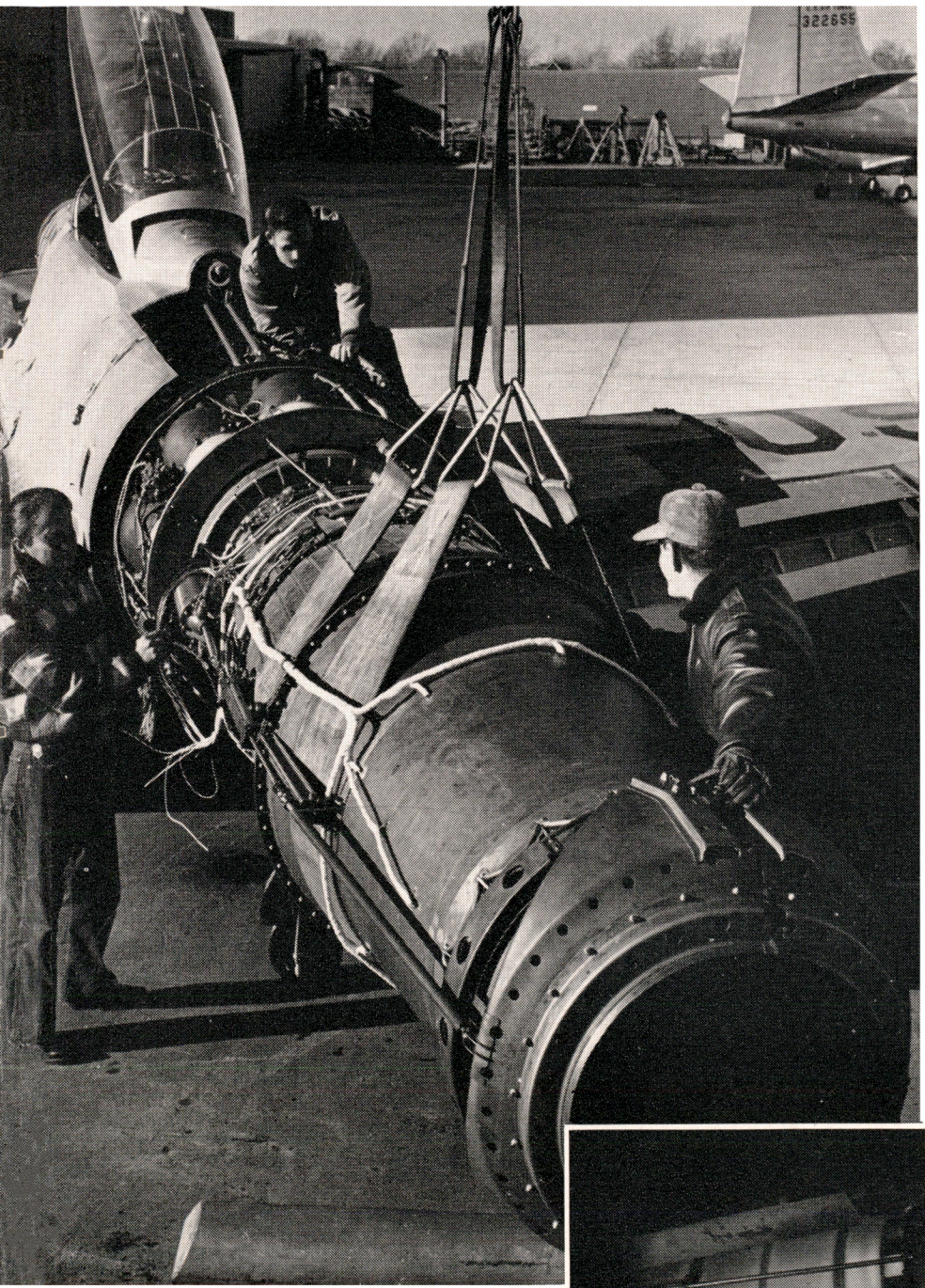


NEW ORGANIZATIONS on campus are satisfying the needs of many students interested in new fields, such as the establishing of a chapter of the Society for Advancement of Management, which will step into the open one of these days. Student interest is great enough to warrant its success, and Mizzou will soon be greeted by the other chapters at some ninety-odd schools as a fellow member. S.A.M. is open to any student interested in management problems, which not only includes engineers, but also Business Administration majors. Another society that made its appearance is the Aero-Tigers; though it is an all-campus organization, it has a goodly proportion of engineers in its membership. So bouquets from Ol' SHAMROCK to the "new comers", and also to the fellows behind them!

ST. PAT'S BOARD class members have been selected, plus a couple of ex-officio members. So the board, headed by Gene Anderson, is all ready to start planning for the 51st celebration of the coming of St. Patrick, who was an engineer; . . . "he engineered the snakes out of Ireland, which was the first *worm* drive." Among the events to be planned early are the Campus Stunt, floats, and the Hamburg Show. The last should have a preventive measure planned against overspirited audience action. The Campus Stunt is always something, that can use plenty of originality, and therefore suggestion would be welcomed by St. Pat's Board.—It has been said, that last year's St. Pat's Week was planned mostly for the benefit of the alumni, which is regrettable from the student's point of view, but can be explained by the Golden Anniversary label on last year's festivities, which brought back many of its originators. Anyway, it is going to take a heck of a lot of work to even equal last year's accomplishments and the publicity received due to the anniversary. Ol' SHAMROCK wishes the board lots of success.

Photography teams with research to slash industry's corrosion bill

Camera and Film work as research tools as International Nickel Company develops new alloys which prove tougher and defy corrosion.



Each year industry saves more and more millions on its corrosion bill by using Monel*, Inconel* and other corrosion-resisting alloys of the International Nickel Company.

To develop such alloys, "Inco" maintains extensive research—research that keeps photography on the job day-in and day-out.

This is because photography provides information which can be obtained and studied in no other way. Photomicrographs show metal structure. X-ray diffraction patterns reveal the arrangement of molecules. High-speed and time-lapse movies display the workings of corrosion.

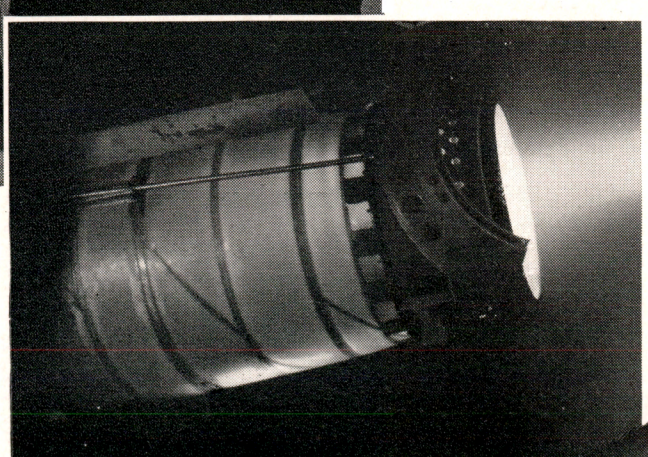
Industries, large and small, find photography an important factor in their research—just as they know it improves manufacturing, cuts costs, and speeds many business operations.

"Today so many new applications of photography exist that graduates in the physical sciences and in engineering find them valuable tools in their new occupations. Other graduates—together with returning servicemen—have been led to find positions with the Eastman Kodak Company."

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

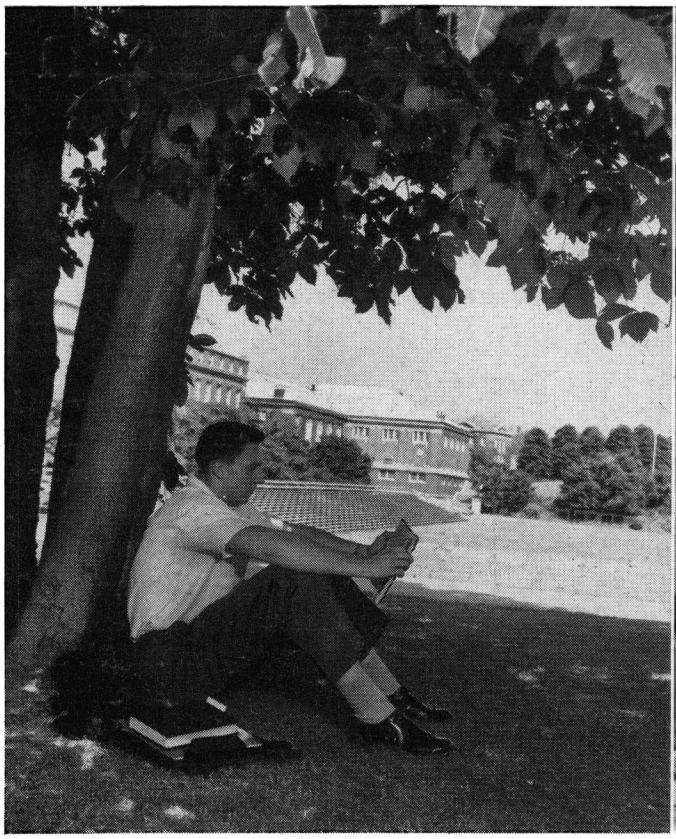
*Reg. trade marks of the International Nickel Co.

Eastman Kodak Company
Rochester 4, N. Y.



To stand up against intense heat and highly corrosive gases, vital jet engine parts such as rotor blades, afterburner, and insulation bindings are made of nickel alloys. Illustration shows a Pratt & Whitney Aircraft turbojet engine with afterburner.

Kodak
TRADE-MARK





FROM CAMPUS — TO CAREER IS A BIG STEP

When the graduate leaves the college campus to begin his career he is taking an extremely important step. For he is leaving the area of directed-development in college and entering the area of self-development in industry.

Closing the gap between his campus experiences and the realities of earning a living is not easy. The complicated maze of modern industrial society has made this transition a tough task. While the craftsmen of former years grew up with the business, the college graduate of today steps into a strange organization at a relatively high level. He has had no opportunity to understand, through a long period, the methods and operations of the concern.

During his first few years, he is finding his place in the organization—learning its policies and objectives, and at the same time shaping his professional career. He needs all the assistance and guidance he can get.

Here at General Electric, hundreds of young men have found that intensive efforts are made to "bridge the gap" between college and industry—and to help young professional people realize their goals. Through extensive training programs, classroom study programs, leadership programs, and guidance in professional development, carefully selected young men are prepared for positions of responsibility and leadership in their individual fields.

Providing college graduates with the opportunity to know the Company and find the right job in it . . . giving them high-level, flexible orientation and training . . . offering continued opportunity for professional growth are most important tasks at General Electric. Nothing is more important—for our young professional people are our biggest asset.

If you are interested in building a career with General Electric, see your college placement director for the date of the next visit of the G-E representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

MISSOURI SHAMROCK

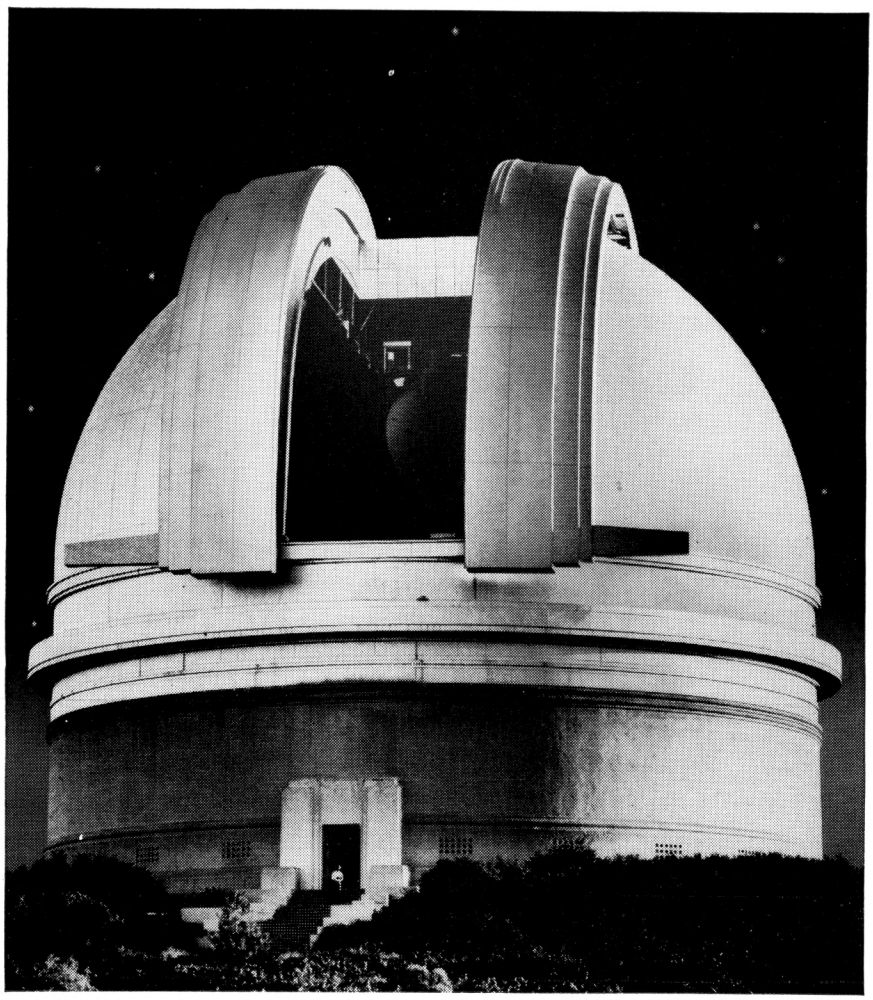


February 1954

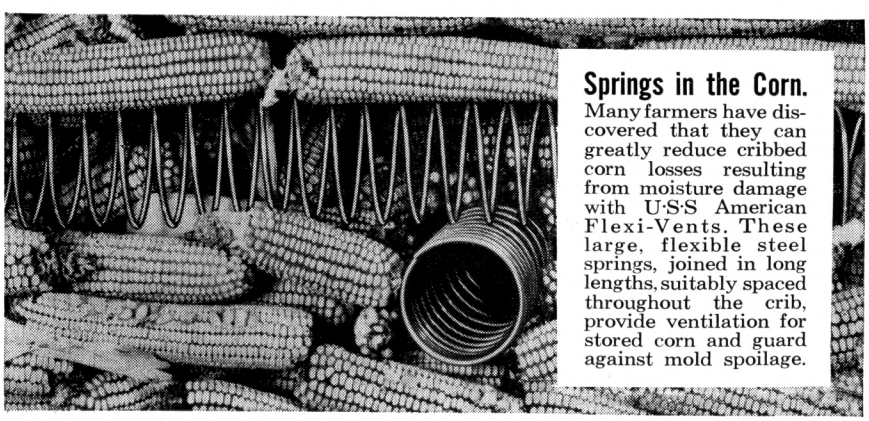
25c

Features: German Automatic Arms of WW II
The Effect of The Engineering Shortage
On The Graduating Engineer.

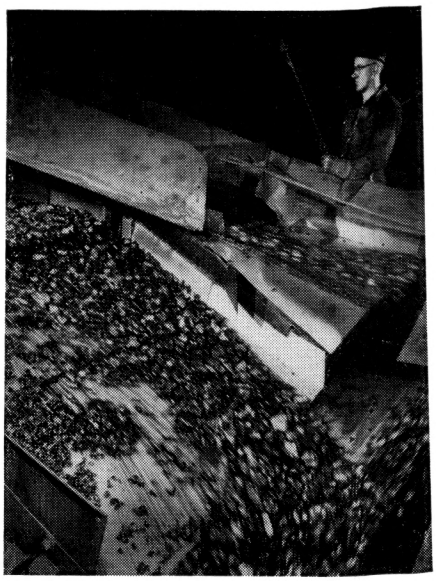
Only STEEL can do so many jobs so well



Steel and the Stars seem unrelated. But in almost every attempt man makes to learn more about his universe, to build bridges to the unknown, steel plays a vital part. Here, for example, in the Palomar Observatory housing the 200-inch Hale telescope—world's largest—the rotating dome with precision balanced shutters is made of *steel,* fabricated and erected by United States Steel. Only steel can do so many jobs so well.



Springs in the Corn. Many farmers have discovered that they can greatly reduce cribbed corn losses resulting from moisture damage with U·S·S American Flexi-Vents. These large, flexible steel springs, joined in long lengths, suitably spaced throughout the crib, provide ventilation for stored corn and guard against mold spoilage.



Zoot Chute. In the processing of anthracite coal, the best-dressed coal chutes, these days, are wearing linings of Stainless Steel. For where ordinary carbon steel chutes wear out and have to be replaced in 2 months, chute linings of stainless steel give 5 years of efficient service. In addition to hundreds of tons of coal, 17,500 gallons of water flow over these chutes each day.

OPPORTUNITIES WITH U.S. STEEL

If you're thinking about what you're going to do after graduation . . . if you're interested in a challenging, rewarding position with a progressive company . . . then it will pay you to look into the opportunities with United States Steel. Your placement director can give you more details, or we'll be glad to send you the informative booklet, "Paths of Opportunity." United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

UNITED STATES STEEL

This trade-mark is your guide to quality steel

For further information on any product mentioned in this advertisement, write United States Steel, 525 William Penn Place, Pittsburgh, Pa.

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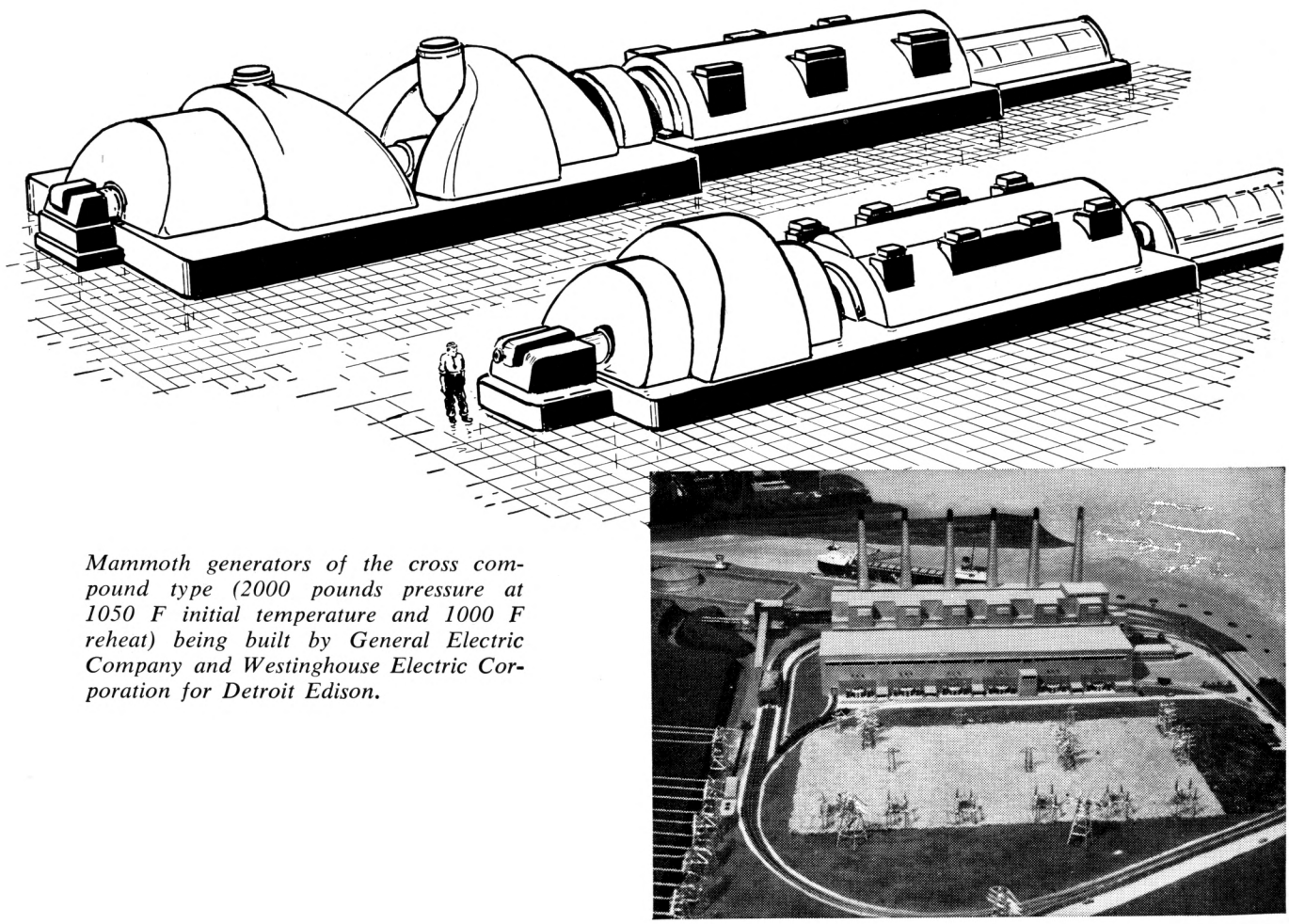

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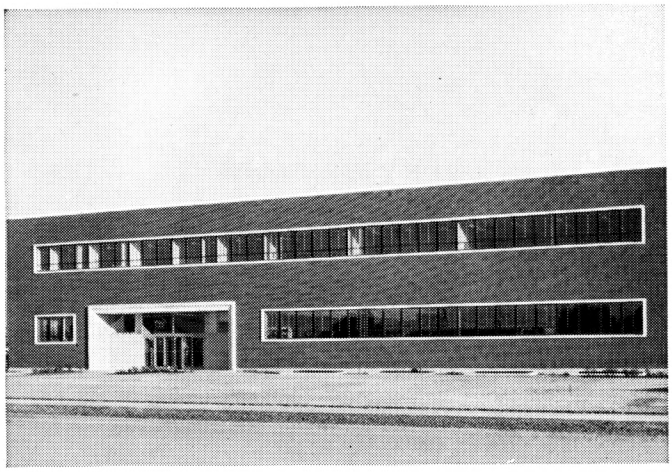

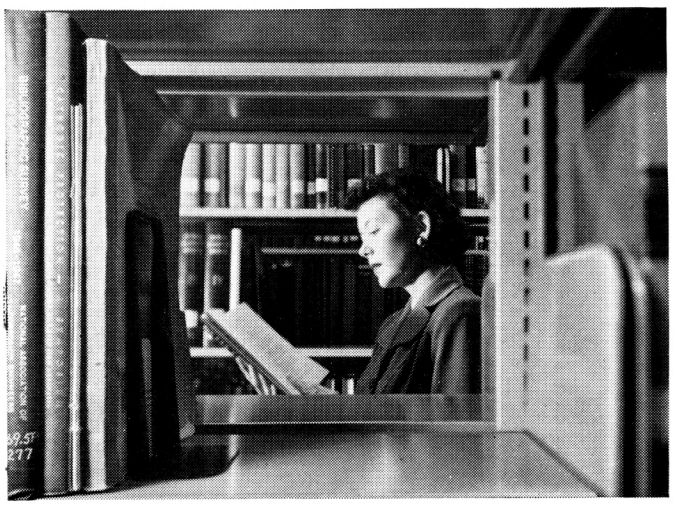



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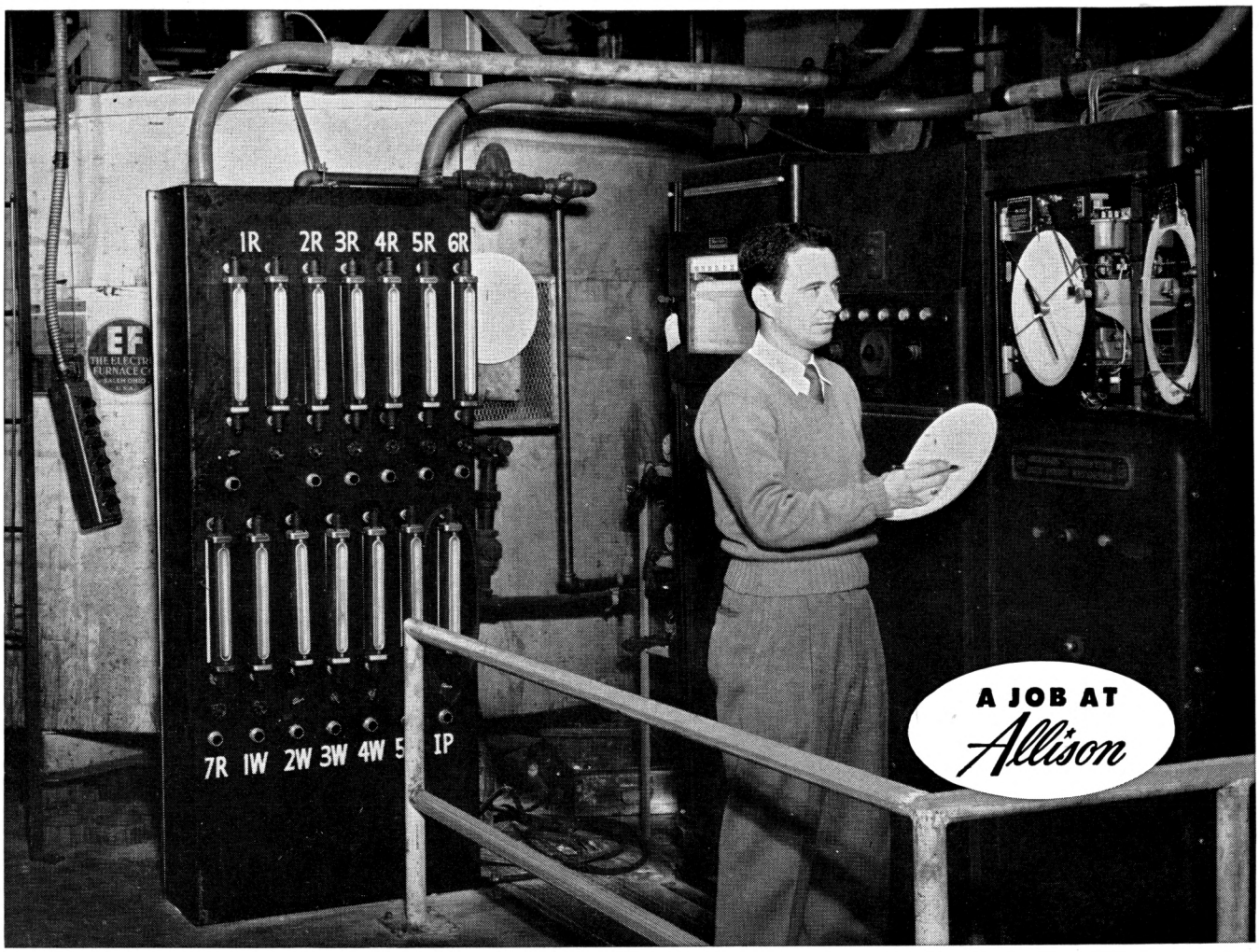

● Even before he was graduated from the U. of Kentucky, Sam Griffin, Jr. was "sold" on a job at Allison. His brother-in-law, who is in Allison aircraft engine test section, had told him about the many advantages and opportunities offered the young engineer with academic training like his.

So, when Sam left school in 1951 with his B.S. in Metallurgical Engineering, he came right to Allison where he is now Experimental Metallurgist in Transmissions Operations.

Allison, along with its aircraft engine activity and production of bearings and Diesel locomotive parts, is the world's largest manufacturer of Torqmatic Drives for heavy duty Ordnance and commercial vehicles and equipment. In all parts of the world, Torqmatic Drives are in use today in big trucks . . . tractors . . . cranes . . . shovels . . . tanks . . . drilling rigs . . . and scrapers.

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Sam has been doing pioneering work in heat treatment control with newly-installed equipment at Allison. He is shown above, as final tests are being made, at the panel of the Dew Point Recorder which checks the amount of moisture in heat treat furnaces. Twenty-four big furnaces are controlled by these two- six-station machines. It was his responsibility to see that the equipment was installed properly, and he also trains personnel in the proper use of the equipment.

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ON THE COVER

—Photo by Henn Liiv

This month Henn took a candid shot of Mr. Pringle telling the M.E. 220 class about journal bearings. He is showing them the wear and the oil groove in an automobile crankshaft bearing. Why he is grinning like he is we don't know, but we imagine he is posing.

MISSOURI SHAMROCK

VOL. XX~~V~~20 NO. 5

FEBRUARY, 1954

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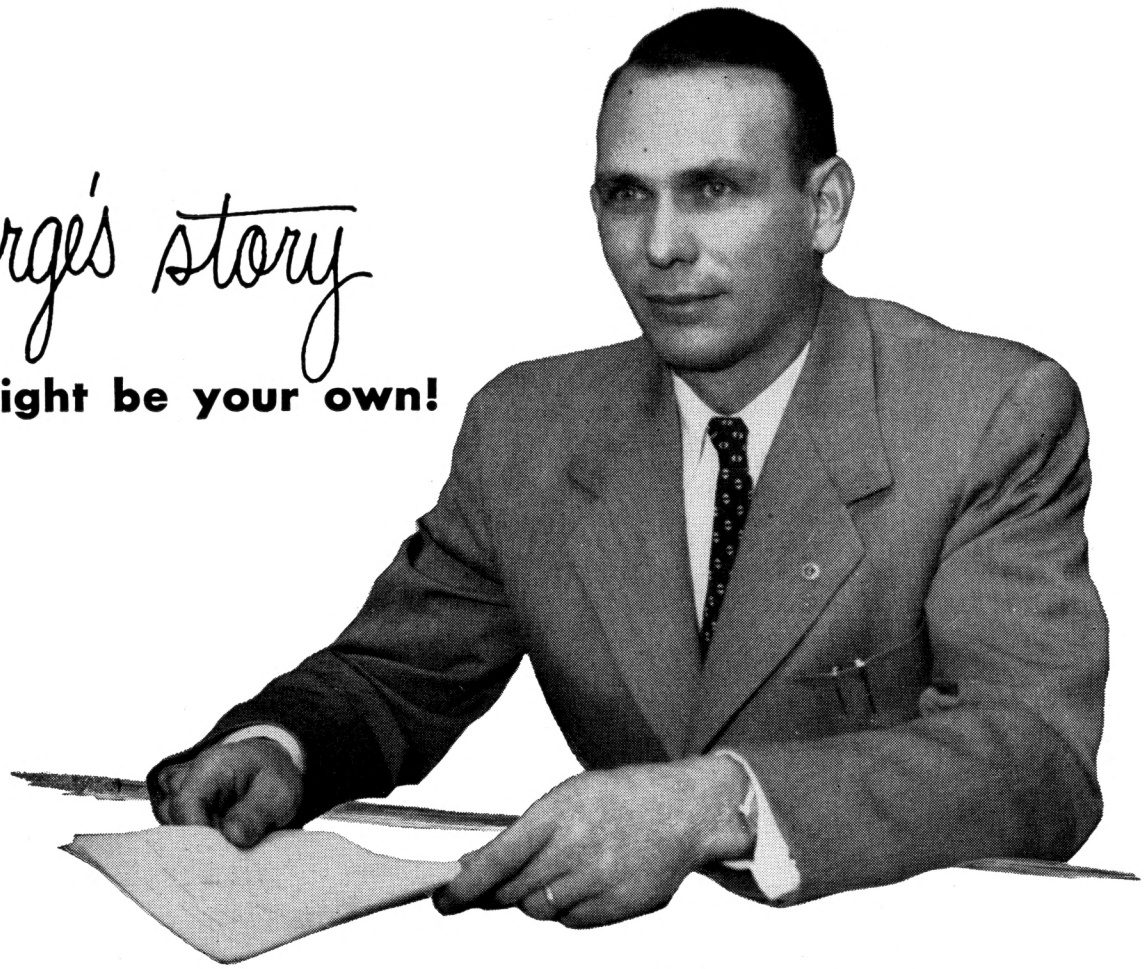
George's story

might be your own!



George L. Cobb is chief engineer of Columbia-Southern's plant at Natrium, West Virginia. He holds the responsible job of supervising the activities of maintenance, engineering and construction. He's a valued member of the Columbia-Southern organization.

Cobb started as a maintenance engineer seven years ago, became assistant maintenance superintendent, then was tapped for his present job. But Cobb's story starts before that.

George attended Arkansas A&M and later Alabama Polytechnic Institute as a student in mechanical engineering. He received his degree in 1944, then served in the armed forces for two years.

Immediately upon his return, he sent his personal resume to 34 companies and received replies from 31 of them. He spent one month travelling over 12,000 miles investigating each promising opportunity which included a meeting with the Columbia-Southern people. Many offers were extremely attractive, but Columbia-Southern suited him best.

Why Columbia-Southern? Well, here's what George says.

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3. Columbia-Southern offered the opportunity to do the type of work he was most interested in—plant maintenance.

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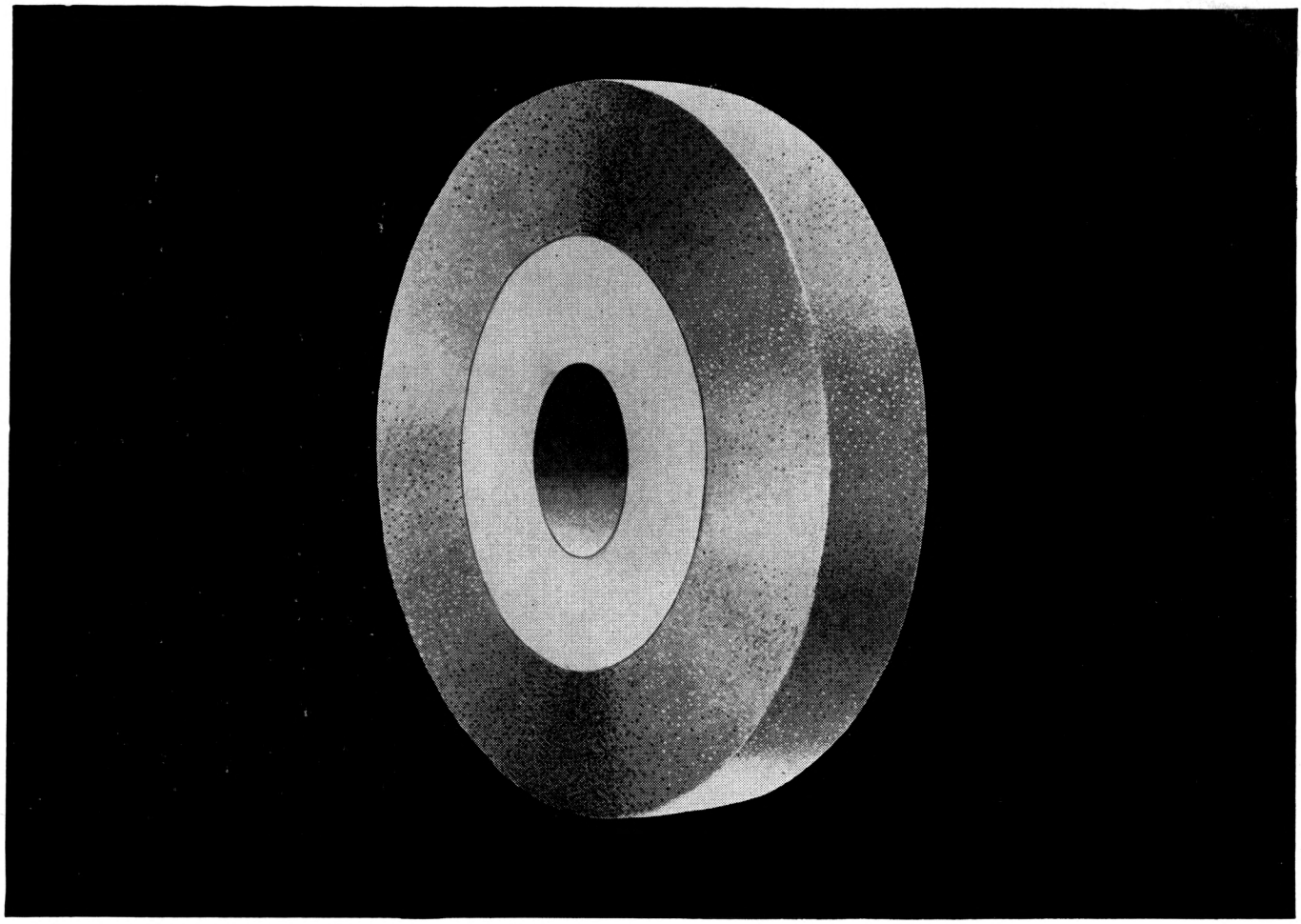

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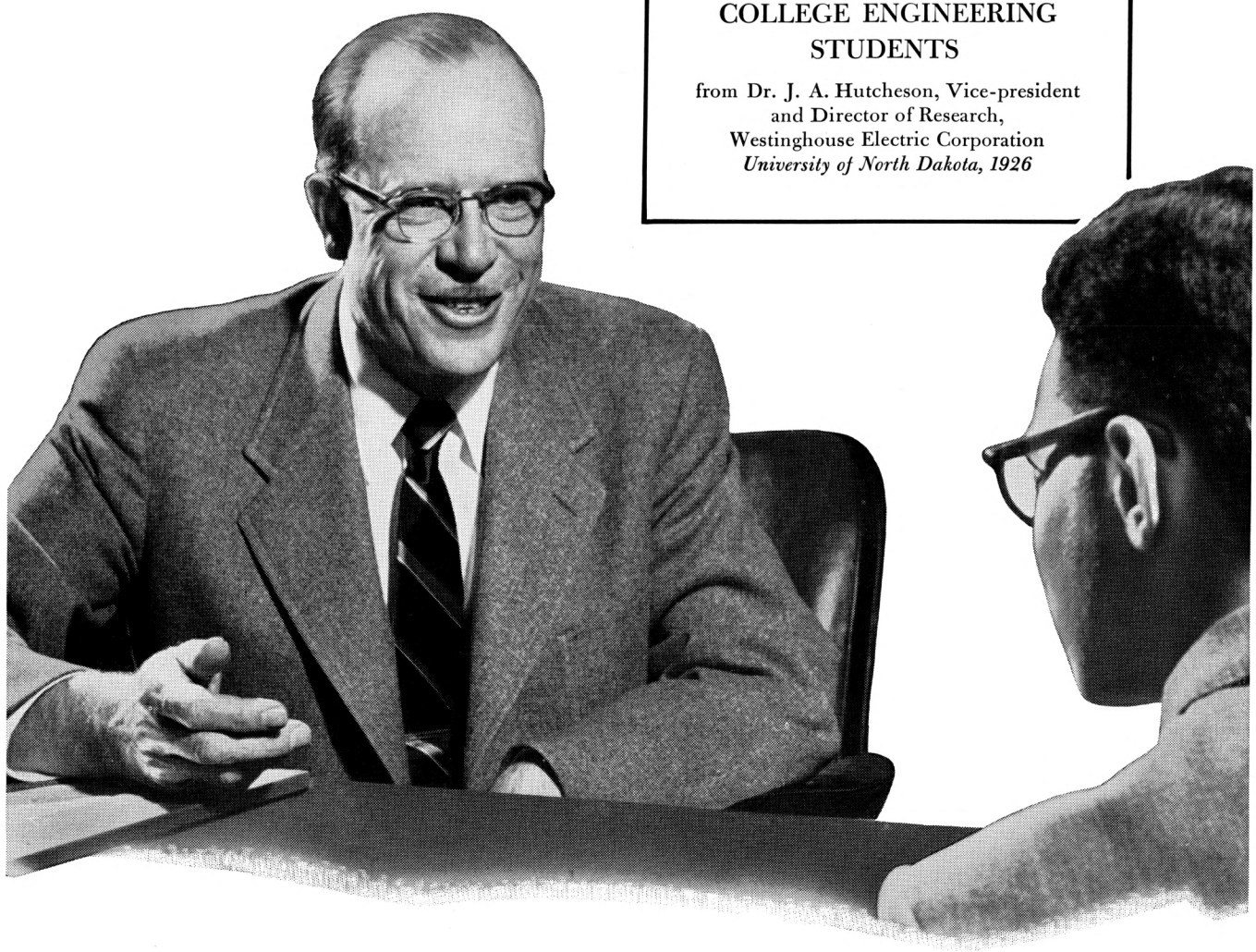
A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from Dr. J. A. Hutcheson, Vice-president
and Director of Research,
Westinghouse Electric Corporation
University of North Dakota, 1926



To the young man bent on conquering the unknown

Behind every successful career, there's a driving force. An inspiration, an ambition—call it what you will—that spurs a man on.

It has been interesting to me to watch the progress of the young men in our research departments . . . watch their ambitions take shape. Men, who only yesterday, it seems, came to us from the universities, and are now engaged in vital projects in our applied and fundamental research programs. These young men are exploring the unknown—looking for something better than ever before. It's a challenging life—and a rewarding one.

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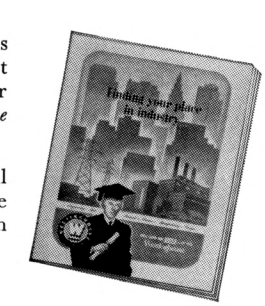
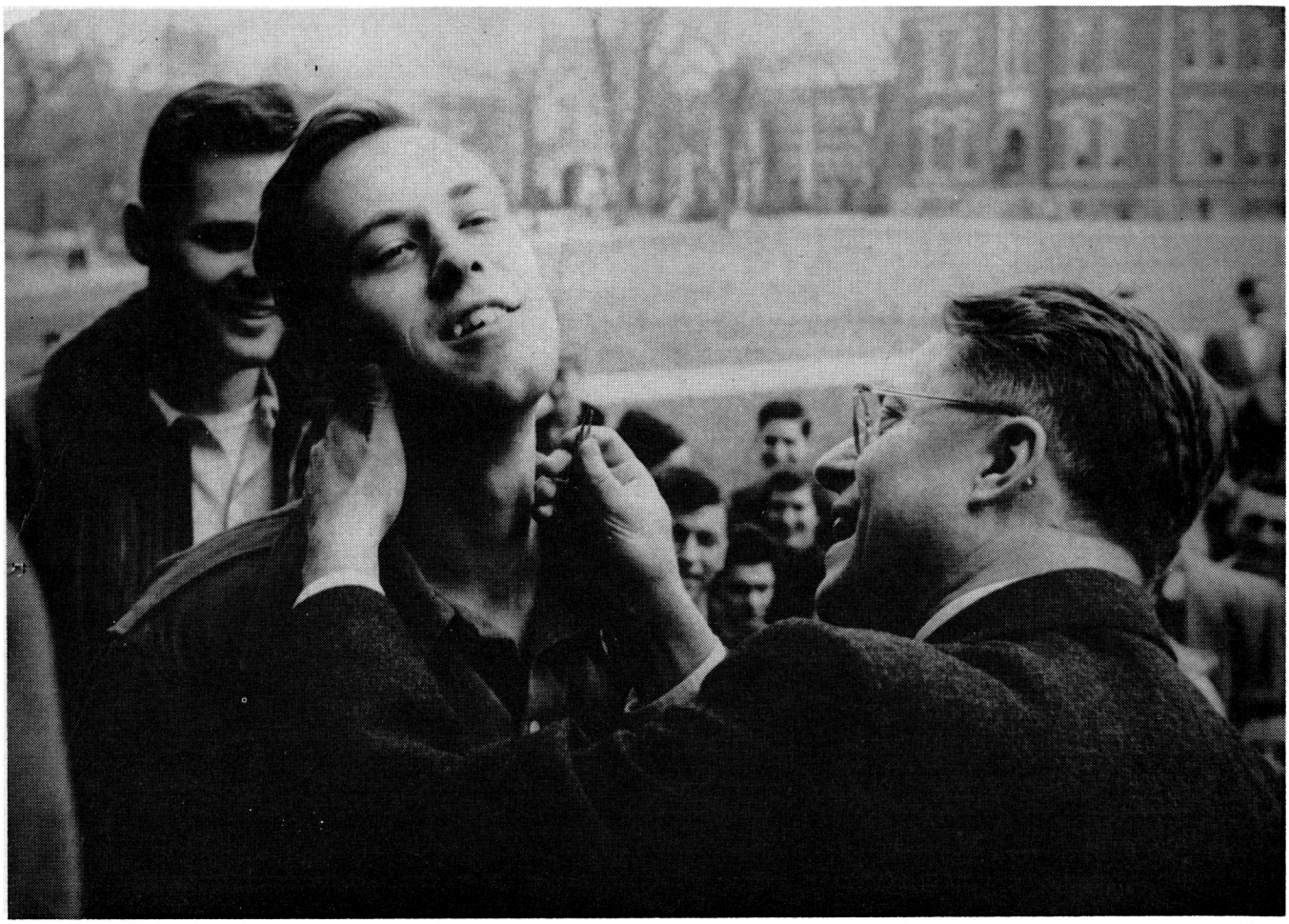




Above, a photo taken three years ago, is a picture of the beard growing contest. Bill English, on the left, was a senior and is now a grad student. The gentleman on the right, Dr. Scorah, had just passed his 39th birthday. Note that the beards were only 5 days old.

Home

In the past years, of the graduates who did not go into the armed services, more than 30% moved outside the state of Missouri when they took a job. The state of Missouri paid, through the taxpayers, more than 10,000 dollars for each of these educations. Since jobs are available in Missouri, why does this percentage of graduates leave Missouri? Is the grass greener on the other side? Are there better chances for advancement outside of Missouri? Does the graduate return after he gains experience? Or is there a lack of interest by the Missouri companies in a graduating engineer?

These questions can only be decided by the graduating engineer and the companies who use engineering services. We must remember though, that each engineer leaving the state to take a job carries with him better than 10,000 dollars in education. This money may not be returned to our state and we lose.

D.B.A.

GERMAN AUTOMATIC ARMS OF WORLD WAR II

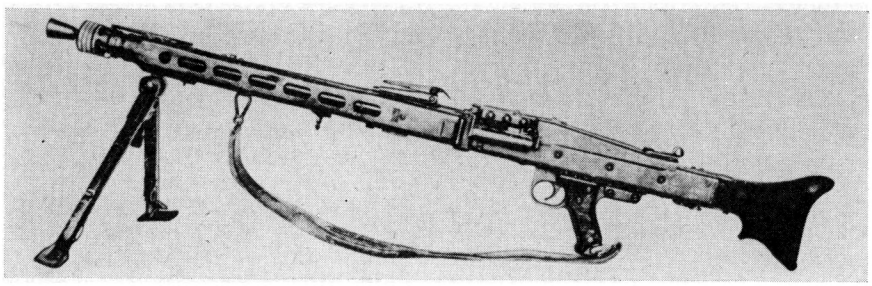
By Maxwell Atchison, M.E. '56

The small arms of our armed forces are in sore need of replacement. The Browning Light Machine Gun, adopted in 1919, are two examples of outdated arms still being issued to our troops. The most alarming aspect of this problem is that not much is being done to remedy it. Only one new weapon (the T-44, a full-automatic rifle) is in the process of being adopted. Arms research and design have steadily decreased since World War I, except for the few brief years of World War II.

Germany, on the other hand, has made tremendous strides in the development of automatic arms that are simple in design and manufacture, yet terribly efficient in use. The German arms designers went by this rule: a weapon should have few and well-designed parts because then it will be easier to manufacture, lighter in weight, and more reliable in operation than a well-machined, complicated weapon. For new and better ideas our arms designers should pay close attention to the arms the Germans made before and during World War II. These are not experimental weapons; they are weapons that have met the trial of battle. With them Germany has laid the groundwork for the weapons of tomorrow.

MG 34-42

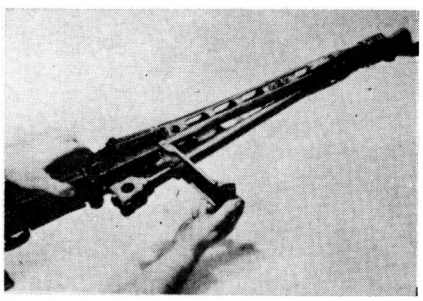
The treaty of Versailles prohibited the Germans from manufacturing heavy machine guns. To avoid this restriction, they developed an all-purpose machine gun which could officially be called a light machine gun, but which had characteristics enabling it to serve as a heavy machine gun. This weapon, the M.G. 34 (Machine Gun, model 1934), has made every heavy and light machine gun obsolete. The M.G. 34 was, however, intricately machined, and was redesigned during the war, reappearing as the M.G. 42. The M.G. 42 weighs 25 pounds and is recoil operated, bipod mounted, and belt fed. Since these weapons are similar in operation, a description of the M.G. 42 is similar to that of the M.G. 34.



The MG 42, the best light machine gun in the world.

To appreciate this weapon, one must understand the over-heating problem of automatic arms. After a weapon has fired 300 to 500 rounds in the space of a few minutes, the barrel becomes so hot that it expands and the bullets fail to grip the rifling. When this occurs, the bullets go end over end a short time after leaving the muzzle making it almost impossible to hit a target. The old way of cooling a barrel was to surround it with a water jacket that held seven to eight pints of water. This type of weapon is a heavy machine gun and has the disadvantage of being too heavy (it weighs nearly 100 pounds with mount) for normal combat.

The Germans developed a barrel removal mechanism for the M.G. 42 that enabled the barrels to be changed so rapidly that the disadvantage of overheating was completely eliminated. Removing a hot barrel and replacing it with a new one is very easy on the M.G. 42. When the gun is cocked, a forward and outward push on a spring catch with the heel of the hand levers the rear end of the barrel completely out of the gun.



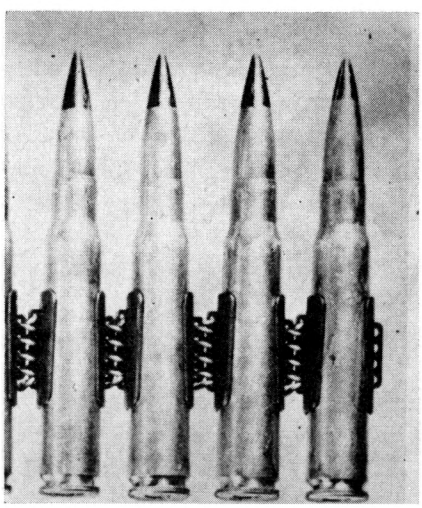
Barrel removal on the MG 42.



The MP 43. Note the sheetmetal stampings.

When the muzzle of the gun is elevated, the barrel slides out of the lever mechanism on its own accord. Asbestos gloves, commonly used with other machine guns during barrel change, are not needed. Inserting the muzzle of a new barrel through the hole in the lever, pushing the barrel forward until its muzzle enters the forward end of the barrel casing, and then shutting the lever prepare the gun to resume firing. No weapon made compares with this one for simplicity and ease of barrel change.

The M.G. 42 uses the 7.92 mm German Service cartridge in a special metal belt. This new type belt permits the use of the simplest belt feed mechanism yet designed. In the old Maxim and Browning systems, the belt was brought into the gun by a lever acting off the bolt. An extricator on the bolt pulled the cartridge out of its belt loop to the rear and then forced it down into the feed slot in the face of the bolt, which then pushed it into the chamber. This type of feed required the use of numerous camming surfaces and of intricately machined small parts that were liable to jams.



MG 34-42 belt.

The German belt consists of a series of individual spring metal links joined together by small pieces of coiled wire. Each link, which is shaped like an ordinary pencil clip, has an opening on one side to permit the feed rib of the bolt to go through it. This feed rib is the same type used on box-magazine fed weapons, such as the M.1918 Browning Automatic Rifle. After the belt is fed into the gun, the bolt merely comes forward and pushes the cartridge from the belt directly into the chamber. This type of feed, which is probably the best ever made, has not been used in a U. S. design.

The shape of the stock is another noteworthy feature of this gun. Older type light machine guns use regular rifle-type butt stocks in which the butt-plate is below the line of recoil. This is necessary to allow the gunner to get his head low enough to see through the sights. This type of stock permits the weapon to pivot during firing causing the muzzle to go up or "climb". The Germans eliminated this "climb" on their M.G. 42 by using high sights and a crutch-like stock, in which the butt-plate is directly behind the line of recoil. There is no pivoting during firing, and a whole belt (250 rounds) can be emptied with no "climb". Another advantage of this type of stock is that it permits the action (bolt, receiver, operating springs and buffer) to be extended clear back to the butt-plate. This long-type action is much more reliable than the short actions used in other machine guns.

During World War II the U. S. Government gave the Saginaw, Michigan, Division of General Motors, a contract to produce the German M.G. 42 (to be chambered for the U.S. 30 cal, cartridge, of course). Unfortunately this American variation was never perfected and the contract was canceled at the end of the war. Why this weapon, or a variation of it, has not been perfected and adopted in this country is a question that the U. S. Department of Defense should answer.

To produce a cheap, highly efficient weapon, lighter than the light machine gun yet with more range than the sub-machine gun, the Germans developed the quite remarkable M.P. 43 Machine Carbine, also named Sturmgewhr 44 (assault Rifle, 44). It has the handling characteristics, the weight (10½ pounds), and the general shape of the American Thompson submachine gun. However, the M.P. 43's special 7.92 mm cartridge is six times as powerful as the Thompson's 45 cal pistol cartridge. Economy, speed of manufacture, and effective full-automatic performance to at least 400 years firing range are the outstanding virtues of this gun.

In order to produce this weapon cheaply and easily, the Germans used more stamped parts in this weapon than any other locked-breech weapon yet designed. Receiver, jacket, frame, and front sight hood are all sheet metal stampings. Costing one-fifteenth as much a stamped part is stronger for its weight than a machined part. The stampings in this weapon have been designed to provide a maximum of reinforcement. Since sheet metal is flexible until it is formed into irregular shapes, the M.P. 43 has about seventy grooves, bends, and curves pressed into it's stampings to make them rigid. This is probably a record number for a machine of this size.

The gas and locking system used in the M.P. 43 has potentialities which should not be overlooked by our arms designers. The gas piston, operating rod, operating handle, spring guide, and bolt camming and locking surfaces are all combined into two units. There are no locking lugs or locking wedges (common on other automatic arms) on this weapon. The weapon is automatically locked when the rear end of the bolt is cammed down by the operating rod into a re-

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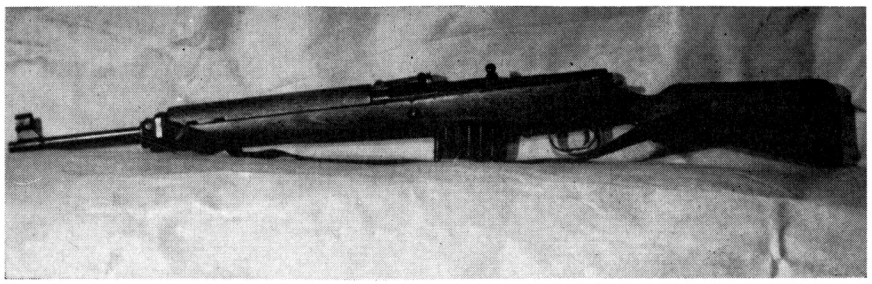


The Gewehr 43

cess in the receiver. The bolt on this weapon performs the same function as a locking wedge does on a complicated weapon. Since the M.P. 43 has just two moving parts, the operating rod and the bolt, it is easier to manufacture and easier to clean and maintain than other automatic arms which have complicated actions.

THE GEWEHR 43

Germany produced one successful semi-automatic rifle during WW II, the Gewehr (Rifle) 43, also called Karabiner (Carbine) 44. As a whole this weapon is inferior to the U. S. M-1 Garand rifle (the locking system is not as reliable), but it is far easier to manufacture. Although the Germans had captured U. S. M-1's early in the war, they did not use the M-1 design because it required too much machining. The Gewehr 43 was designed to permit mass production, and it has some features that possibly could be used in future U. S. weapons.

The method of mounting the barrel to the receiver is one of the simplest yet designed. Most other rifles have a threaded barrel that is screwed into the receiver. The drawback of this method is that it requires very close tolerances to enable the barrel to be seated tightly and still have the barrel in the correct position, (the front sight and the gas port must be vertical). Threads are not used on the Gewehr 43. The barrel is machined over-sized and the receiver is machined under-sized. The barrel is frozen to shrink it while the receiver is heated to expand it, and the two components are forced together in a hydraulic press. A retaining pin is then inserted through the receiver and barrel to further stengthen the coupling.

Like in other German weapons, sheet metal stampings were used in the Gewehr 43 wherever possible. The front sight hood, forearm band, bolt cover, magazine, trigger guard and butt-plate are all stampings. The merits of stampings have been stated above. The Gewehr 43 is an example of how they can be used in rifle manufacture.

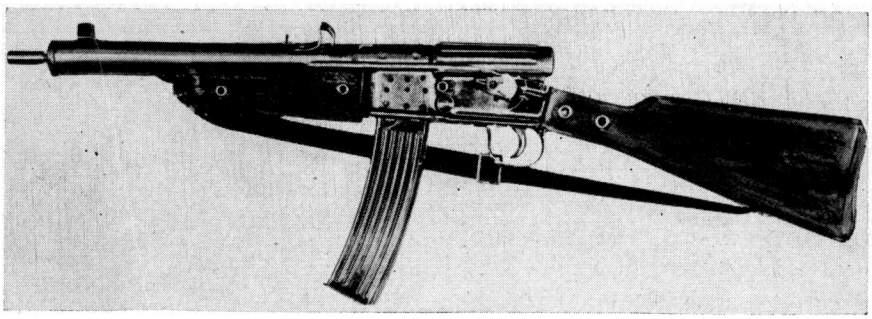


The MP 40 "Burp Gun"

THE M.P. 38-40 SUBMACHINE GUN

The Germans designed the first submachine gun that permitted true mass-production, the Schmeisser M.P. 38-40 (Machine Pistol, model 1938 and modification 1940), also called the "burp gun." This design is well known and variations of it are in use today by all of the major powers of the world. It is described here because an understanding of its operation covers most modern submachine guns.

A submachine gun has a short barrel and uses low-powered pistol cartridges (the M. P. 39-40 is chambered for the 9/mm Lager cartridge). The Germans found that the breech of a submachine gun could be held closed at the moment of firing by the inertia of a heavy, moving bolt. This type of action is called blowback operation, and is used in the M.P. 38-40. When the trigger of the M.P. 39-40 is pulled, the bolt is released and moves forward to push a cartridge from the magazine into the chamber. The firing pin, which protrudes from the face of the bolt at all times, fires the cartridge as soon as it is seated. The inertia of the heavy bolt in forward motion is much greater than that of the light bullet, and the action does not open until the bullet has left the muzzle. By this time the breech pressure has dropped to a safe limit. The bolt is then blown to the rear to continue the firing cycle as long as the trigger is held.



The Volksturm Geschuss

VOLKSTURM GESCHUSS CARBINE

The last weapon to be developed by the Germans before their defeat was the Volksturm Geschuss ("People's Shooter") carbine. Originally intended as a cheap expendable arm to be issued to the people for home defense, it represents an entirely new departure in the field of low cost ma-

(*Continued on Page* 28)

THE EFFECT OF THE ENGINEERING SHORTAGE ON THE GRADUATING ENGINEER

By Robert J. McCloud, C.E. '54

Most people connected with engineering know that in recent years the demand for graduate engineers has far exceeded the supply that graduate each year from the engineering schools throughout the United States. We all recognize the fact that this shortage can be detrimental to our standard of living as well as to our national security. But I wonder if there may not be another harm, just as great, even though it may not be quite so obvious. This harm, that I have in mind, is that the general quality of the engineering graduates may be declining due to this shortage. Although I hope that I am wrong in my observations I have noticed a general attitude upon the part of a number of engineering students that is indicative of this decline.

Their attitude is basically this, "I am assured of a good engineering position upon graduation, with a high starting salary, as compared to other professions, so why should I try to impress my prospective employers with a high scholastic standing or an impressive school record. All that is required of me to get a job is to get a degree in engineering, regardless of how poor my record may be." Their reasoning is substantiated by the records of previous years, which show that most graduates received from two to five job offers regardless of scholastic record.

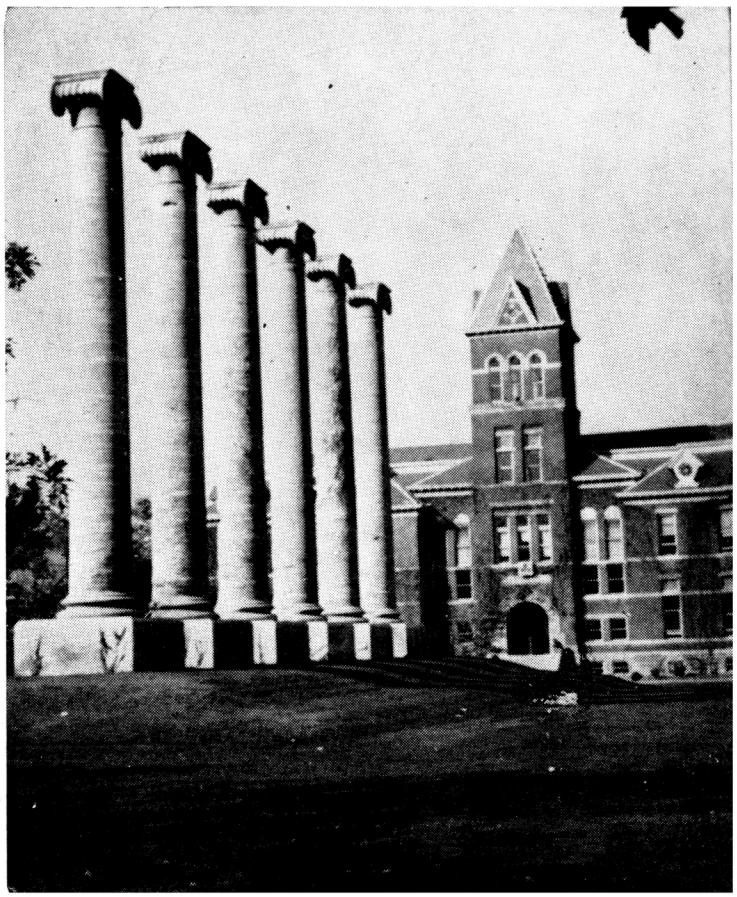
This then may be the harm. These men are not so much concerned with becoming competent engineers as they are with getting a degree in engineering so that they may take advantage of the shortage of engineers and thereby receive a well-paying position. Instead of studying and working hard to obtain a well-rounded and thorough knowledge of engineering principles, they only study and work to the extent necessary to receive a passing grade in the required subjects. They are more concerned with the grade they receive in a course than with the knowledge they obtain from the course.

Just what kind of engineers can we expect these men to become? Undoubtedly some of them may develop into outstanding engineers, regardless of all indications to the contrary, but all of them cannot expect to be endowed with the natural engineering ability.

Does this mean that we will have a crop of engineers who will never really be engineers but just holders of the engineering degree? Can we expect to obtain any more from these men than they originally expected to obtain from their engineering education? If not, then it is something that should be given considerable thought, for the health, the security, the very future of our country depends to a great extent upon the number, and more important, the quality of the men in the engineering profession.

I do not propose any sure plan for correcting this situation, if it does exist and I sincerely hope it does not. But if it does then all people connected with the engineering profession should be made aware of the fact so that they might bring to the student's attention the fallacy of their reasoning which is simply this: even though the graduating engineers are assured of immediate employment this does not necessarily mean that they shall retain this employment, or always be able to obtain new employment should they lose the old. If a man cannot produce results for his employer then of what use is he? And how can he produce results in the engineering profession if he is not an engineer!

MIZZOU MEMOS



The Staff

Back again with some news of old and new grads. We are expecting to see many of you down here for the 52nd celebration of St. Pat's Week. While you are here, drop in the SHAMROCK mail box news of yourself and others.

We hear that DALE CUNNINGHAM, BS in E.E. '51, is now working the Special Products Plant of Bendix Aviation Corporation. The plant is located in Mishawaka, Indiana; and Dale lives at 430 Gernhart, Mishawaka.

ERNEST MELLOW, BS in Ch. E. '40, M.S. in Ch. E. '46, is now working for the Phillips Petroleum Co. of Bartlesville, Oklahoma.

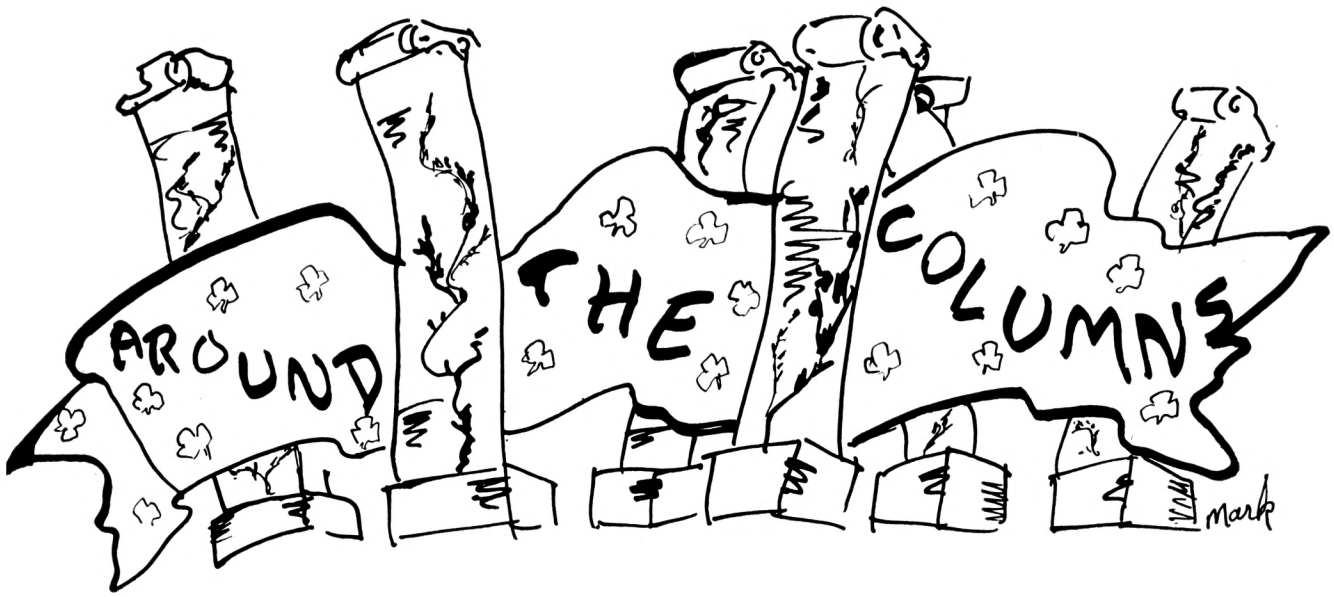
The Ch. E. Department notifies us that CARL BAUMGARTNER, BS in Ch. E. '21, is employed at the Jones Mill Works of Reynolds Metals Co. at Lake Catherine, Arkansas.

GEORGE KLIEN, JR., BS in Ch. E. '49 is Chief Engineer at the Refinery Engineering Co. of Tulsa, Oklahoma.

ROBERT RUTHERFORD, BS in Ch. E. '49 is Sales Representative for The Industrial Chemical Dept. of the Spencer Chemical Co. which is located in the Dwight Bldg., Kansas City, Mo.

Also we've noticed that C. WILLIAM ADE, B.S. in Ch. E. 1948 and M.S. in Ch.E. in '49 is now employed by the Plants Division, Design Branch of the Army Chemical Center in Edgewood, Md. Incidentally, Bill lives at 31 McCann St., P. O. Box 799, Edgewood, Mo.

It is with deep regret that we announce the death of one of our alums, HOMER K. SMITH. Mr. Smith, who graduated with a B. S. in Engineering in 1906, died Nov. 1953. Mr. Smith originally came from Holt County, Mo. After graduation he spent a short time with the electrical Dept. of the St. Louis Transit Co. From there he went to the Panama Canal where he took the position of electrical superintendent of the Pacific Division during construction. Upon completion of the canal he went with Westinghouse Company, where he served in various capacities until his retirement in 1949 after thirty-six years of service. Upon retirement, Mr. Smith lived at 1025 Windsor Drive, Menlo Drive, Menlo Park, Calif., with his wife, Mrs. Boda Fuller. It can truly be said that Mr. Smith was a credit to the Engineering Profession and will long be remembered by his friends and associates.



By Slipstick Sam, B.S. '99

Well, happy days are here again. It looks like it will really hit the fan, come January 28 through February 4. Nothing like a good old Final Week to turn a normal human being into a bleary eyed monster representing something from outer space. The really good thing about the whole deal is the extensive vacation after finals are over. Why, in four days you almost have enough time to go home.

A word to the wise. Why doesn't some quick-witted engineer put down his slide rule long enough to ask *that* blonde Susie in M.E. 1 to maybe attend an engine club meeting once in awhile. Might be the start of a budding romance. Tune in next month to hear the next chapter of John's Other Wife.





Here is some info about the guys who graduated last year.

For all of you who remember Sam Sloan who graduated in 1953, he worked for a corporation in Kansas City by the name of Howard, Needles, Tammen, and Bergendoff. Sam received a degree in Civil Engineering and worked for this firm as a detailer. He is now stationed at Lackland Air Base in Arizona while serving in the Air Force.

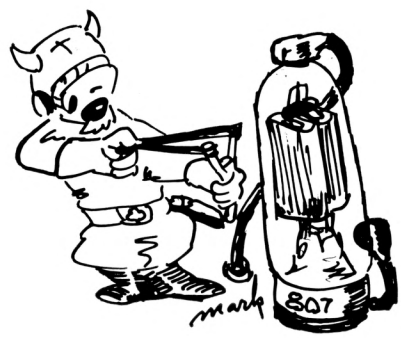
♣

Another grad from way back in '52, George Satterlee who also was C.E. is now in the Army Corps of Engineers and is being sent to school around the country. He has attended Purdue and also a school in West Virginia. He is now stationed at Biel Air Force Base in California.

Larry Dallem who will graduate in February of this year plans to continue his studies and go into graduate school to learn more about structural engineering. Larry is planning to teach C.E. 102 after this time. Larry, old buddy, just put in a plug that Slipstick Sam is a good guy when he takes this course.

♣

Well, Sitting Bull Gingrich is at it again, when he gave his lecture on color ranges and the spectrum in physics 24, he also included a portion on black light. When the room was darkened, he turned the light on himself, he had painted his face like an Indian, just like that old proverb; you can't teach an old Indian new tricks.



♣

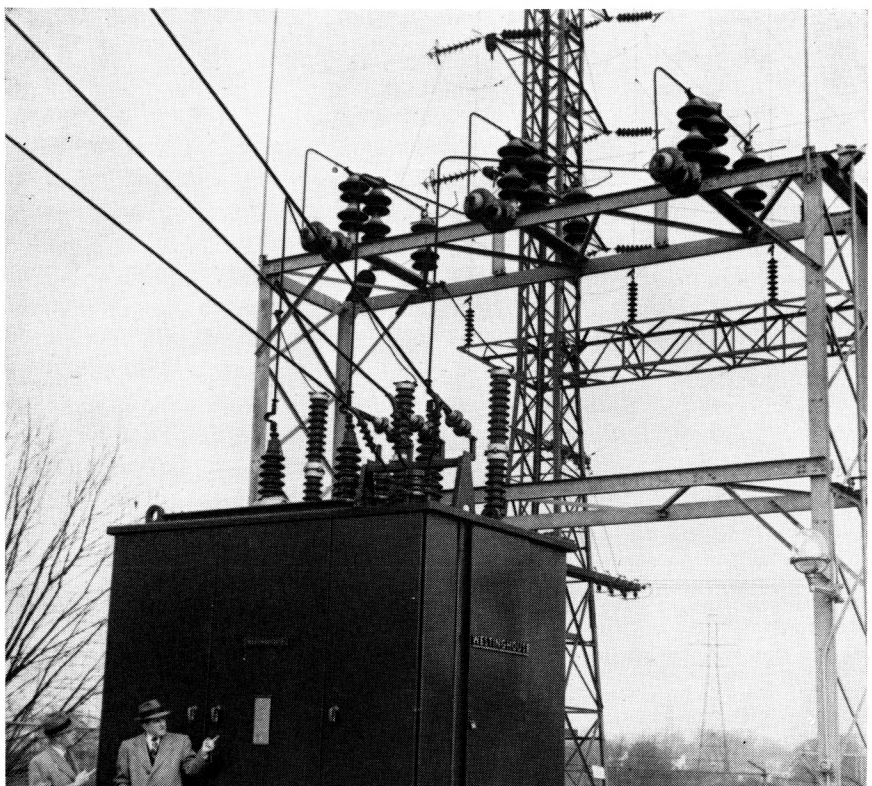
Did you know that Sangster who teaches C.E. 240, was an all around athlete when he was in school up at

(*Continued on Page* 32)

KWIK PIK

SINGLE SHOTS

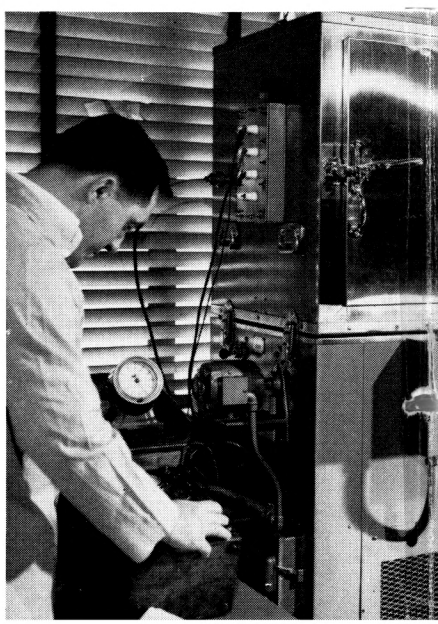
OF ENGINEERING INTEREST



—Cut Courtesy Westinghouse

The Westinghouse Electric Corporation single-circuit substation (CSP power transformer) has been improved in appearance—which is important in residential areas—and made so safe electrically against accidental or mischievous contact that the fence can be omitted if desired. The unit now has a 22-kv air-insulated, load-break switch coordinated in design and physical arrangement with the transformer compartment.

Other CSP power transformers have been improved appearance-wise by better shaping the roof to give an overhang edge, and by providing fewer but full-length doors. To assist in closing these long doors a latch mechanism guides the door top and bottom over the last two inches of travel.

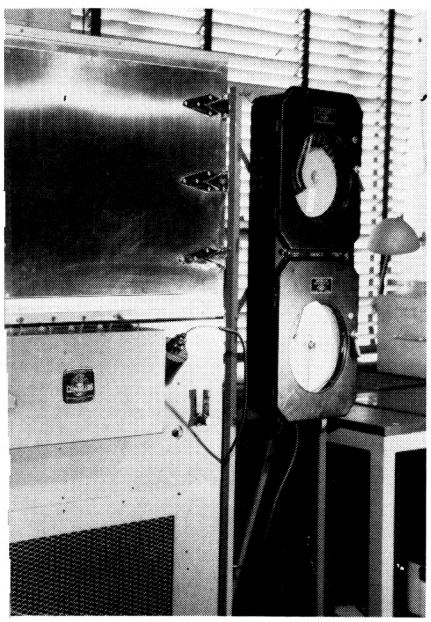


With growing demands, particula vironmental testing, this humidity c Pittsburgh laboratory facilities of th Ranges in temperature from 32 degre air to saturation are possible. A pro environment cycle. Manipulation of sa from outside without breaking the sea



—Photo Courtesy North American

Newest jet trainer is this North American TF-86, two place version of the Korea-famed Air Force F-86 Sabre Jet. The swift prototype trainer is basically an F-86F with tandem cockpit, dual controls and a fuselage five feet longer than the fighter version.



—Cut Courtesy Westinghouse

ly by government agencies, for en-
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Westinghouse Electric Corporation.
F to 160 and in humidity from dry
am controller provides any desired
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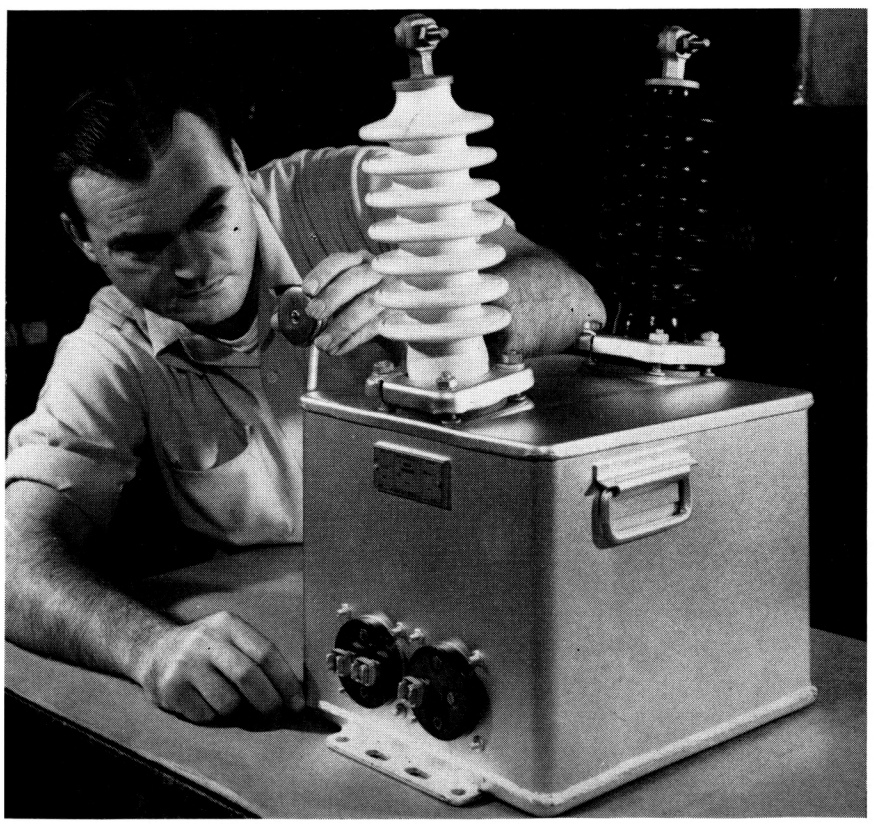
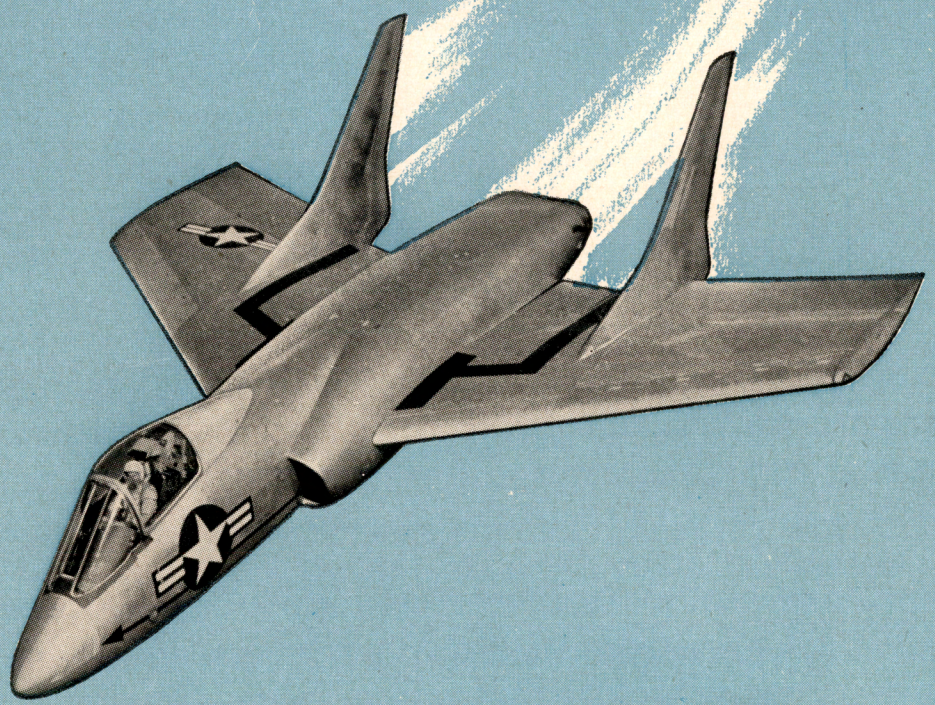


—Cut Courtesy Westinghouse

Generating voltages—long stationary at 11 and 13.8 kv, are beginning to rise. Voltages of 15, 18, 21, and even 23 kv are not uncommon. To serve these generating voltages new instrument transformers have become necessary since air-insulated instrument transformers for these voltages have not existed—and power companies don't like oil-containing apparatus inside powerhouse.





36 YEARS OF NEW IDEAS

To MAINTAIN a top position in the aircraft industry for more than 36 years requires the engineering of new designs through the application of engineering experience plus imaginative thinking. Chance Vought Aircraft has offered the opportunity for such a career since the day of its founding in 1917 when it began the design of the VE-7, a two-seated biplane which was redesigned for the Navy as the VE-9.

During the past 36 years young engineers and scientists have been an important source of these new ideas. Today, more so than ever before, many interesting career opportunities are available at Chance Vought as the company designs the latest versions of the F7U-3 Cutlass, the "Regulus" guided missile and other high speed fighter aircraft projects.

The achievements of the past 36 years at Chance Vought, great as they have been, offer little means of evaluating fully the potential of aviation's future. If you are interested in a position with an unlimited future, a position with the constant responsibility of evaluating and applying new ideas, if you are interested in working for a company with a wealth of experience in its line and yet ambitious to create the latest designs in its field, investigate the employment opportunities at Chance Vought.

Engineering and scientific graduates are invited to contact their Placement Officer to arrange for a personal interview when the Chance Vought Engineering Personnel Representative visits on campus.

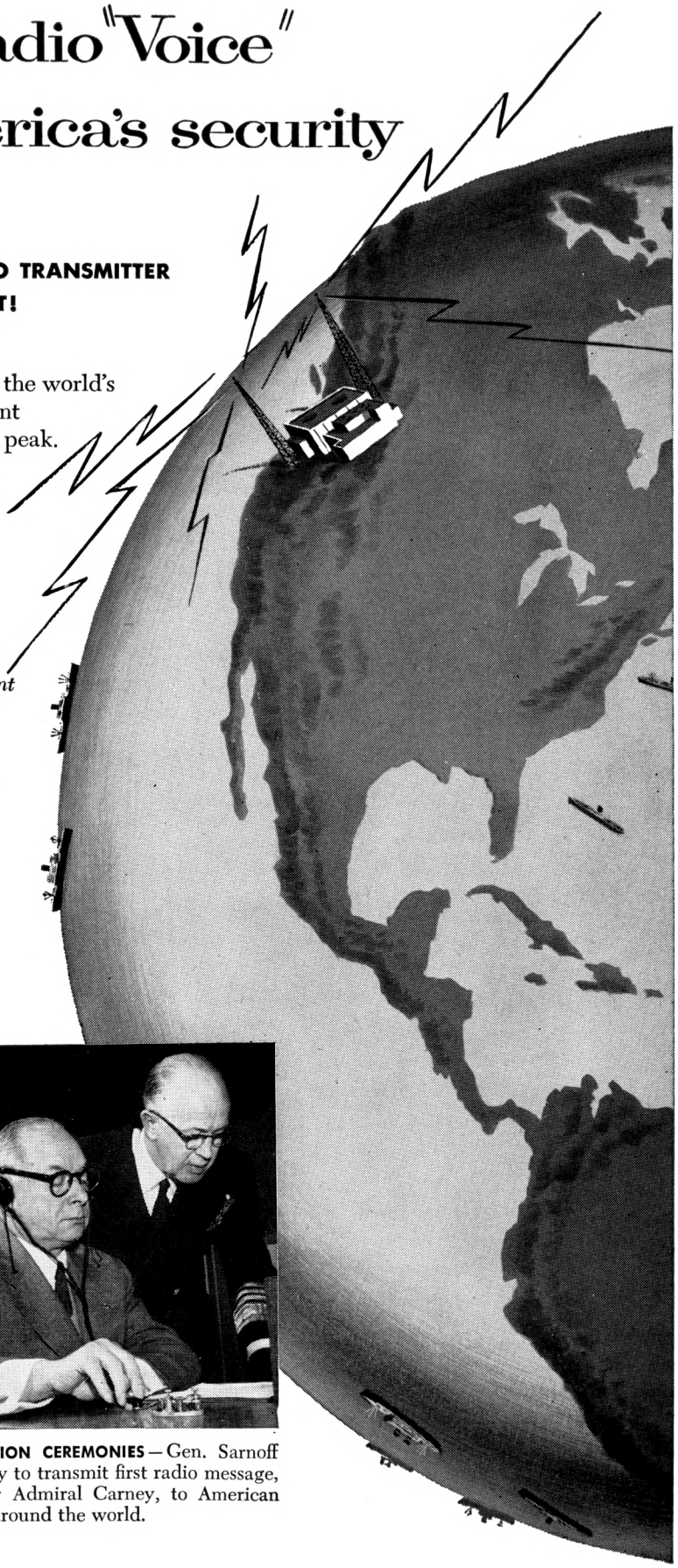
CHANCE VOUGHT AIRCRAFT

INCORPORATED

CHANCE VOUGHT

Dallas **Texas**

Navy's new radio "Voice" dedicated to America's security



WORLD'S MOST POWERFUL MILITARY RADIO TRANSMITTER
A 6-YEAR NAVY-RCA PROJECT!

On Jim Creek, in the State of Washington, stands the world's most powerful military radio transmitter—its giant antenna stretches from mountain peak to mountain peak.

A 6-year project of the Navy and RCA, "Big Jim" was built and installed to provide the Navy, for the first time, with instant communications with naval units everywhere, on the seas and under the seas, on land and in the air.

Speaking at the dedication ceremonies, Brig. Gen. David Sarnoff, Chairman of the Board of RCA, said:

"May I express the wish, which I know all in our Armed Services share, that this powerful instrument for transmitting intelligence may add to our national security and to the peace of the world."

The first message flashed by the "Big Jim" transmitter was from Admiral Robert B. Carney, Chief of Naval Operations, to U. S. Navy personnel around the world. He said:

"With this message we forge another link between you and your homeland. With it, we build a new security channel from America to the naval units which form its outer ramparts of defense."

INTRIGUING OPPORTUNITIES FOR GRADUATING ENGINEERS

You're sure to find the exact type of challenge *you* want in Engineering Development, Design, or Manufacturing at RCA. Men with Bachelor's, Master's or Doctor's degrees in EE, ME, IE or Physics are needed. *You'll find your optimum career work* among the hundreds of products RCA produces for the home, science, industry and Government.

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AT DEDICATION CEREMONIES—Gen. Sarnoff operates key to transmit first radio message, dictated by Admiral Carney, to American fleet units around the world.

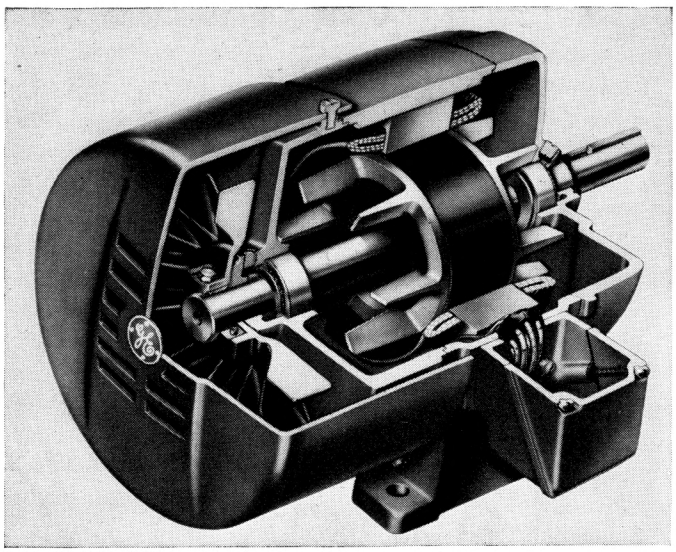
RCA®

RADIO CORPORATION OF AMERICA

World leader in radio—first in television

NEWSTUFF

By Mike McDanield



—Cut Courtesy General Electric

One of the oldest and most annoying headaches in industry—machinery noise—will be greatly alleviated as the result of a new electric motor design.

General Electric Company engineers, after five years of extensive research into the causes of noise in electric motors, have developed what they call a "sonant" motor.

Special electronic tests prove the success of this latest concept of engineering: The new 10-horsepower motor was shown to have about the same over-all noise level as the old 2-horsepower motor.

By isolating the three main causes of motor noise—bearing rattle, magnetic hum, and windage (the rush of air through the motor)—the scientists were able to decrease the noise and, perhaps more important, make the sound frequency more pleasing to the human ear.

Since electric motors are the most widely used form of machinery in the modern world, attacking the noise problem at this level is a major technical advance for all industry, the engineers explained.

The official name of this new motor is the Tri-Clad "55" and the motor is about half as large and as much as 40 per cent lighter, horsepower per horsepower than previous 10 horsepower motors.

What is believed to be the world's most powerful mechanical arm has been developed by the General Electric Company to substitute for human brawn in radioactive areas where men could not survive.

Named O-Man (for overhead manipulator) the 15-ton remote-controlled giant will make possible the assembly or disassembly of large machinery by the twist of a knob or flick of a lever.

O-Man has been developed by GE for the Aircraft Nuclear Propulsion Department. This department, under the sponsorship of the Atomic Energy Commission and the Air Force, is engaged in developing an atomic engine for aircraft.

The new Mechanical "Arm" has been built as the answer to the need for a device with several times the lifting power of existing mechanical arms, yet of equal versatility. "Push-button" operations in buildings designed to prevent the escape of radiation are necessary in certain types of atomic energy work. O-Man's operator will work through special glass windows, with the aid of binoculars or a telescope.

By comparison, if a man were as strong as O-Man, he would be able to carry 5000 pounds on his back, lift 3000 pounds from the floor, hold 1000 pounds with his arm extended horizontally, or lift and manipulate a piano with his forearm and wrist. O-Man's chief job will be to pick up heavy parts, position them and fasten them into place. It can drill and tap holes, use power wrenches, hammers, or riveters, and if need be, can handle a sheet metal saw.

In a strong man test, it twisted an iron bar into a corkscrew, then for good measure, tied it into a neat knot.

Although it won't be called upon for delicate tasks, O-Man has demonstrated that, with its twin steel fingers, it can whip up, slice and serve a cake or pick up and pour a glass of water.

Resembling a gun turret, the big device will operate from a crane bridge. Its vertical maneuverability will range from floor level to the height of the crane bridge.

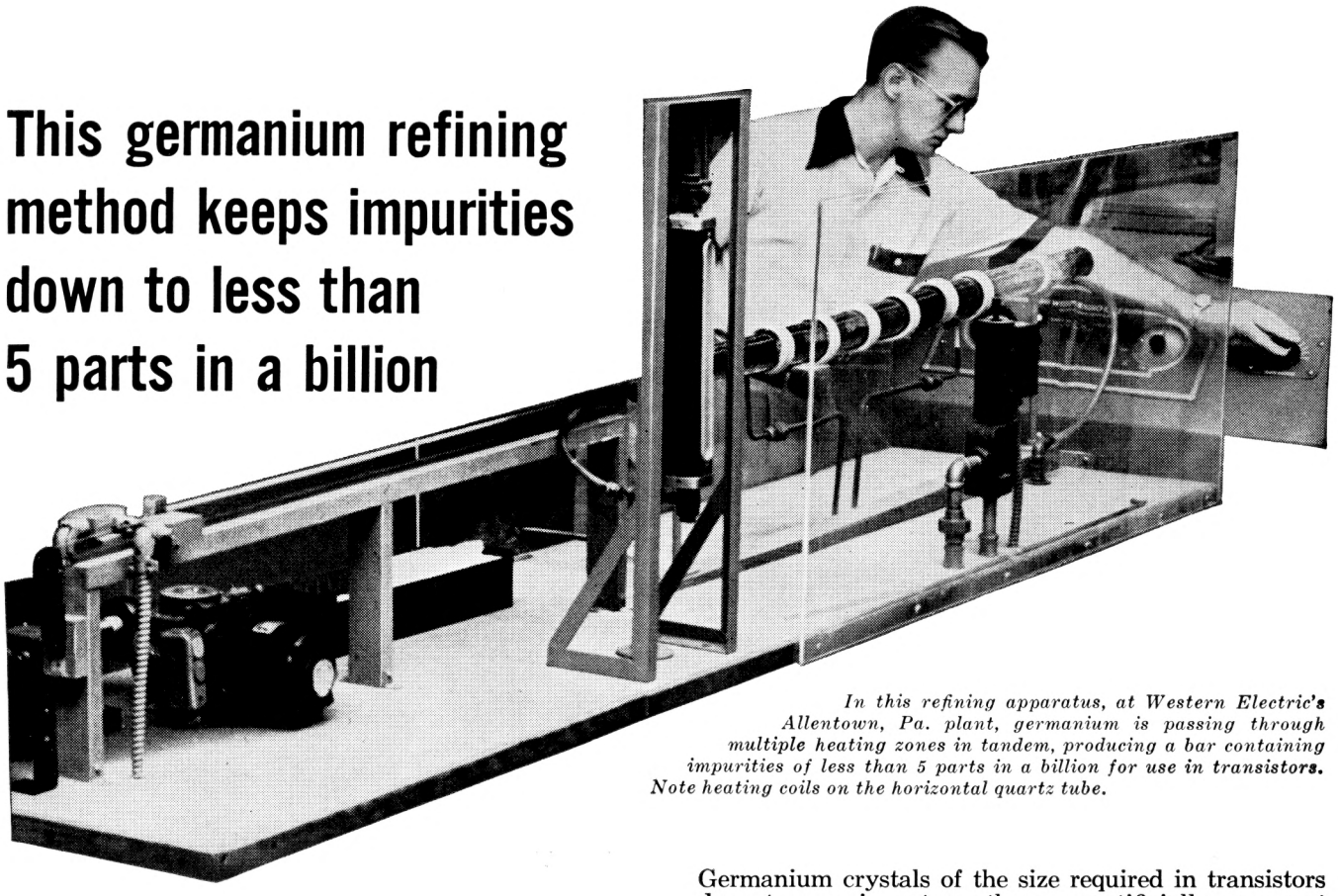
While its grip lacks the flexibility of human fingers, it otherwise possesses the same degree of motion as the human hand and arm, plus the ability to telescope its "forearm" and revolve its "wrist".

Power control is brought to O-Man via 140 separate wires in multi-festooned cable; the heart of the control mechanism is a system of eight amplidymes, GE developed devices that provide automatic control, giving smooth operation and limiting all motions to prevent damage to equipment.

While soldering has, for many years, been the accepted method of making

(*Continued on Page* 30)

This germanium refining method keeps impurities down to less than 5 parts in a billion



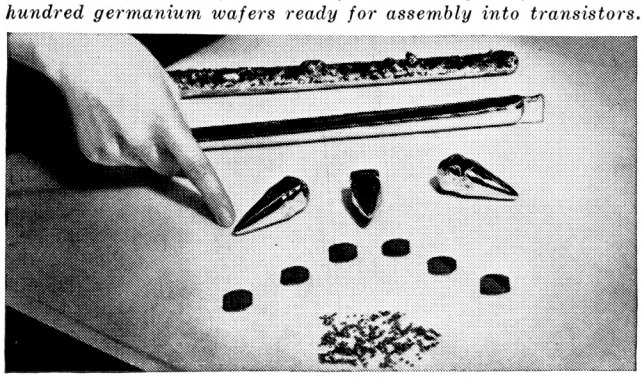
In this refining apparatus, at Western Electric's Allentown, Pa. plant, germanium is passing through multiple heating zones in tandem, producing a bar containing impurities of less than 5 parts in a billion for use in transistors. Note heating coils on the horizontal quartz tube.

A new method of metal refining, currently in use at the Western Electric plant at Allentown, results in the production of germanium that is better than 99.9999995% pure – the highest degree of purity ever attained in a manufactured product.

The need for germanium of such exceptional purity came about when research by Bell Telephone Laboratories in the field of semi-conductors led to the development of transistors, which are manufactured by Western Electric.

The transistor is a tiny crystal device which can amplify and oscillate. It reduces space requirements and power consumption to a minimum.

Various forms which germanium takes before being used in transistors are shown in this photo. Bar at top is an ingot of germanium after reduction from germanium dioxide. Next is shown the germanium ingot after the zone refining process used by Western Electric. Below the ingots are shown 3 germanium crystals grown by machine, 6 slices cut from these crystals, and several hundred germanium wafers ready for assembly into transistors.



Germanium crystals of the size required in transistors do not occur in nature; they are artificially grown at Western Electric. At this stage in transistor manufacture, other elements are introduced in microscopic quantities to aid in controlling the flow of electrons through the germanium. But before these elements can be introduced, it is necessary to start with germanium of exceptional purity, so that the impurities will not interfere with the elements that are deliberately added.

So Bell Telephone Laboratories devised an entirely new method of purification, known as zone refining, which was developed to a high-production stage by Western Electric engineers.

In zone refining a bar of germanium is passed through a heat zone so that a molten section traverses the length of the bar carrying the impurities with it and leaving behind a solidified section of higher purity. By the use of multiple heating zones in tandem, a number of molten sections traverse the bar. Each reduces the impurity content thus producing a bar which contains impurities in the amount of less than five parts per billion.

Because of the importance of the transistor in electronics, the zone refining process – like so many other Western Electric developments – has been made available to companies licensed by Western Electric to manufacture transistors.

This is one more example of creative engineering by Western Electric men. Engineers of all skills – mechanical, electrical, chemical, industrial, metallurgical, and civil – are needed to help us show the way in fundamental manufacturing techniques.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Manufacturing plants in Chicago, Ill. • Kearny, N. J. • Baltimore, Md. • Indianapolis, Ind. • Allentown & Laureldale, Pa. • Burlington, Greensboro & Winston-Salem, N. C. • Buffalo, N. Y. • Haverhill & Lawrence, Mass. • Lincoln, Neb. • St. Paul & Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City.

BULLARNEY



By Gray

Some girls are like a zippered nightie. Pull anything and it's all off.

♣

When a guy breaks a date, he usually has to. But, when a girl breaks a date, she usually has two.

♣

"A collision is when two things unexpectedly come together. Lee, can you give us an example of a collision?"

"Yes'm, twins."

♣

Say, Jim, you should pull down the curtains. The whole neighborhood saw you kissing your wife last night.

Haw, the joke's on you, Ray! I wasn't even home last night.

♣

Even if you can't read a girl like a book, it's nice to thumb the pages.

♣

John: "Love was born with that kiss, darling."

Margie: "O.K., but hurry and wipe off that birth mark. Here comes Mom."

♣

Shirley: "Do you know the horrible things they've been thaying about me?"

Jim: "Why do you think I came over?"

♣

Sailor: "Waiter, bring me some tomato juice for a pickup."

Waiter: "Yes, sir; and what will you have for yourself?"

♣

Frosh: My roommate says there are some things a girl should not do before twenty.

Soph: Well, personally, I don't like a large audience either.

♣

J.A. "Did Judy blush when the strap on her bathing suit broke?"

B.L. "I didn't notice."

B.L.: "Why didn't I make 100 on my test?"

Soc. Prof. "You remember the question, 'Why did the pioneers go into the wilderness?' Well, while your answer was very interesting, it was incorrect."

♣

Student: "Sir, I don't think I deserve an absolute zero."

Professor: "Neither do I, but it is the lowest I can give."

♣

Coed: "How about a date, big boy?"

Engineering student: "Can't. Gotta go to bed and get some sleep."

Coed: "Why?"

Engineering Student: "Tomorrow's my tough day. Gotta shave."

♣

The deans who think our jokes are rough
Would quickly change their views
If they'd compare the ones we print
With those we're scared to use.

♣

Bum: "Have you a nickel for a cup of coffee?"

Engineer: "No, but I'll get by somehow.

♣

Customer: "I'd like to try on that dress in the window."

Clerk: "I'm sorry, Miss, you'll have to use the dressing room."

♣

English Teacher: "What does F-E-E-T spell?"

Backward Ag. student: "I don't think I know."

Teacher: "Well, what is it that a cow has four of and I have only two?"

—The class was dismissed.

♣

"My girl friend drinks nothing stronger than pop. But then again pop drinks darn near anything."

Prof: "Young man, are you teaching this class?"

Frosh: "No, sir."

Prof: "Then why don't you quit acting like a fool."

♣

"Honey, did that kiss I gave you make you long for another?"

"It sure did, but he's out of town."

♣

It's all right to tell a woman that she has pretty ankles but don't compliment her too highly.

♣

Hey, Dad, I'm home from school again.

What the devil did you do this time?

Graduated.

♣

Small boy: "Dad, is Rotterdam a bad word?"

Dad: "Why no, son, it's the name of a city."

Boy: "Well sis stole my candy and I hope that it'll rotter dam teeth out."

♣

He: "Am I the first boy that you ever kissed?"

She: "Are you being funny or are you working for Kinsey?"

♣

Waitress (slapping a customer): "I'm not the tomato that comes with the 40-cent lunch.

♣

Even when the gal is as pretty as a picture, most fellows like to take a peep at the frame.

♣

Country constable: "Sorry miss, no swimming allowed in this lake."

Sweet young thing: "Why didn't you tell me before I undressed?"

Same constable with a very quick thought: "There ain't no law against undressing."

THE DU PONT DIGEST



Technical Sales

A major in glibness and a minor in solid information—those were the mythical requirements for a salesman in the old days. But they really never sufficed for a man selling the products of chemical technology.

Today, the diverse applications of Du Pont's 1200 products and product lines create a need for trained sales personnel representing many different technical backgrounds. These men must deal intelligently with problems in chemistry and engineering applied to such fields as plastics, ceramics, textiles, and many others.

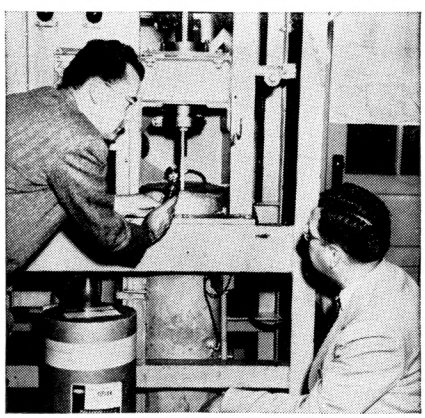
Du Pont technical men are assigned to various types of technical sales activity. In some spots they are equipped to handle all phases of selling. In others they deal mainly with customer problems. Also, certain departments maintain sales development sections, where technical problems connected with the introduction of a new product, or a new application for an established product, are worked out.

For example, a technical man in one of Du Pont's sales groups was recently called upon to help a customer make a better and less expensive hose for car radiators. Involved were problems in compounding, such as choice and amount of neoprene, inert fillers, softeners, accelerators, and antioxidants. Correct processing methods also had to be worked out, including optimum time and temperature of milling and extruding. The successful completion of this project naturally gave a good deal of satisfaction to the customer as well as Du Pont.

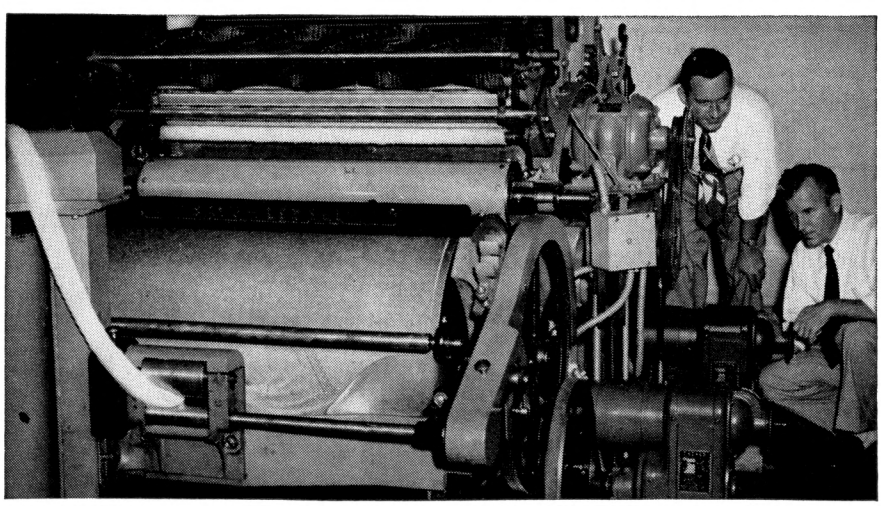
In another case a customer wanted to reduce carbon contamination of arc welding rod stock. A Du Pont technical service man suggested changes in cleaning procedures that lowered contamination by 90 per cent. The new process also reduced metal loss during heat treatment—a benefit that more than offset the cost of the additional cleaning operations.

Technical men interested in sales work usually start in a laboratory or manufacturing plant where they can acquire needed background. Depending on their interest and abilities, they may then move into technical sales service, sales development, or direct sales.

In any of these fields, the man with the right combination of sales aptitude and technical knowledge will find interesting work, and exceptional opportunities for growth in the Du Pont Company.



W. A. Hawkins (*left*), B.S.M.E., Carnegie Tech., demonstrates extrusion of "Teflon" tetrafluoroethylene resin for a customer.



James A. Newman, B.S. in Ch.E., North Carolina State (*left*), discusses study of optimum settings and conditions for carding nylon staple with Prof. J. F. Bogdan of North Carolina State's Research Division.

ASK FOR "Chemical Engineers at DuPont." This new illustrated booklet describes initial assignments, training, and paths of promotion. Just send a post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware. Also available: "Du Pont Company and the College Graduate" and "Mechanical Engineers at Du Pont."

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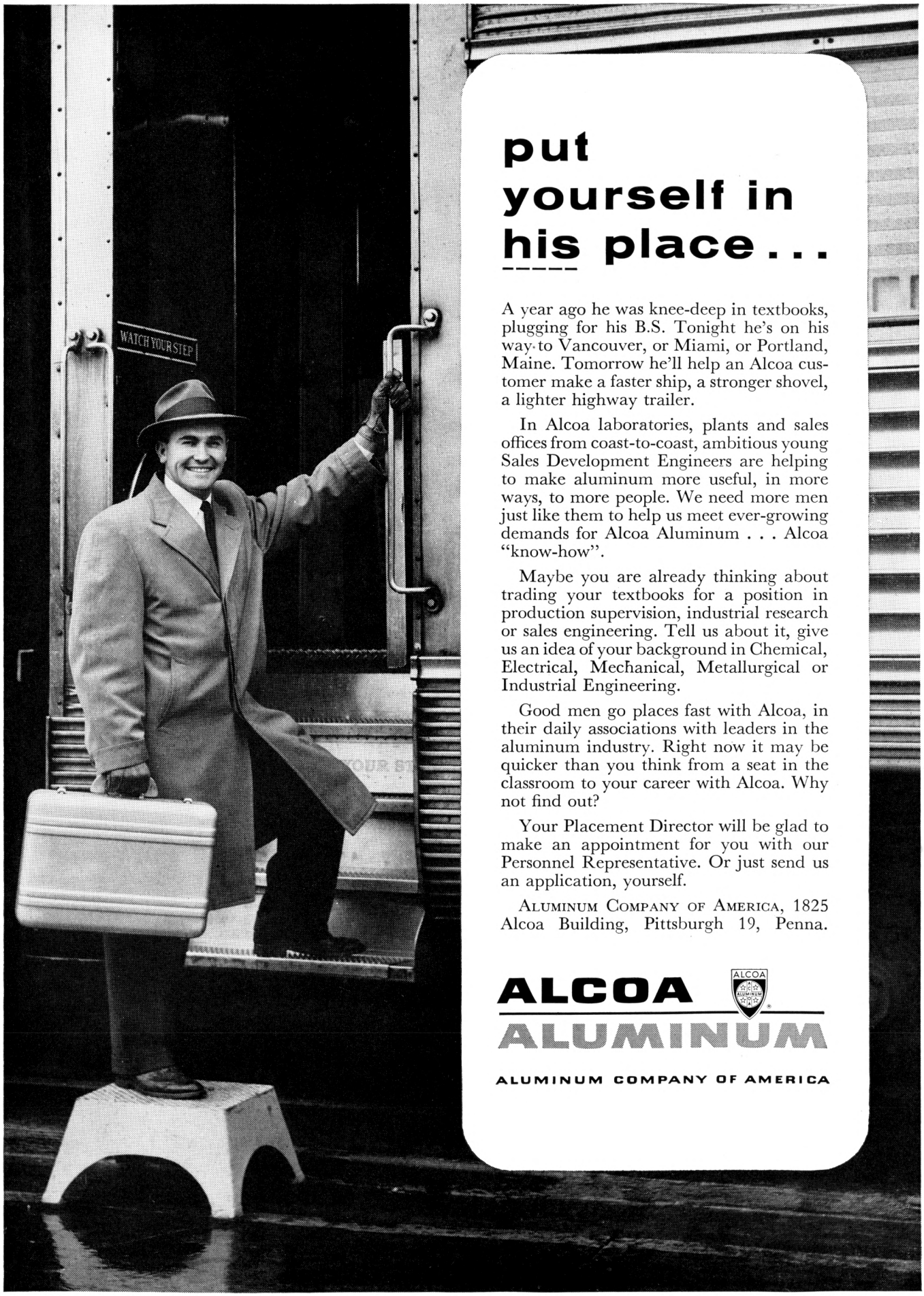
1. Articles may be technical or semi-technical on any engineering subject.
2. All students of the College of Engineering are eligible.
3. All articles should be 1200-3000 words in length.
4. All articles submitted become the property of the SHAMROCK and may be changed, edited, or published at the discretion of the staff.
5. Judges will be Dean H. O. Croft, Prof. M. M. Bolstad, Dr. Edwin Wetterstrom, Dr. R. H. Luebbers and the Editor of the SHAMROCK
6. Judging will be on a point basis for suitability, accuracy, reader interest, coherence, and general effect on the reader. Winners will be those with largest number of points.
7. Contest closes March 15, 1954.
8. Winners will be announced in the May issue.

Here is your chance to win a prize and have the fun of seeing your by-line in print!



put yourself in his place...

A year ago he was knee-deep in textbooks, plugging for his B.S. Tonight he's on his way to Vancouver, or Miami, or Portland, Maine. Tomorrow he'll help an Alcoa customer make a faster ship, a stronger shovel, a lighter highway trailer.

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ALCOA ON TV brings the world to your armchair with "SEE IT NOW" featuring Edward R. Murrow. Tuesday evenings on most CBS-TV stations.

GERMAN ARMS

(*Continued from Page* 14)

chine weapons which can be manufactured very easily. This weapon uses the powerful 7.92 mm Special cartridge. Where heretofore the use of a powerful cartridge has required the employment of locked breech weapons of costly design or of very powerful springs and unwieldly weight, this arm uses gas from the discharge to hold the breech closed. A possible U. S. variation of this weapon could be a cold-weather arm. Since there is no lock in this weapon, it cannot be jammed by freezing. (The close measurements and friction of the locking surfaces cause a locked-breech weapon to fume in extremely cold weather.)

This weapon consists of a stamped receiver to which the barrel is mounted securely by rivets. Over the barrel from front end is mounted a tubular sliding member, or housing. Its forward end is machined to receive a removable cylindrical muzzle piece, or sleeve, which is attached to the housing by an outside spring catch. This housing and sleeve function in the same manner as the slide on an automatic pistol. As a bullet travels down the barrel it passes over four gas ports about 2½ inches before reaching the muzzle. Gas escapes from the barrel through these ports into the space between the sleeve and housing to exert a forward thrust. The sleeve is shaped to insure that most of the gas will be exerted toward the concave forward end. As this is a straight blowback weapon without a lock, the recoil force of the rearward action of gas against the head of the cartridge case drives the action to the rear. However, this check system delays the opening of the action long enough to permit the use of a cartridge that normally requires a locking device.

The importance of using simple and efficient designs in weapons manufacture cannot be over-emphasized. Time and money are saved in manufacture, and the finished weapon is more reliable and deadly in combat. Our arms designers need not use the entire design of a German weapon to make a successful adaptation of it. For example, the feed system of the recoil operated M.G. 42 could be applied to a gas operated light machine gun. The locking system of the M.P. 43 Machine Carbine could be applied to an automatic rifle.

The German-design weapons that the U.S. has adopted have been very successful. The M 1903 Springfield Rifle, copied from the '98 Manser, is still being used today after fifty years of service. The M3 Submachine gun, copied from the M.P. 40 Schmeisser machine pistol, has replaced all other types of submachine guns in our armed forces. In view of the success the U. S. has had with these two weapons, our arms designers should incorporate other new designs which are found on German weapons.

KARL EVANS

Karl H. Evans, associate professor of civil engineering at the University of Missouri, was elected president of the Mid-Missouri Section of the American Society of Civil Engineers at the annual meeting of that organization in Jefferson City on Tuesday, Dec. 15.

Prof. Evans succeeds Vernon A. C. Gevecker, assistant dean of the School of Mines and Metallurgy at Rolla.

Other officers elected for the year include: 1st vice-president, Robert C. Gibson of Jefferson City, engineer of the Bureau of Public Roads; 2nd vice-president, Daniel Kennedy of Rolla, division engineer of the U. S. Geological Survey; secretary-treasurer, Samuel M. Rudder of Jefferson City, engineer of the State Highway De-

(*Continued on Page* 32)

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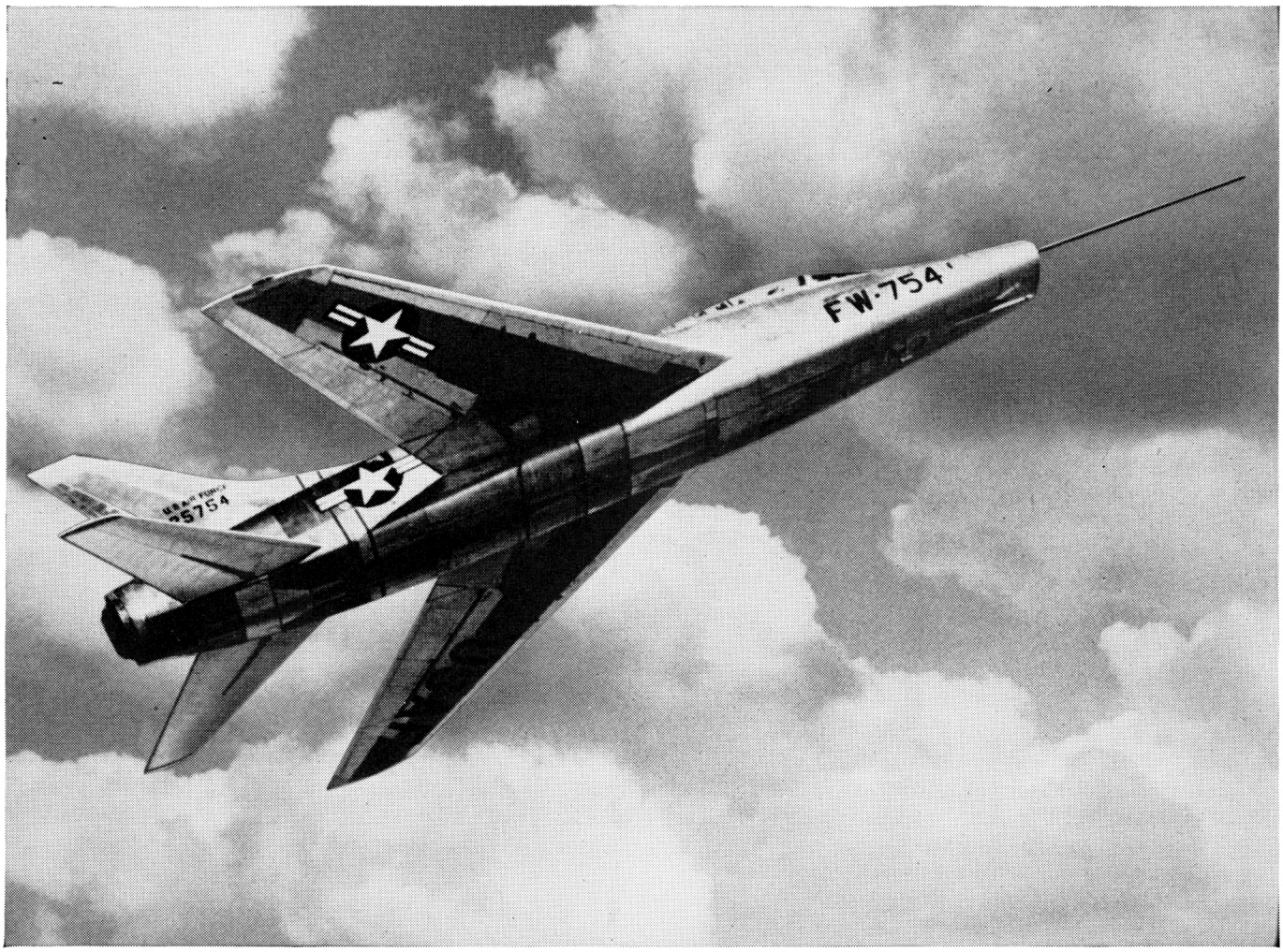


JET PLANES like this F-100 may be made more effective by Standard Oil's development of a new grease using aryl-substituted ureas that outperforms any previous one in certain high temperature bearings of aircraft.

HOW "GREASED LIGHTNING" IS GREASED

These days airplanes are flying faster and higher. The great heat created by jet engines and the extreme cold encountered at high altitudes have brought about many new grease performance problems for lubrication specialists.

Using aryl-substituted ureas for the first time as grease-thickening agents, Standard Oil scientists recently developed a new grease in cooperation with the Wright Air Development Center of the U. S. Air Force. It was made by thickening silicone oil with aryl-substituted ureas and it will lubricate bearings at high temperatures longer than any previous grease.

Standard's grease has passed laboratory tests on high-speed bearings of well over 500 hours at 450 degrees Fahrenheit. It can perform at temperatures up to 600 degrees for short periods. When ordinary greases are used under the same conditions, bearing failure soon occurs because of coke formation, oil evaporation, or excess leakage.

The new grease also lubricates effectively at temperatures as low as 40 degrees below zero. Another grease, still in the experimental stage, is being tested in the range of 65 below zero to 450 degrees above. These developments are part of our continuing scientific search for further improvements in the lubrication field.

In such an atmosphere of progress, young men with training in chemistry or engineering can find lasting satisfaction in Standard Oil laboratories. There they can use their skills and imagination to help shape the future of America's machines . . . and of America itself.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

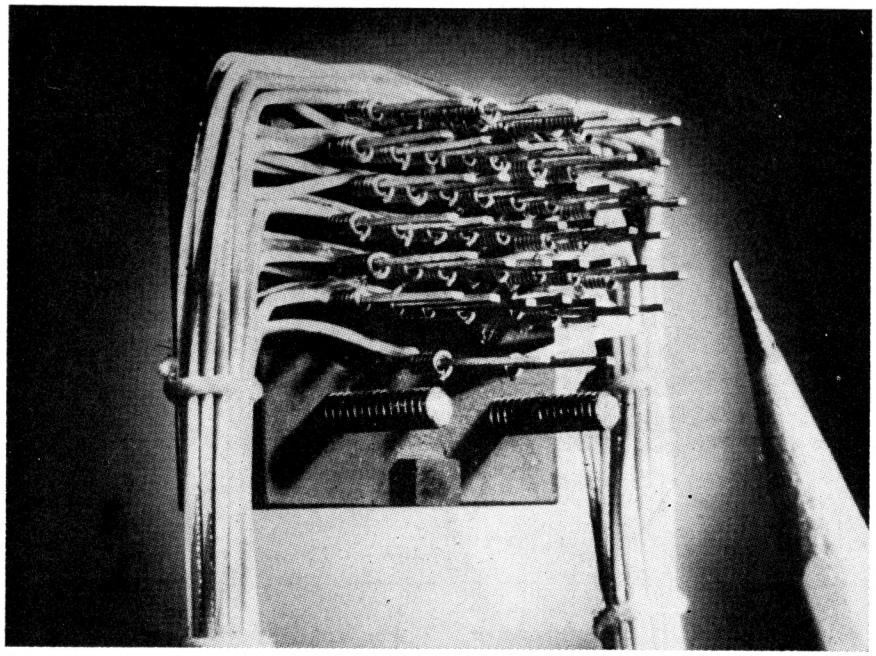
NEWSTUFF

(*Continued from Page 22*)

electrical connections, it has long been recognized that the process has many undesirable features. A new method of connecting wire leads to terminals, developed as the result of a joint five-year project by Bell Telephone laboratories and Western Electric Company, largely eliminates the disadvantages associated with soldering. Moreover, the new method produces more satisfactory connections and requires less operator skill and considerably less time.

The Key to this operation is a hand-held, power-operated tool which automatically wraps a wire lead around a terminal so tight that no solder is necessary. The tool, which is similar in general appearance to a conventional pistol-grip hand drill, has a barrel which fits directly over the terminal. The end of the wire lead is skinned of insulation and inserted into a spindle inside the barrel. When power is applied, the spindle rotates, wrapping the wire around the terminal to form a mechanically sound, electrically efficient metal-to-metal joint.

Terminals giving best results are formed to a rectangular shape. The wire and the terminal will then bite into each other to form a tight joint under the wrapping pressure exerted by the tool. As shown in the photograph of an experimental terminal block, as many as forty-four connections can be made in a space of less than one square inch.



—Photo Courtesy Westinghouse

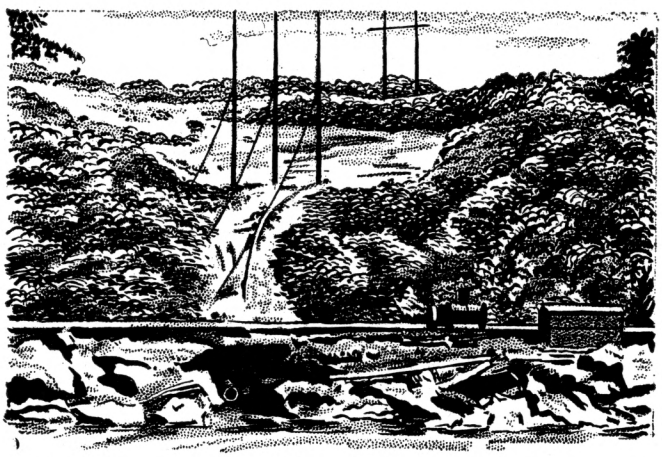
A circuit breaker capable of snapping off in one-twentieth of a second more electrical energy than any other breaker presently in operation in the world has seen constructed by the General Electric Company.

The New breaker constructed for the nation's first 330,000-volt power transmission network will be installed at the Muskingum River Plant of that Ohio Power Company, at Beverly, Ohio.

The 80-ton circuit breaker stands more than 25 feet high and has three 3,550-gallon oil tanks measuring more than 11 feet in diameter. Oil is used in the breakers for insulation.

A total of 16 breakers will be supplied for this power transmission network which is now under construction. Upon completion, the network will be the highest voltage lines in commercial operation in the United States. It will serve and benefit a seven-state territory.

During short circuit interruptions on power lines each of the breakers will be capable of interrupting, in one-twentieth of a second, a flow of energy equivalent to lifting a 100-ton locomotive 460 feet in the air.



The first submarine installation of a pipe-type cable system **was recently installed under the Hudson River at Poughkeepsie, N.Y. Three cables, each nearly ¾-miles long, were simultaneously pulled into a six-inch welded steel pipe laid across the river bottom. The pipe was then filled with oil maintained at 200 lbs. pressure, enabling a 110,000-volt power circuit to cross the river safely.**

This kind of system is called Oilostatic — a design which has long been first choice among utilities for handling large blocks of power by means of a high-pressure pipe-type cable system. Increased circuit reliability and savings on installation and maintenance costs are realized.

Oilostatic's new role as a submarine cable is typical of the significant contributions to better electrical service made by Okonite engineers.

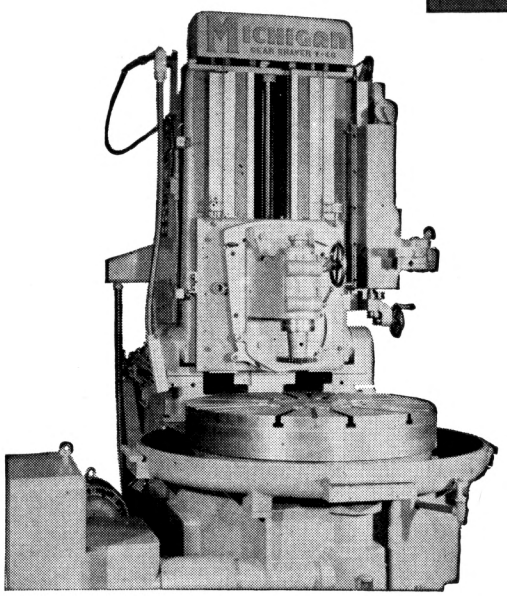
● ● ●

Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

OKONITE *insulated wires and cables*

8789

Another page for **YOUR BEARING NOTEBOOK**

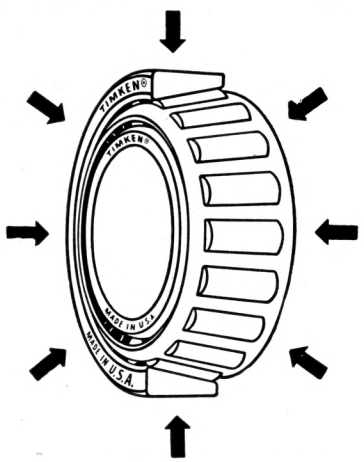


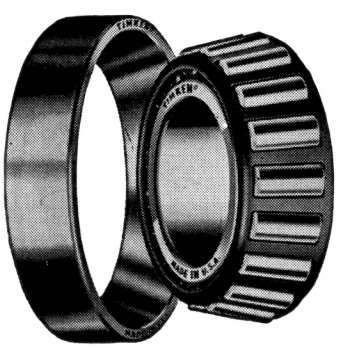
How engineers designed .0002" accuracy into a gear shaver table

To get the high accuracy necessary in gear shaving operations, engineers had to have extreme spindle rigidity. If the spindle could be held rigid, it would eliminate chatter and vibration. To get this rigidity, engineers mounted the table spindle of this gear shaver on Timken® tapered roller bearings. The result—a measurement of this gear shaver's accuracy showed a maximum runout of .0002", exceptional in view of the fact that these bearings have 17⅝" and 16⅜" bores.

How TIMKEN® bearings hold spindles in rigid alignment

Deflection is minimized, end-play and chatter eliminated because the tapered construction of Timken bearings enables them to take *any* combination of radial and thrust loads. Line contact between rollers and races gives spindles wide support for extra rigidity.

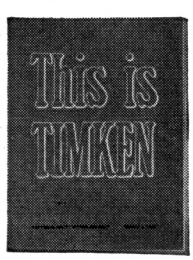




TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⓞ AND THRUST —ⓞ— LOADS OR ANY COMBINATION ✳

AROUND THE COLUMNS

(*Continued from Page* 17)

Iowa; Seems he majored in varsity football and basketball.

♣

During the slick weather, it showed which school was on the ball, as our sidewalks seemed to be the only ones with salt or sand covering them to protect yours and mine.

♣

If anything happens around Engine School that *you* think is humorous or any information that you have, it would be appreciated by old Sam and the whole staff if you would write it down and slip it under the door of the Shamrock office with Slipstick Sam on the front. Remember this is *your* mag, and Around the Columns is about *you.*

♣

See your smiling face next month, meanwhile I'll see you around the columns (Tripod and me that is.)

KARL EVANS

(*Continued from Page* 28)

partment; and junior director, Clifford D. Muir of Rolla, assistant professor of civil engineering at the School of Mines and Metallurgy.

The Mid-Missouri section of the American Society includes about 140 members of the national organization residing in the area embracing Rolla, Springfield, Jefferson City, and Columbia.



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NEEDED--- A NEW APPROACH!



HE HAD ONE

McDonnell engineers have again demonstrated their pioneering spirit. The problem—how to land a speedy, transonic airplane—normally requiring a mile or more of runway—in the short space available on an aircraft carrier deck. This is but one of the many complex problems successfully solved by M. A. C. engineers in developing the new Navy F3H Demon, now in production.

Youthfulness is another characteristic of this progressive engineering team, the average age being under thirty. Engineering graduates find working with men of their own approximate age group greatly facilitates getting acquainted and gaining that "feeling of belonging" more quickly.

If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when our representative will visit your school. Ask him about the McDonnell Graduate Study Plan.
You may also write to:

Technical Placement Supervisor
Box 516, St. Louis 3, Missouri

VERNON E. NETHERTON
Design Engineer—Airplane Division
B.S.A.E. U. of Illinois 1947

Vernon had a fresh approach to the problem of landing high-speed jet aircraft on carrier decks and was responsible to a large degree for an improved landing hook now being used on McDonnell airplanes.

Starting his engineering career "on the board" as a Draftsman in 1947, Vernon is now a key member of a design group concerned with the F-101 Voodoo airplane.

If your interests lie in the field of airplane development, a challenging career awaits you at McDonnell. We need more young men like Vernon Netherton—*engineers with a new approach.*

BUILD YOUR FUTURE WITH A COMPANY . . . . YOUNG IN YEARS, YOUNG IN SPIRIT AND IDEAS

McDONNELL Aircraft Corporation
Manufacturers of AIRPLANES AND HELICOPTERS ★ ST. LOUIS 3, MO.

Successful designs must have low manufacturing costs.

HOW TO CUT COSTS WITH WELDED PRODUCT DESIGN

LOW manufacturing costs are a "must" in today's product planing. As a result, every engineer must know, above all, how to eliminate needless cost in machine designs.

First consideration in designing machinery must be the material used. Steel is three times stronger, twice as rigid as cast iron, yet costs only a third of the price of gray iron.

That's why machine parts built with welded steel designs often cost 50% less to produce.

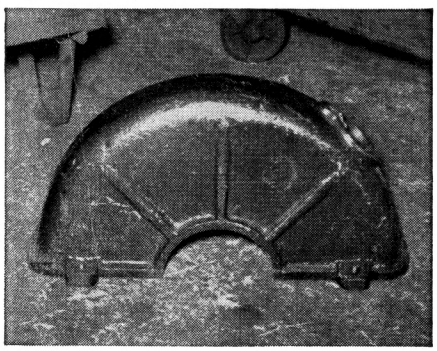


Fig. 1. Original construction *of gear case cover weighed 66 pounds... required milling of bottom edge for oil-tight seal with gear case.*

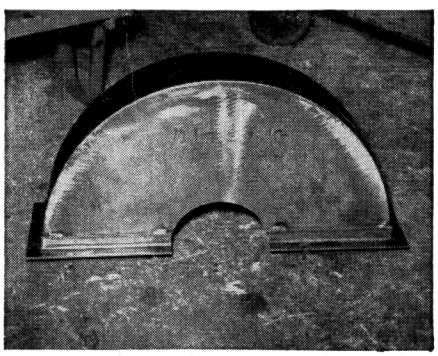
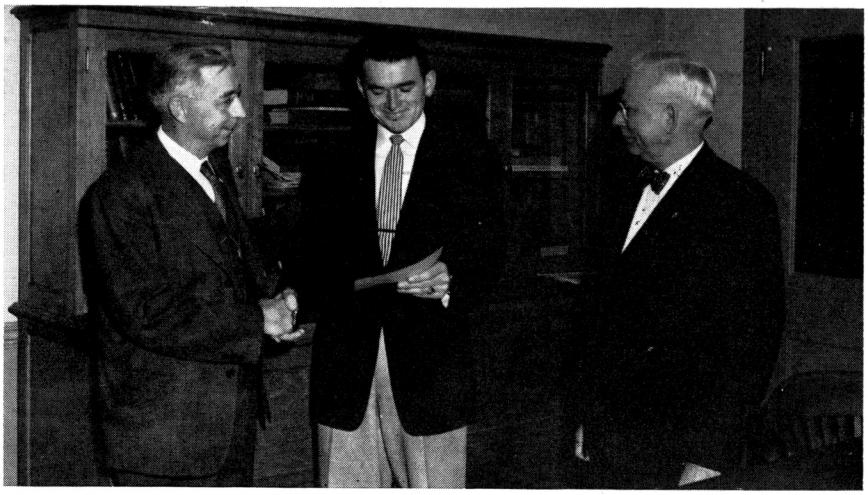


Fig. 2. Steel designed gear case *cover now used weighs only 10 pounds... costs half as much to produce. Fabricated entirely in the manufacturer's own shop by arc welding.*

Keep in step with the rapid progress in manufacturing with arc welding. Latest design developments are available in bulletins and handbooks that guide the engineering student. Write

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT



OPI NEWS RELEASE

Ronald Young, freshman student in Agricultural Engineering at the University of Missouri, is congratulated by Dean Huber O. Croft of the College of Engineering upon being selected as recipient of a Forney Foundation Scholarship for the 1953-54 year. Looking on at right is Prof. Mack M. Jones, chairman of the Department of Agricultural Engineering. Young is the son of Mr. and Mrs. Ova Young, RFD 2, Lebanon, Mo.

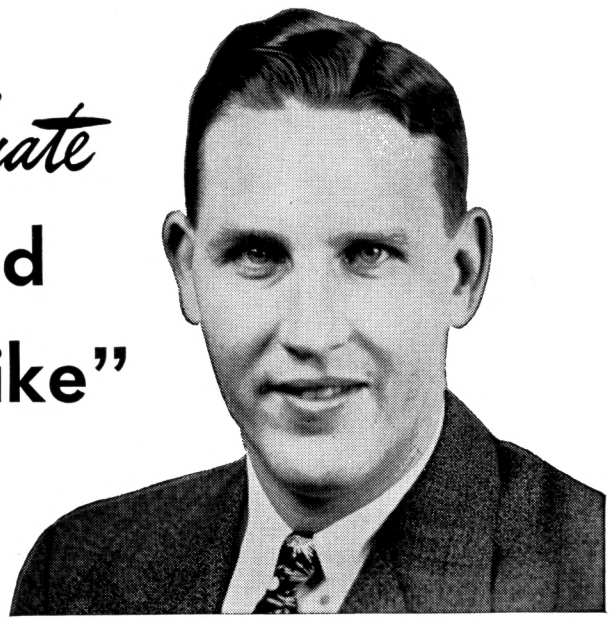
The scholarship provides a stipend of $250.

The Forney Foundation is a non-profit corporation with headquarters in Fort Collins, Colo. The scholarship is awarded on the basis of the applicant's special interest in the development and use of mechanical equipment on the farm as demonstrated by his record of high school work in mechanical training, with emphasis on his ability to handle machinery on the farm. Taken into consideration also is his record participation in church and religious activities in his home community and his interest in developing this phase of community life. Secondary factors are economic need and academic scholarship.

Two other Missouri farm youths, freshmen at the University, were awarded Forney Foundation Scholarships. They are Paul Haynes of Centralia and Buddy Anderson of Anderson.



"Allis-Chalmers Graduate Training Course Helped Me Find the Work I Like"



says HUGH C. SELLS,
Syracuse University, BS—1942
and now Manager, Knoxville District Office

"I guess I was like many graduating engineers. I didn't really know what I wanted to do. When the Allis-Chalmers representative visited the campus, and described their Graduate Training Course, it sounded like the type of postgraduate training I really needed.

"What appealed to me then—and still does—is the broadness of the program. Here is a company filling a unique spot in industry. It makes important, specialized equipment for almost any industry you can name."

Wide Choice of Activity

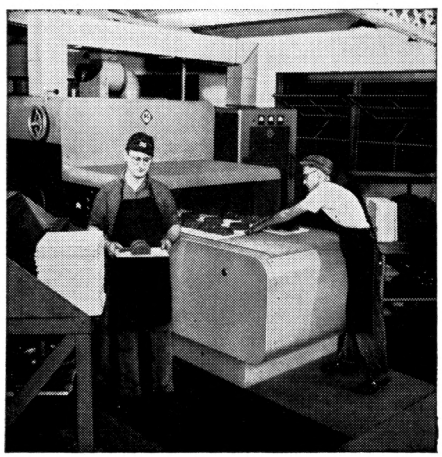
"It's like a big department store for industry. But that isn't all! In addition, it offers a wide choice of activity within each of these many product groups . . . whether it be sales, design, research or production.

"After getting the broad look at industry the program offers, my interest began centering on Service and Erection of large equipment. This led me into many departments of the company, and I learned about everything from steam turbines to sifters for flour mills."

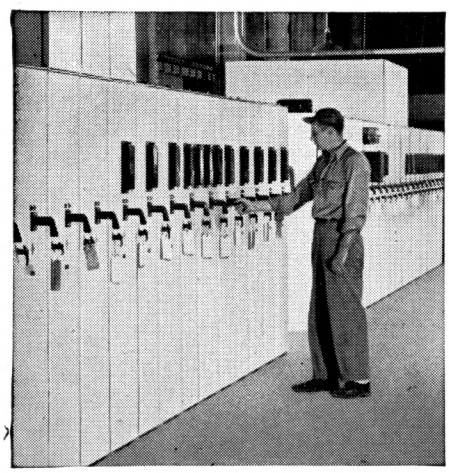
Valuable Background

"The transition from service to sales was natural. The background of service and erection work proved very valuable.

"So you see, whether you think you know what you want to do or not, the Allis-Chalmers Graduate Training Course is so flexible, so broad in its scope, you have a real chance to find yourself. Best of all, you don't have to waste time doing it."



ELECTRONICS—Modern way to dry sand cores is with Allis-Chalmers *Foundromatic* Sand Core dryer. Revolutionary new process dries cores in minutes instead of hours.



POWER—Neat, compact and safe switchgear installation is big improvement over open framework and knife switches in older installations.

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

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C-5677

SHAMROCK



SEZ

CRITIC'S REPORT came in on first two issues just after the last issue. He made a few suggestions for improvement and we are going to see how they work. He says that ours is the only magazine that is casual, of sorts; the rest seem to be more formal. Which way do you want it? We realize, too late, some of the mistakes we made on the December, January issues.

YE ED needs a new alumni editor, for the one he has now is going to be an alumni before this issue comes out. Don Brooker did a fine job in gathering news and putting it in readable style, but from now on he is Mr. Brooker, instructor in Ag Engineering. Ye Ed thanks Don for the help he has given Ol' Shamrock this year; we expect to hear from him often. Any man that wants to fill Don's job as alumni editor step up to the office some day, real quick, and see Aldag.

THE DEADLINE for the article contest is still March 15. The prizes are 25, 15, and 10 bucks. You have a good chance to win, and the job isn't too hard. Sit down some night and expound on your pet theory—or maybe you like Stanley Steamers. Tell all of us about it. Submit your article 1500-3000 words long, and you can walk off with enough jack to finance a beer bust of your own.

YE ED walked into the top floor head the other day, and noticed some pencil scrawls on the walls. Most of these were juvenile poems and sayings dealing with the emptying of the bladder. There's no place in Engine school for a guy that scribbles such adolescent stuff. Any guy that goofs off like that won't last long in Engine School. Either some senior with a club, or some faculty member with a grade will remove this "little kid" from our midst. To any jokers prone to write such sayings on the walls you had better revise your ideas of sex and the genitals.

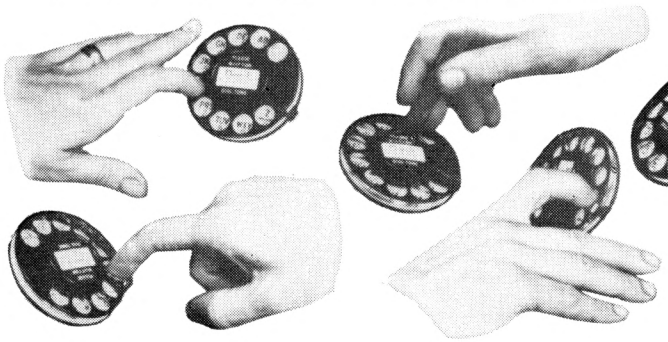
ENGINEERING HONORARIES have made their choice of new initiates, and the first pay-off for sleepless study-nights has been received by a fair-sized bunch of engineering students. Wearing an honorary fraternity's key distinguishes one to his prospective employers and creates respect a long time after graduation. The Honoraries select their men on scholastic average first, leadership and general attitude toward Engine School being the second requirement. A pointer to under-classmen from OL' SHAMROCK: by establishing a good average grade during the first two years, the chances of maintaining that average are much greater during the last years, which have separated quite a few boys from men. As Tau Beta Pi sums it up in its declaration: you may not succeed in trying for the right to wear its key, but you'll be a better man for having tried . . .

ST. PAT'S week is rolling around, and the plans for all the activities are becoming more and more concrete. As time goes, each man on St. Pat's Board is going to need more and more help; the societies need help for the floats and lab exhibits. The success of the Week depends on every man in the Engine School, for his help is the proverbial nail that shoed the horse. . . . So if you see some fella wandering around the halls, dark rings under his eyes, blank zombi stare, over-all dissipated look, give him a hand on his St. Pat's activities.

FOR THE MORE IMAGINATIVE one in school, we could use a darn good Campus Stunt and some new ideas in Lab Exhibits. The mechanicals aren't doing such a good job in bringing eye-catching appeal to their exhibits. They tried hard last year and got a few results—pleasing too. Why not illustrate some of the applications of simple physics to the industrial fields?

BRING YOUR mom and dad down to see St. Pat's week. They would probably enjoy seeing the activities held on Friday and Saturday of the Week.

PHOTOGRAPHY AT WORK—No. 7 in a Kodak Series



Photography reads the meters *2500 an hour!*

Dial a call—an accurate register counts it—then each month photography records the total, precisely right, ready for correct billing.

TWENTY-FOUR hours a day, hundreds of thousands of dial phones click their demands in many central exchanges of the New York Telephone Company.

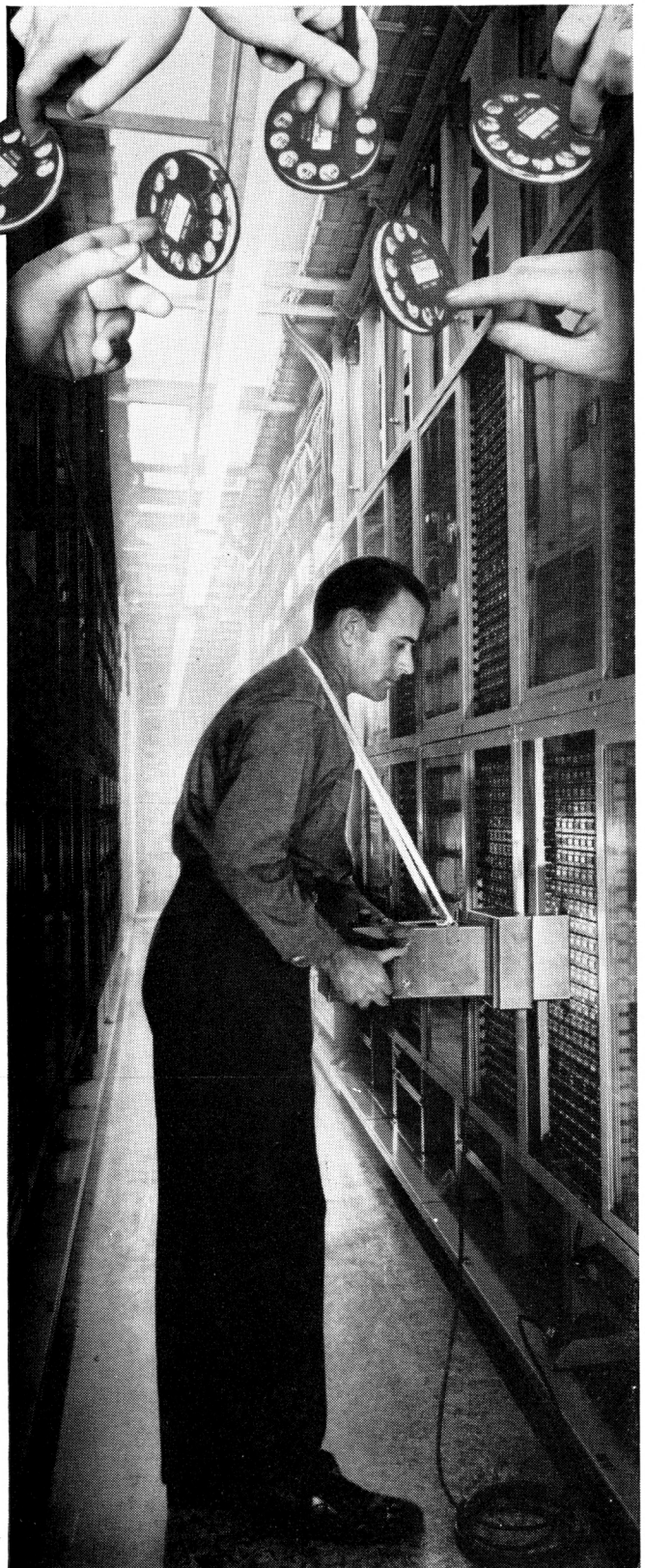
Little meters keep careful tally of the calls. Then the night before each bill is dated, photography reads the up-to-the-minute totals in a fraction of the time it could be done in any other way. Here is an idea that offers businesses everywhere simplification in copying readings on meters, dials or other recording instrumentation.

Photography fits this task especially well for two reasons. It is lightning fast. It can't make a mistake.

This is another example of the ways photography saves time, cuts costs, reduces error, improves output. In large businesses—small businesses—photography can do big jobs. In fact, today so many new applications of photography exist that graduates in the physical sciences and in engineering find them valuable tools in their new occupations. Other graduates—together with returning servicemen—have been led to find positions with the Eastman Kodak Company.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.



At New York Telephone Company exchanges a unique camera records the dial message register readings—up to 25 at a clip—saving countless man-hours of labor, assuring utmost accuracy and at the same time providing a permanent record.

Kodak
TRADE-MARK



RESEARCH—World famous for its achievements in both pure and applied science, G-E research is led by scientists whose names are known everywhere. The many Company laboratories cover a wide range of scientific investigations. Research activities include physics, chemistry, metallurgy, mechanical and electrical problems, ceramics, and many other fields.

ENGINEERS

IS YOUR CAREER HERE?

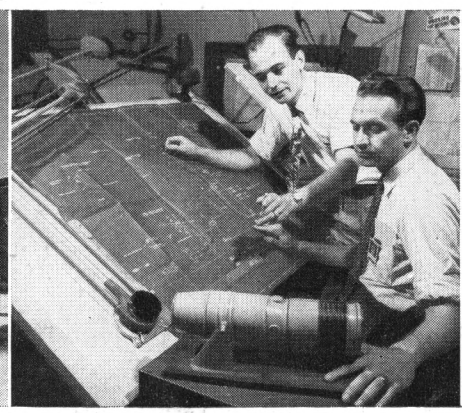
Sound engineering is one of the foundation stones of General Electric's leadership in the electrical industry. The importance of the role of the engineer has been recognized from the very beginning of the Company. Since 1892, G.E.'s Engineering Program—the oldest on-the-job training program in industry—has been affording young engineers widespread opportunities for professional development.

Besides the engineering fields briefly described here, career opportunities with a bright future are waiting for engineers in other important fields at General Electric . . . in manufacturing engineering . . . sales engineering . . . installation and service engineering . . . advertising . . . administration . . . other specialties in engineering.

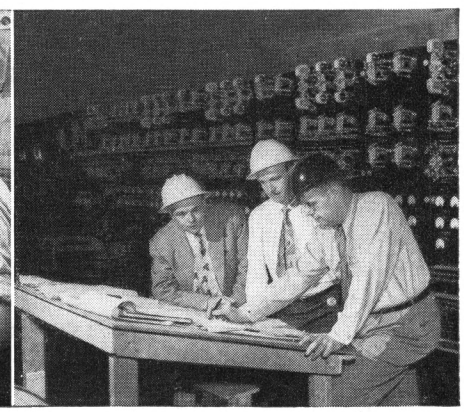
If you are an engineer interested in building a career with an expanding and ever-growing Company see your college placement director for the next visit of the G-E representative on your campus. Meanwhile, for further information on opportunities with G.E., write to College Editor, Dept. 2–123, General Electric Co., Schenectady 5, N. Y.



DEVELOPMENT ENGINEERING—Development engineers are continually obtaining and assessing new basic engineering and scientific knowledge to make possible new developments. They serve as consultants to help in the solutions of engineering problems, which often require research, experimentation, and the development of a new product or component.



DESIGN ENGINEERING—To maintain leadership in the electrical field, design engineers are constantly striving to develop new and better products. Their skill is largely responsible for the steam and gas turbines, motors, heat pump, control equipment, and many other products. In electronics, they design equipment for television broadcasting and reception, radar, and other electronic equipment.



APPLICATION ENGINEERING—Since much equipment today is designed for a specific use, the application engineer must have a broad knowledge of the industry for which a particular product is being designed. Because G-E products are widely used throughout industry, imagination, determination, and a sound knowledge of engineering are important assets in this ever-growing field.

You can put your confidence in—

GENERAL ELECTRIC

MISSOURI SHAMROCK



March 1954

25c

Features: Lee, Queen of Love and Beauty
The Herrmann Engine
Einstein's Special Theory of Relativity
Queens in Review
The Museum of Transport

Reductio ad optimum



U·S·S CARILLOY electric-furnace aircraft quality steel meets every requirement for these vital parts. The precision machining and expert heat treatment it gets at Cleveland Pneumatic Tool Company complete the job.

● "Reduced to the most favorable degree" describes exactly what happens to the huge U·S·S CARILLOY steel ingots from which are formed the rugged main columns in the landing gears of *every* B-36.

To provide the tremendous strength and shock resistance required to safely cushion the landing impact of 179 tons of bomber weight—and, at the same time, to keep the weight of the landing gear as *low* as possible—calls not only for steel of the highest quality but also for unusual procedures in fabrication as well.

Consider these facts. The original ingot weighs approximately 37,500 lbs. From it are produced two cylindrical columns weighing only about 1200 lbs. apiece. Approximately 93% of the steel is removed by machining to proper contour and in hollow-boring the column. When finished, a mere 7% of the original ingot is left to do the job.

That U·S·S CARILLOY steel has been exclusively selected for this application—one of the most exacting in the aircraft industry—is, we believe, highly significant. The same care and skill, the same ability to meet requirements that are beyond the ordinary, go into every order of CARILLOY steel we make—whether it's an ingot of giant size or a few tons of special steel.

U·S·S CARILLOY is just one more example of the better steel products developed and produced by United States Steel. If you are interested in additional engineering training, why not investigate *your* opportunities with U. S. Steel? For more information, contact the Placement Director of your school, or write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

USS

UNITED STATES STEEL

A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from A. C. Montieth, Vice-President
in Charge of Engineering and Research,
Westinghouse Electric Corporation,
Queen's University, Kingston, Ontario, 1923



The second most important decision in your life

Now, as you near graduation, you are about to make a decision—second in importance only to choosing your life's partner.

I'm talking, of course, about that all-important first job. Which company will it be? I wouldn't presume to answer that question for you. But I would like to emphasize the importance of this decision.

You have a lot at stake. The direction your career takes will most certainly be influenced by the company with which you cast your lot. May I offer a few personal suggestions.

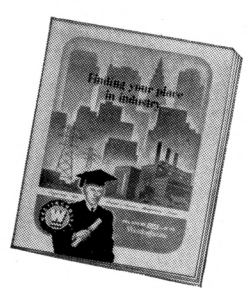
Choose a company not for its bigness or smallness, but for how it will treat you as an individual. Choose it not only for its engineering activities alone, but also for how it is set up to help its engineers develop themselves professionally. Choose your company with an eye on the opportunities ahead—and an eye on the future of the company itself. Above all, select a company that has a definite program to help you determine the work for which you are best fitted.

Only you can make this vital decision. Whatever it may be—good luck! G-10275

YOU CAN BE SURE...IF IT'S
Westinghouse

For information on career opportunities with Westinghouse, consult the Placement Officer of your university, or send for our 44-page book, *Finding Your Place in Industry.*

Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 N. Seventh Street, St. Louis 1, Missouri.



PROGRESS OF A PROBLEM

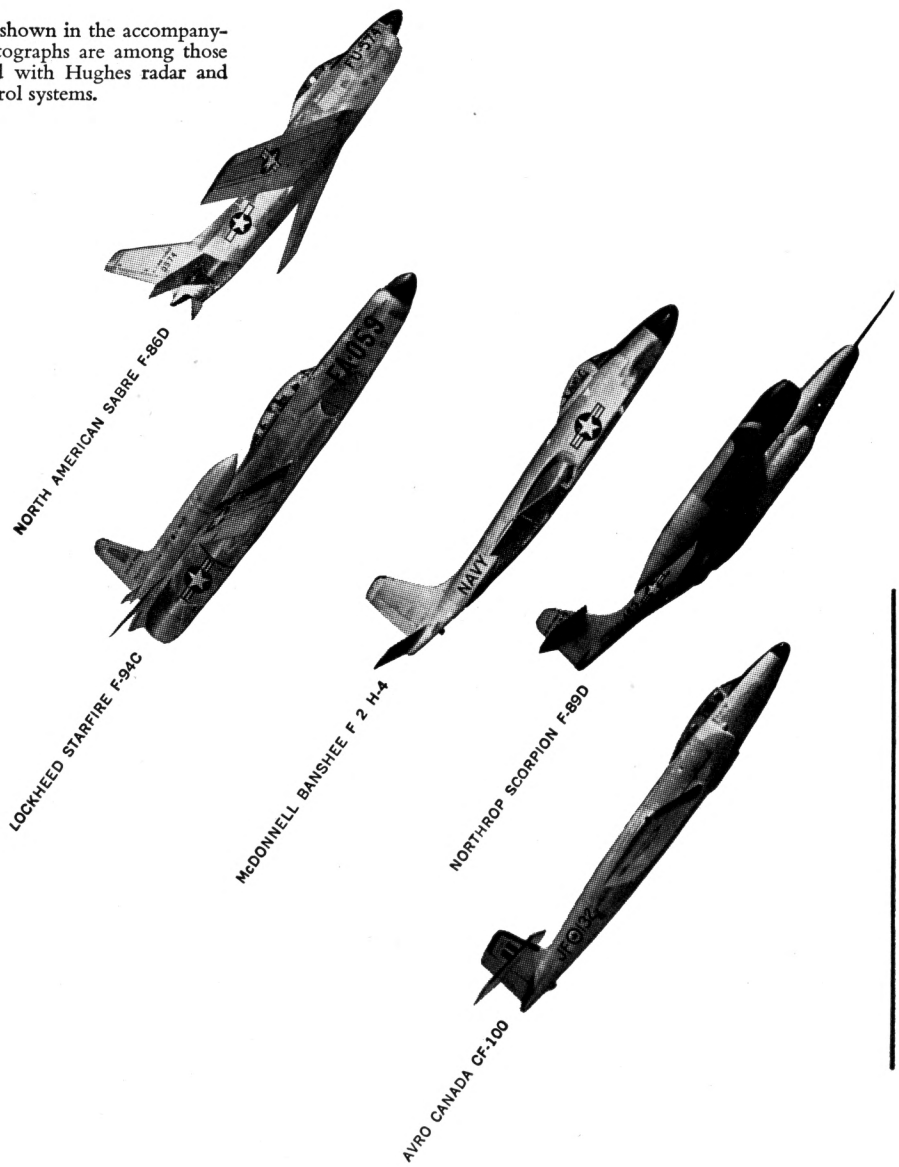
THE PROBLEM:

To design and manufacture advanced radar and fire control systems for military all-weather fighters and interceptors—equipment that must be light in weight, versatile, and capable of accurate operation day or night under extreme conditions.

At Hughes the answers to these requirements for complexly interacting systems involving advanced radar and fire control have been under continuing development from *1948* and in production since *1949*. Even more advanced systems are currently in process of development for supersonic aircraft.

Beginning with systems engineering and analysis, the military studies are initially concerned with evaluation of the strategic and tactical needs of the services in order to establish design objectives. This is followed by the analysis of problems involving noise, smoothing and prediction, multi-loop nonlinear servos, aircraft dynamics and controls, and the properties peculiar to conversion of analog information to digital quantities. From the analytic stage evolve the requirements for systems design and circuitry, designs of computing sub-systems, microwave transmitting and receiving equipment, the presentation of information to an airplane pilot, and advanced testing needed to optimize over-all system performance.

Aircraft shown in the accompanying photographs are among those equipped with Hughes radar and fire control systems.



SYSTEMS ENGINEERS

CIRCUIT ENGINEERS

Further advancements in the fields of radar and fire control are creating new positions on our Staff for engineers experienced in the fields of systems engineering and circuit design, or for those interested in entering these areas.

SCIENTIFIC AND ENGINEERING STAFF

HUGHES

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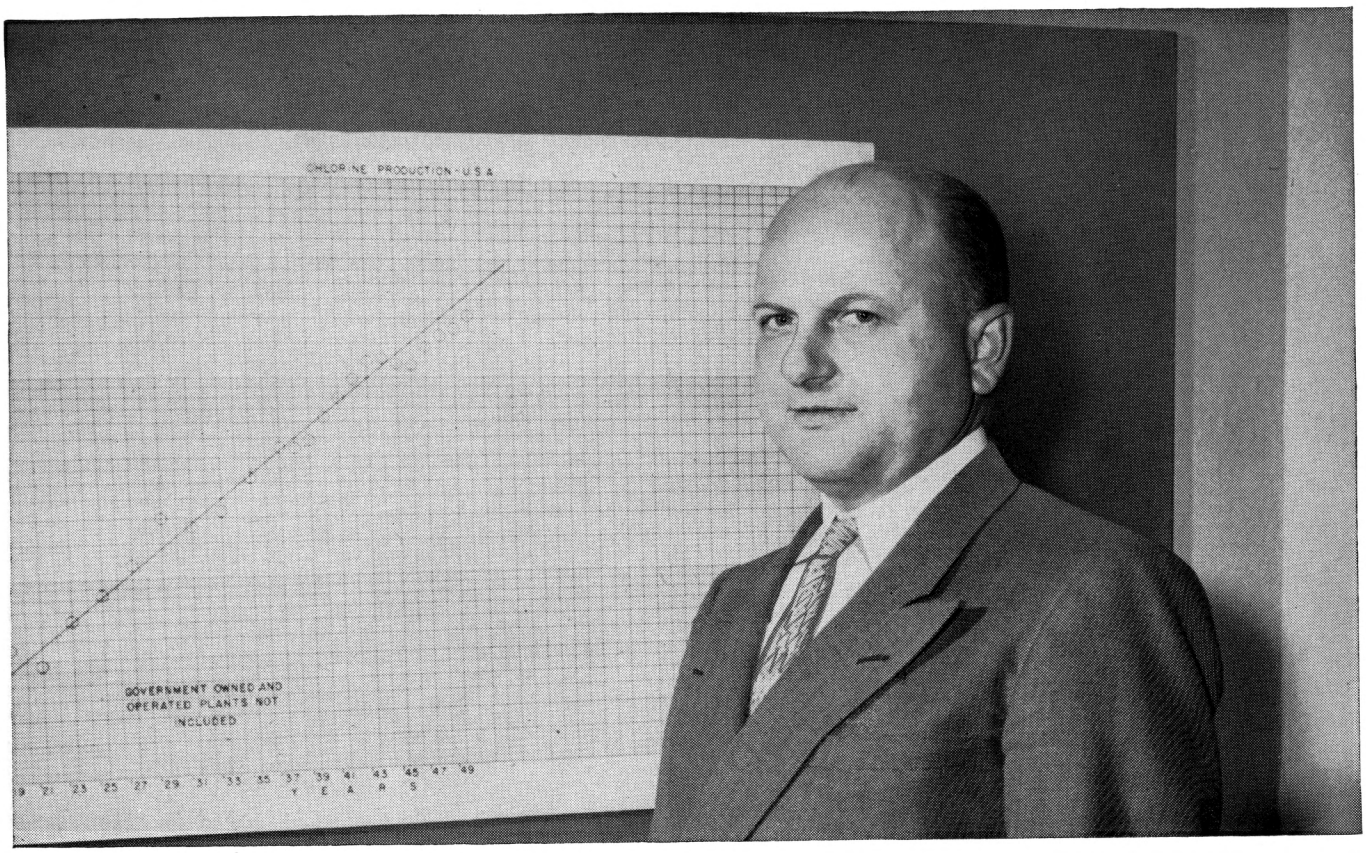
Culver City, Los Angeles County California



"...Give him the opportunity to grow"

This is Joseph A. Neubauer. He is an important member in the Columbia-Southern organization.

Right now, Mr. Neubauer is Technical Director of the Corporation. He has been on the move, upward, ever since he joined Columbia-Southern after graduation from college.

His progress is worth emulation. But initiative alone is not always the answer to a man's career. You can't launch an ocean liner in a mountain stream. Neither can a man travel far in an unprogressive, stagnant organization. A man needs freedom to put his ideas into action; he needs to move ahead without waiting for vacancies to occur from death or retirement. We believe Joe Neubauer's story will interest you and give you something to think about.

He graduated with a Bachelor of Science degree in Chemical Engineering from Case Institute of Technology in 1932. In 1933, a depression year, he joined Columbia-Southern as a production operator. Within a year, he was named shift foreman.

Shortly afterward, Joe was assigned to the Development Department to work out some problems involving the Soda Ash process. Following this he supervised the engineering and construction of Columbia-Southern's first chlorine unit at the Barberton, Ohio plant. He became assistant production manager at Barberton and, in 1942, was assigned to engineering and construction of the plant at Natrium, West Virginia.

He was elevated to superintendent of operations at Natrium and in 1946 moved to Pittsburgh as technical assistant to the Vice President. In 1949 he was named Technical Director of the Corporation.

Recently he was selected and sent by Columbia-Southern to take the Advanced Management Program at Harvard University.

Joe Neubauer has some good advice to pass on to the 1954 graduate. "The main thing for a graduate is to select a company which will give him the opportunity to grow. In the Columbia-Southern organization, the road to top positions is open from many fields . . . whether it be sales, chemical engineering, electrical engineering or various other backgrounds. I would strongly advise any graduate who has an interest in the future to look into the opportunities at Columbia-Southern."

For further information, write now to Dept. P, at our Pittsburgh address or any of the plants.

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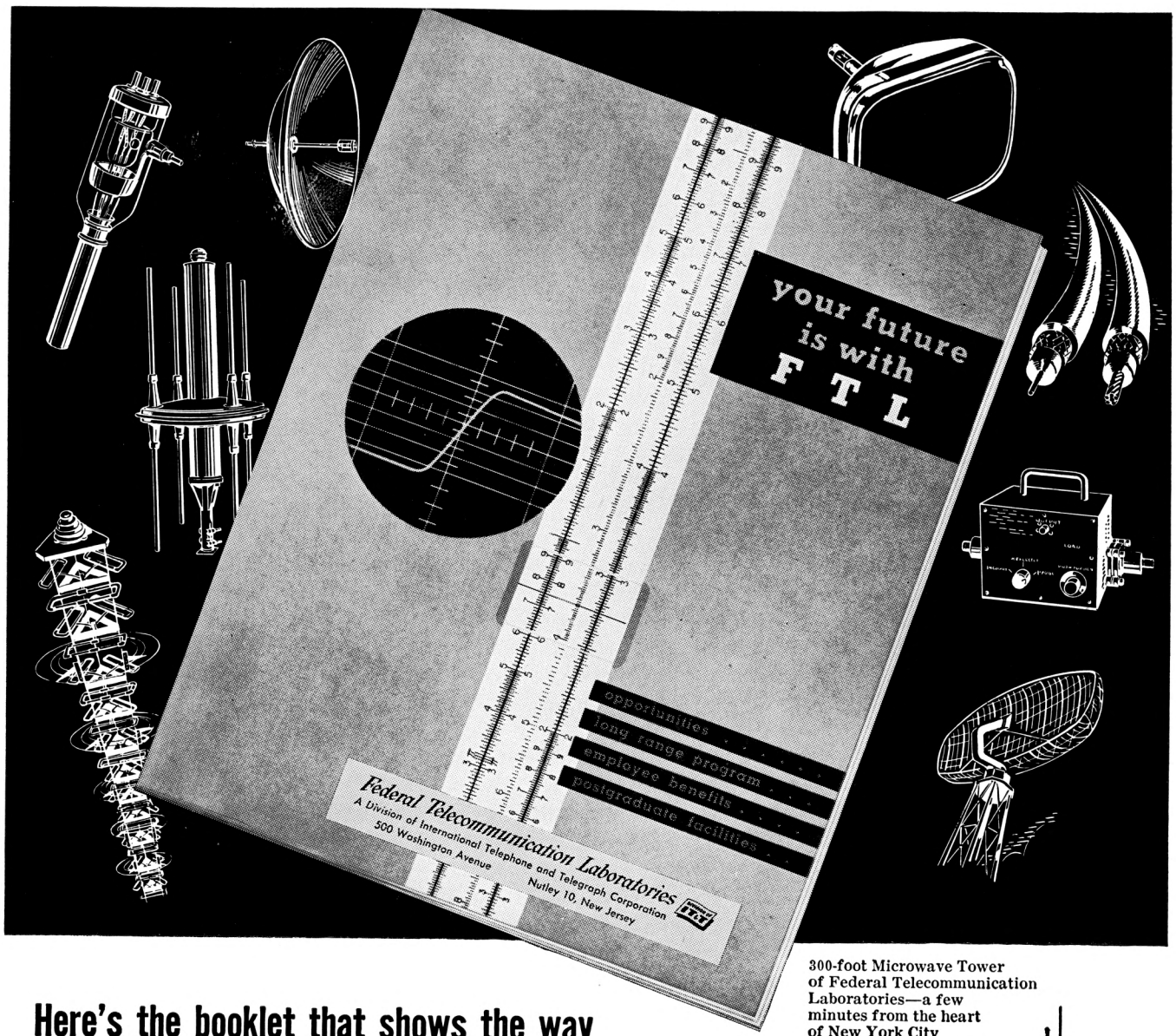
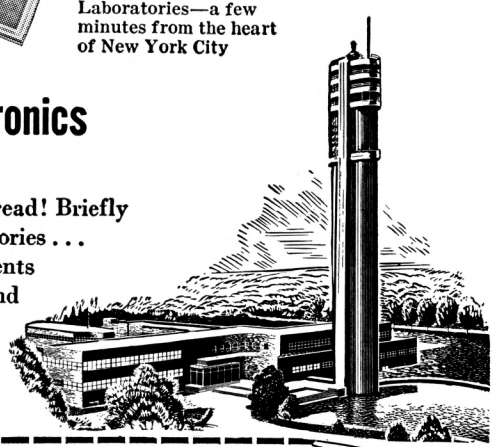


300-foot Microwave Tower of Federal Telecommunication Laboratories—a few minutes from the heart of New York City



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ON THE COVER

We introduce the Queen of Love and Beauty, Miss Lee Blount, the Engineer's choice.

—Photo by Ghio Studios

MISSOURI SHAMROCK

VOL. XXV NO. 6

MARCH, 1954

♣

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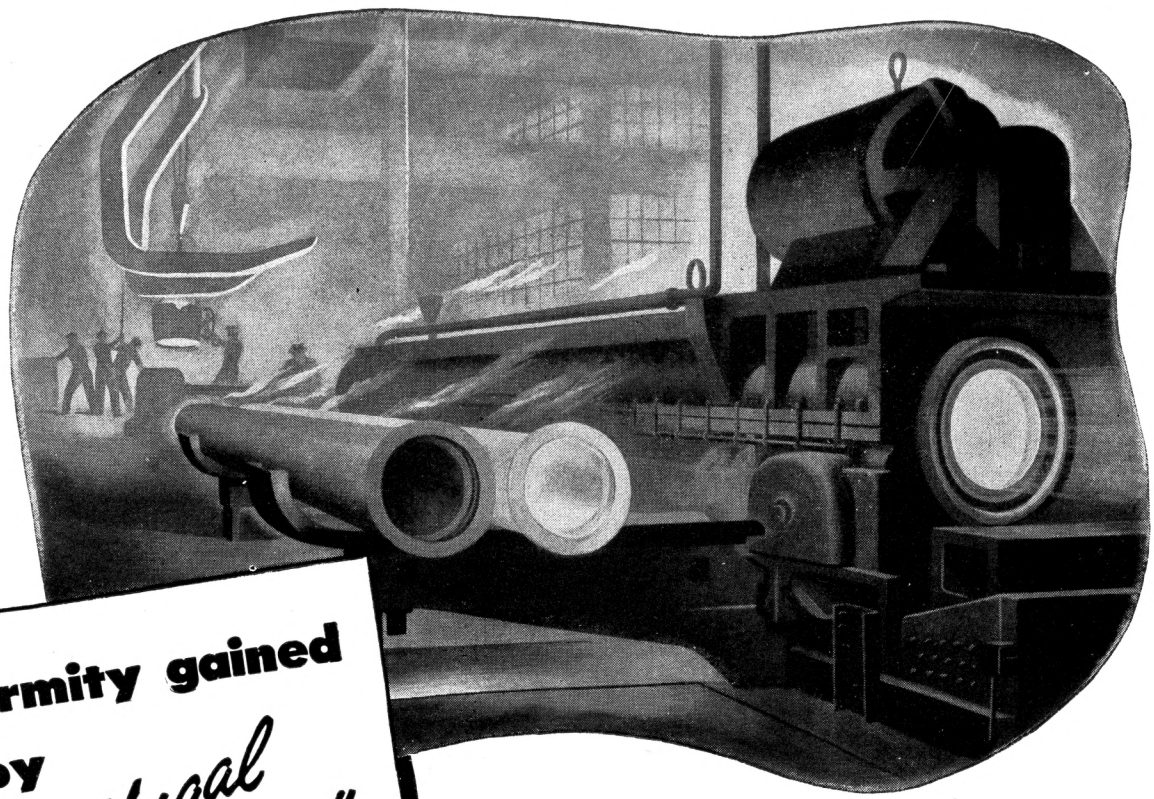


Uniformity gained by "Centrifugal Casting"

The great majority of cast iron pressure pipe produced today is cast centrifugally, in metal or sand-lined molds.

When this mechanized process was introduced 27 years ago, its potentialities for improved production controls were evident. For human fallibility was largely replaced by machine accuracy based on scientific principles.

The improved production controls made possible by the centrifugal casting process have long since been realized. Hundreds of millions of feet of centrifugally-cast-iron pressure pipe are now in service. All of this pipe is more uniform in metal structure, in wall thickness, and in concentricity, than pipe not centrifugally cast.

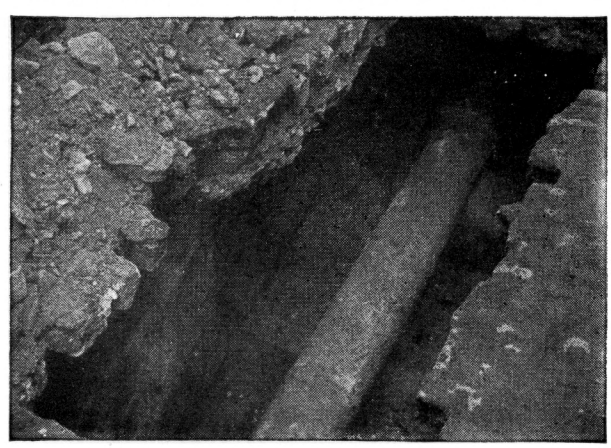
Better production control means better pipe; it results in greater uniformity of quality.

Production controls in cast iron pipe foundries start almost literally from the ground up with inspection, analysis and testing of raw materials; continue with constant control of cupola operation by metal analysis; and end with rigid tests of the finished product.

By metallurgical controls and tests of materials, our members are able to produce cast iron pipe with exact knowledge of the physical characteristics of the iron before it is poured into the mold of a centrifugal casting machine.

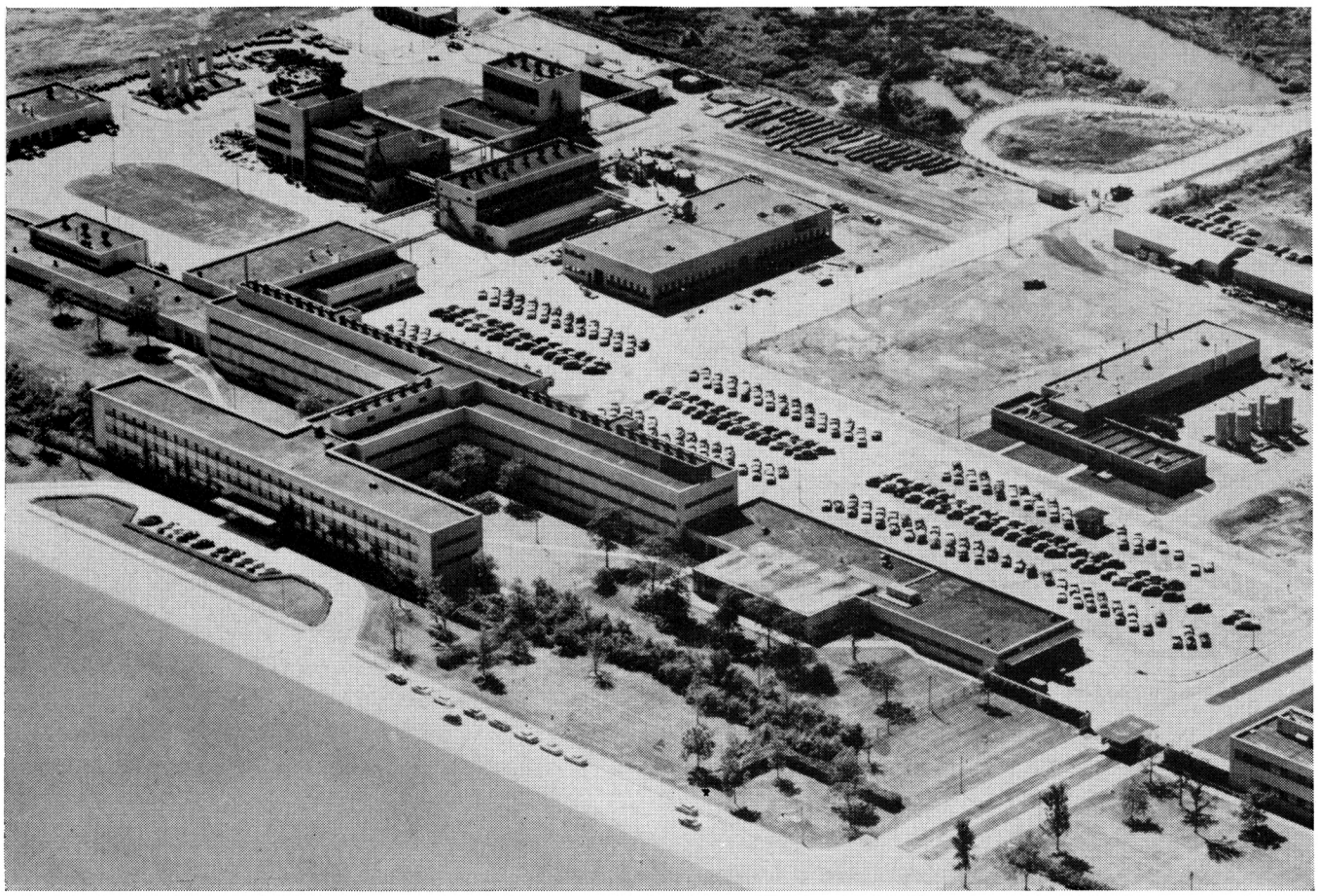
Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction.

Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Avenue, Chicago, 3, Illinois.



Section of 114-year-old cast iron gas main still in service in Baltimore, Md.

CAST IRON PIPE SERVES FOR CENTURIES



MOST OF THE RESEARCH WORK that led to the development of Ultraforming—a more efficient and economical refining process—took place in the Whiting research laboratories of Standard Oil, above. Extensive studies in seventeen research-scale units demonstrated the merits of cyclic regeneration.

Standard Oil scientists develop **Ultraforming--** the latest in catalytic reforming

After several years of research, Standard Oil scientists have developed a new and important refining process—Ultraforming.

The process is a better way of improving the low-octane straight-run gasoline found in crude oil. To make such gasoline suitable for present day cars, refiners must change it into an entirely different material, which gives good anti-knock performance. The change is known as reforming.

Ultraforming is the last word in catalytic reforming. It gives greater yields of higher octane gasoline than were previously possible and gets good results even with poor feed stocks. In addition, it raises the yield of hydrogen, an increasingly valuable by-product of catalytic reforming.

Ultraforming units do not have to be shut down when the catalyst begins to lose activity through use. By a new technique, an improved platinum catalyst is regenerated to maintain peak performance.

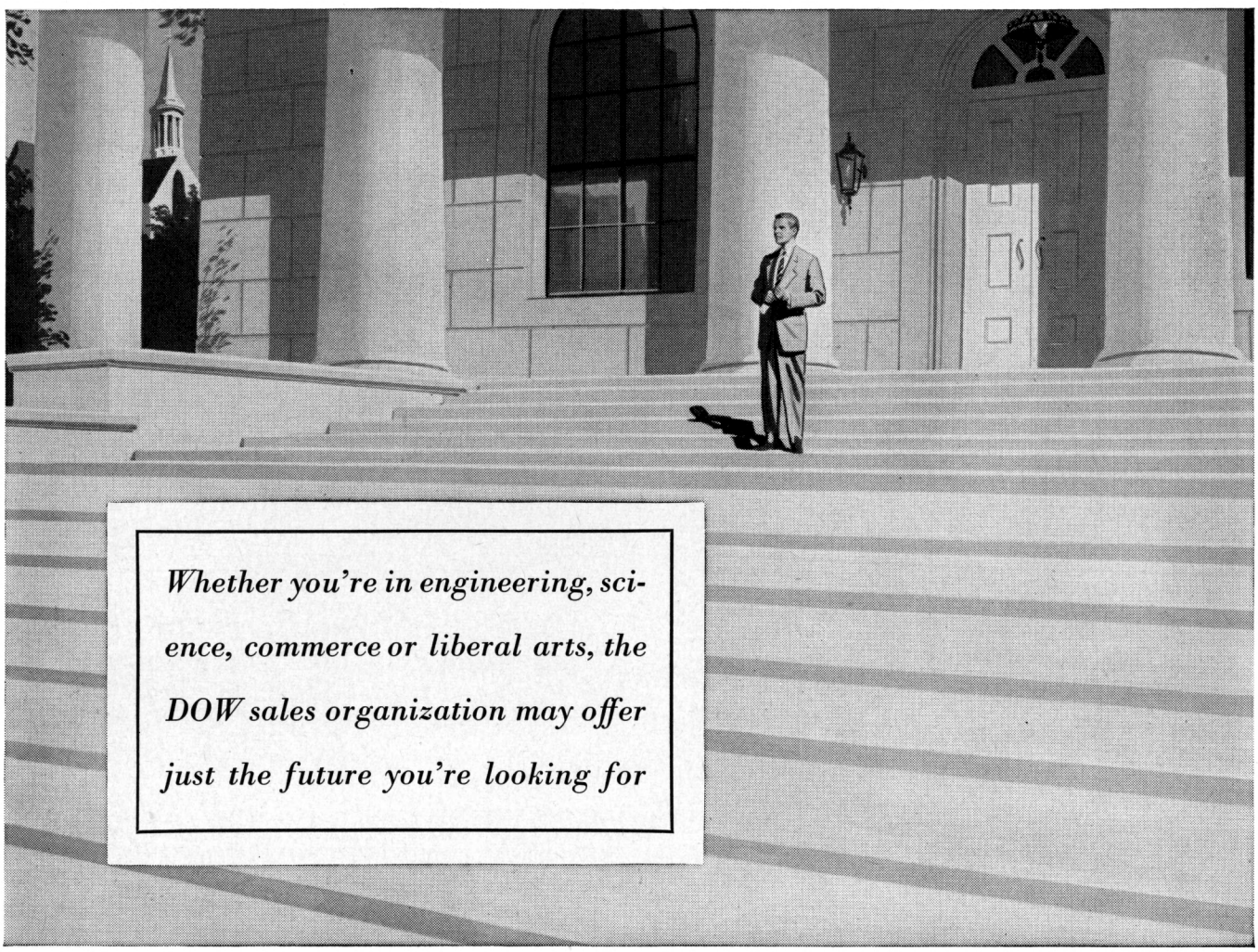
The advantages of Ultraforming over previous methods are so great that Standard Oil and its subsidiary companies are building units at four refineries. They will start operating this year. The new process, of course, is available to the petroleum industry through licensing arrangements.

At Standard Oil, young engineers and chemists work with the stimulating knowledge that they are participating in important and lasting contributions to the oil industry and to their country.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD



What About Your Future?

Your opportunities for advancement are excellent because Dow is growing—continually building new plants, developing new production operations—adding new products, opening new markets.

Dow fits you for the job with a comprehensive training course which explains company organization, policy, finance, research, production, technical service and sales methods.

You'll find that Dow is a friendly company. You'll discover that promotions are usually from within, from Dow's own staff. Seldom is an outsider considered for a top job at Dow. Moreover, you'll find a highly developed spirit of cooperation between men and departments.

At Dow, your future can be more secure because of Dow's diversification of products serving many different markets —a real advantage if business slows—and certain to multiply opportunities as business expands. Also at Dow —group insurance, pension plans and employee stock purchase plans have been a tradition.

If you or any of your friends majoring in other fields of study who have had pre-engineering or one year or more of college chemistry are interested in finding out more about a future at DOW, write to Dow's Technical Employment Department today.



Dow's Booklet, "Opportunities with The Dow Chemical Company," especially written for those about to enter the chemical profession, is available free, upon request. Write to THE DOW CHEMICAL COMPANY, Technical Employment, Midland, Michigan.

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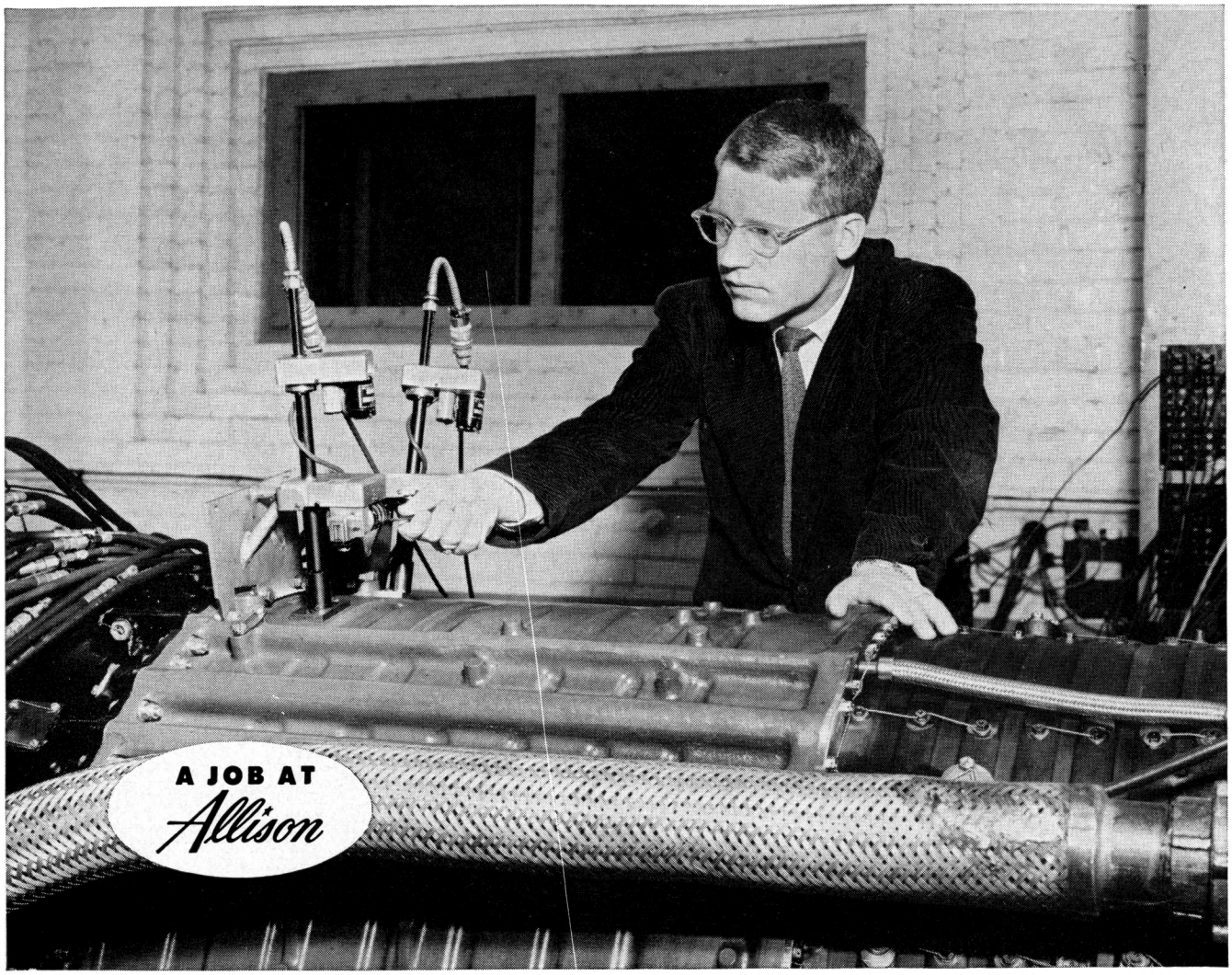
DOW



● Donald L. (Don) Dresser was a Physics Major at Beloit, class of '50. He was a member of Sigma Chi; played basketball, and shot golf in the 70's. He received his Masters from the U. of Wisconsin in 1951.

Before coming to Allison something over a year ago, Don was recalled to military service and served another 16 months in the Navy.

Now, he is a specialist in the instrumentation and electronics group at Allison. Don was assigned a problem in studying the air flow through jet engine compressors with a hot wire anemometer. It was his job all the way, working with the vendor in supplying necessary equipment which was developed to study rotating stall in axial flow compressors.

Don is shown making an adjustment on one of the probe actuators of the anemometer on a jet engine in a test cell. Cables from the anemometer lead to the control room panel where results are recorded and studied.

The very nature of Allison business continually presents a variety of challenging problems to the engineering staff, which—along with the Mechanical Engineers, Aeronautical Engineers, Electrical Engineers, Metallurgical Engineers, Chemical Engineers and Industrial Engineers—includes quite a few majors in Math and Physics like Don.

Allison needs more technically trained people, especially young graduate engineers to help handle the increasing work load in a field where future development is unlimited. Why not plan NOW for your engineering career at Allison, the only manufacturer whose jet engines have accumulated over three million hours in the air!

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Not of engineering interest as engineering function, these five young ladies are this year's candidates for Queen of Love and Beauty. They are, from left to right, Lee Blount, Mary Ann McKinstry, Dottie Burger, Barb Faris, Norma Umlauf.

Dust to Dust . .

Do you remember the time twenty years ago, when you saw dust, smelled it, and even ate it with your food? Many of us in school are too young to recall the great concern over the loss of topsoil in the Western plains. You remember, though, the reason for the coming of the Big Dust Bowl. It was caused by extreme cultivation of the soil, followed by years of drought. Is the drought here again? Have the plains been overcultivated in the past few years? If this is true and a new Dust Bowl is on the way, you, who have lived through one trial of dust, have not learned a lesson. You have failed to see the continuous threat of crippling agricultural loss. You have failed to remember that all life comes from the sun and soil. You have failed us, who can't remember; and yet part of the reconstruction is our responsibility. We will do our job, but the damage will have been done. What is there to do now? The land has been opened; the winds are dry, and nothing in our power will stop the blowing winds. We must appeal, pray for suitable weather to prevent another Dust Bowl. I want to see the sun set after a clear sky.

D.B.A.

LEE, QUEEN OF LOVE AND BEAUTY



LEE BLOUNT

Ol' Saint Pat really hit the jack pot this year. The gal who caught his eye and won his favor is brown haired, brown eyed Chi Omega beauty, stands 5 feet 3 inches from the mean datum level, weighs 115 pounds, and was 19 years old in August—we didn't even have to twist her arm. A sophomore, she is in the process of transferring from Ag school, where she was a major in Home Economics. We didn't want any Aggies in this contest anyhow. The transfer to Liberal Arts is a wise move. Of Engineers, she says, "They're swell." We hope she doesn't think this way just because her brother is a Chemical Engineer, but because she thinks a lot of all Engineers. When we asked Lee why she wanted to be St. Pat's Queen, she said in a soft voice that would melt the heart of any engineer, "Because it would be a great honor and also a lot of fun." This gal has all the right answers as she says of the Lawyers, "Horrible." She attended Maplewood-Richmond Heights High School in Maplewood, while living in Richmond Heights. This incidentally is the home town and high school of the editor of this mag—ahem! Lee came to the University of Missouri to be "close to home." When asked why she didn't go to Washington University in St. Louis, she said, "Too close to home." Queen Natalie, she likes to be called "Lee," considers Tom Collins' the best mixed drink. We like 'em too, when someone else buys. Lee likes trout fishing, and can even bait her own hook, with worms yet. She attended the University of Colorado last year—maybe this was too far from home, and played varsity tennis at Colorado. Lee likes tennis a lot and plays basketball and volleyball, too. The engineers, as tolerant as they are of Aggies and Washington U. were very lucky to have Lee Blount for their Queen this year. May her reign be one of the happiest in the history of St. Pat's weeks.

MARY ANN McKINSTRY

Begorra and tis the time when the thoughts of the engineers begin to stray from the Calculus, Steam Tables, etc. and concentrate on some of the finer things in life, for instance the lovely candidate for St. Pat's favor, Mary McKinstry. A brownette, five feet three inches tall, and 18 years of age, she tips the scales at 54.2 kilograms (slide rule accuracy). This soft brown eyed Tri-Delt pledge is a secretary for the Shamrock; a labor of love, no doubt. When asked what she thought of Engineers growing beards she said, "I think it's cute." Cute? Her major is in social work and she plans to specialize in underprivileged kids. Could she mean the Engineers? She is a real outdoors gal and her favorite sports are ice skating, roller skating, and swimming. She didn't say anything about Hink Parties. She said she doesn't know an Engineer without his slide rule (or beard). All Engineers please note and if you've not got a beard you better carry that slipstick. 3.2 is on her list of preferred beverages. *We'll drink anything. Anyone for shaving lotion? (The Staff)* Mary Ann was born in Kansas City and attended Southwest High School before coming to the State U. this year.

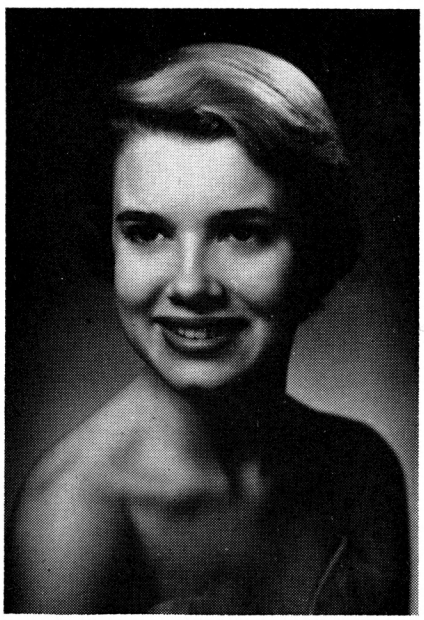


DOTTIE BURGER

Dottie floated into the office the other day, sat down and told us just how things were with her, specification wise. She stands about 5′ 2″ tall and tilts the scales at 105 pounds. A cute little chic she is, huh? She hails from Webster Groves, Missouri and she told us she was 20 years old in January and she is proud of it. Still she doesn't smoke because, "It tastes bad." This is Dottie's first year here, and she is at present a junior taking primary education, she says she likes kids. Dottie wants one girl and three boys, all engineers, in her family . . . she heard about the engineering shortage. Since there is an engineering shortage, she decided she had better find one quick for a steady

AND HER ATTENDANTS

fella. She is pinned to Russ Simmons, and she feels sorry for him and other engineers because they have to do too much work. She claims to be an engineering widow since Russ has to study all the time . . . Dottie doesn't care for this at all. "When he does come over, he talks an entirely different language." *All the time? (Ed Note)* At the present price of coffee, Dottie figures she better quit drinking it—she likes coffee. Dottie transferred here from Colorado College in Colorado Springs where she says it was hinkin' weather all the time, but no hink, so—. Dottie finds



her favorite culinary delight is the Tastee Freez, the big quarter kind, and she says any more than this fills her up too much. With this, our little blonde Kappa Kappa Gamma cutie bade us goodby, and strolled out of the Shamrock office for a rendezvous with Russ.

BARBARA FARIS

Barb, a petite little brunette is one of the smallest of our candidates this year. She weighs 98 pounds, was once a 97 pound weakling until she took "Dynamic Tension" as prescribed by Charles Atlas. Now, we know big surprises come in small packages. Barbara is 20 years old, a Junior, and she is majoring in Education. She wants to teach in the elementary schools, preferably the second grade. But fellas, you can't cast your eye on



this pretty school marm' because she is already pinned to Dud Gilmore, a double E. We don't think the teachin' career will last too long, as Dud and Barb are to be joined in holy wedlock sometime this summer. Besides her formal learning, Barbara is learning how to cook the best meals, in anticipation of this summer. She is active in Red Cross, recommends that we give blood, and offers to bandage our heads if we have a headache or hangover, or other head splitting circumstances . . . Thermo, ME 210, etc. Barb expended most of her energies in her freshman year as a cheer leader—give us the Big T, the T, yell damnit, yell. Did this kind of enthusiasm come from her old Alma Mater, Webster Groves, or from Pi Beta Phi, her sorority? We don't know, but as we said before, "Big surprises come in small packages."

NORMA UMLAUF

Norma is a member of the Kappa Alpha Theta sorority and has brown hair and light blue eyes. She weighs 110 pounds and stands 1.647 meters tall. Born in Kansas City, she moved to Moberly soon after, and thence to Columbia. She is majoring in Music Education and is a senior. She wants to teach voice in high school and eventually in college. She plays the piano and likes both classical music and Boogie. When asked what she thought of the engineers, she said, "They're great as far as I know," but



delving into the subject further we found that she was once pinned to an Engineer and in her own words, "He dropped out of Engineering School so we got unpinned." Rah! Her pet peeve in the University is such large classes. She should come over to the lair of the Engineers where we have small "select" classes. She likes a mixed drink called grasshoppers. "If anyone drinks enough of these they find themselves less than knee high to a grasshopper." *We haven't been knee-high to a grasshopper for a long time, but watch our dust tonight (The Staff)* These grasshoppers are the pure stuff, no pollution with such things as water, or soda, they are creme de mint, creme de cocoa, and something else. A Chartreuse drink, it is "to be sipped slowly," says Norma. With two of the finer things in life in mind, wine and women, we leave Norma and return to the salt mine called Engine Building.

THE HERRMANN ENGINE

By KARL L. HERRMANN

—Photos Courtesy Herrmann Engineering Co.

The Herrmann internal combustion engine was designed and developed because its type of construction requires 70% less manufacturing equipment, 50% less material and 50% less maintenance. Cost of the basic engine is less than 60% of the cost of conventional power plants now available. It is slightly more economical in its fuel requirement. Up to 60% less weight and space is required depending on type of installation.

This type of engine is suitable without major change for marine, stationary or portable compressors, generators and pump services. It is also intended for aircraft, automobile, truck and locomotive installations.

The development work has been carried on since 1936 (excepting the World War II years) and thousands of hours of testing on 24 engines built and rebuilt have proven this construction feasible and qualifying as above.

These strong claims are supported in detail in this article with description, diagrams, photographs and drawings. The parts, test data and engine operation can be examined at our plant by prospective customers, engine manufacturers and interested research organizations.

Very Sincerely,
Karl L. Herrmann

HISTORICAL

The original Watt's engines built in 1770 to 1780 had a walking beam one end of which was connected to the engine piston and the other end to a pump using connecting rods and guide rods. The early engines were used for pumping water out of coal mines.

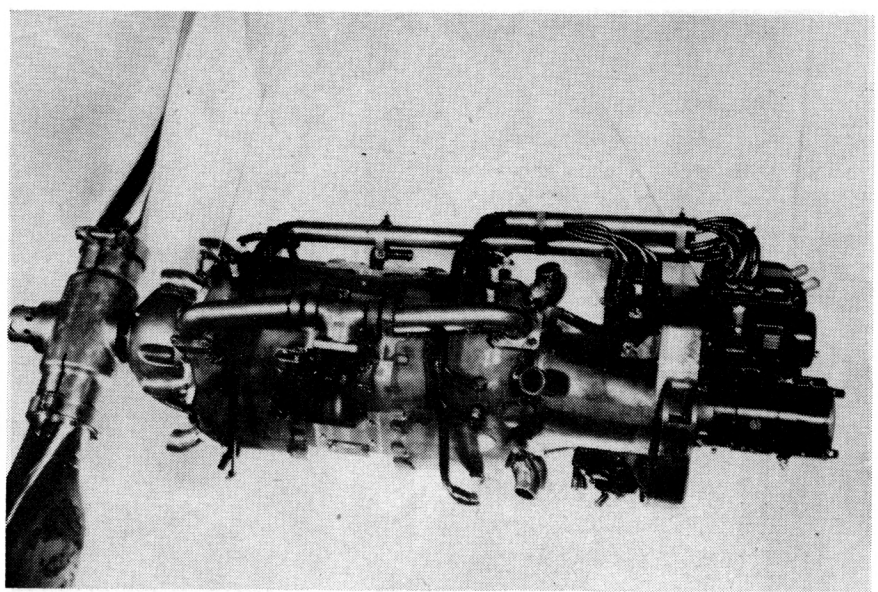


Figure I

About 1780 Picard built crank engines for turning mill shafts and received a patent which for a time prevented Watts from selling engines for mill purposes. A Picard engine built in 1880 and in use until 1929 can be seen at the Ford Greenfield Village Museum.

Since Picard invented the crank engine and until 1900 the requirement for increased power was satisfied by increasing the speed, weight, number of cylinders and pressure at the piston. Other improvements were multiple steam expansion, the cutoff, the steam turbine and the internal combustion engine.

When about 1900 automobiles were being developed it was necessary to still further increase power with a substantial reduction of weight and space. Also the internal combustion engine superseded all other engine types. This increase in power was accomplished with still more speed and cylinders, with higher gas pressures. To obtain lighter weight available materials were stressed closer to their fatigue limits.

As speeds were increased reciprocal forces and gas pressures caused tortional vibration of the relatively flexible shafts. The shorter connecting rods produced varying piston velocities difficult to balance. It was necessary to add vibration dampers, counterweights, flywheels and rubber mountings to prolong engine life and produce smooth operation.

However, since Picard's use of the crank, no basic improvements were made in the disposition of reciprocal

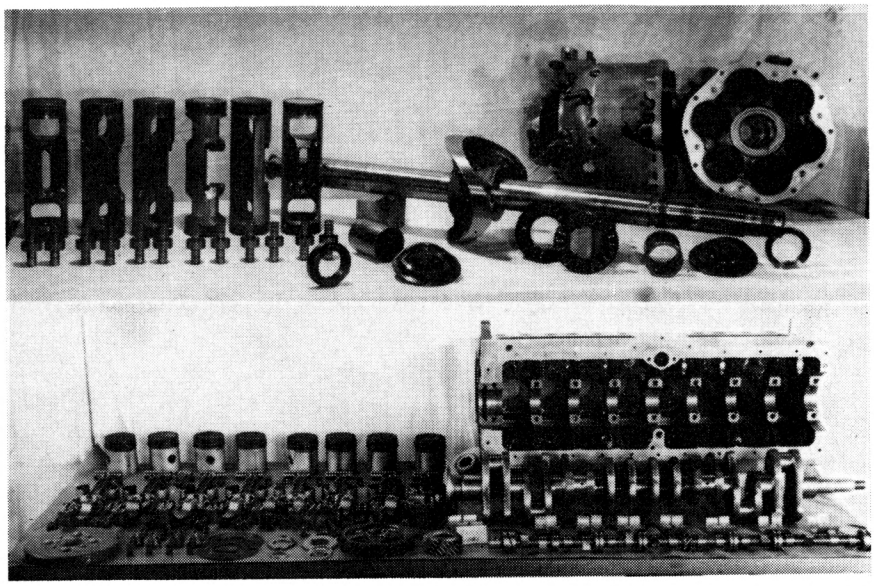


Figure 2

and torsional forces which are by far the most injurious to engine life.

In view of the history, the Herrmann Engineering Co. developed the following engine.

SOMETHING NEW IN ENGINES

Undergoing Type Tests as specified by the Civil Aeronautics Authority, at Glendale, California is an engine, Fig. 1, which is a very novel departure from the conventional engines now in production.

This engine has *no* crankshaft, *no* crank case, *no* main bearing, caps, liners or bolts, *no* connecting rods, caps, liners or bolts, *no* separate valve cam shaft with its bearings and timing gears, *no* vibration damper, *no* counter weights, and *no* flywheel.

The conventional main bearings are replaced with four bronze bushings pressed into the drum shaped cylinder block. The crankshaft is replaced with a straight shaft and a main cam. The valves are operated by two disc cams mounted on the main shaft.

The number of vital parts eliminated can be seen by comparing engine parts shown in Fig. 2. The parts shown at the top of Fig. 2 are of the new engine and replace the parts of the conventional engine shown below. In addition the engine shown at the top is much larger having 12 cylinders, 373 cu. in, displacement and developing 210 H.P., the engine shown below has 8 cylinders 250 cu. in displacement and develops 140 H.P.

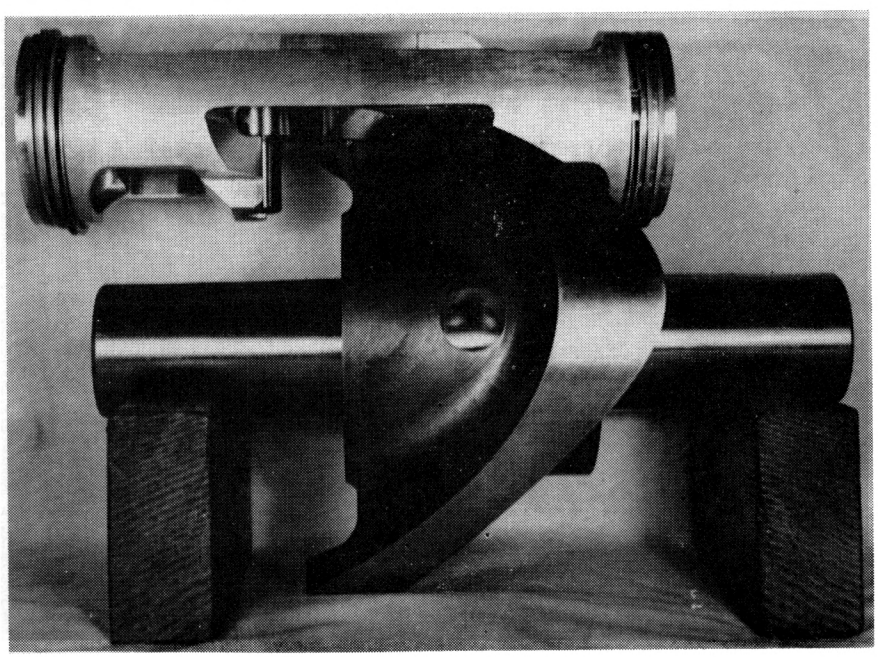


Figure 3

THE MAIN CAM

An important element in this new engine is the main cam, Fig. 3. It is a very rigid member as compared with the crank of the conventional engine which it replaces. The reciprocal forces of the double ended pistons and gas pressures are transferred to the main cam via two trunnion rollers in each of the two pistons.

The cam shape is designed to produce harmonic motion of the piston and the resulting inertia forces are completely washed out in the cam without reaching any other engine part. Similarly gas pressures are partly offset and only their resultant is passed on to the main shaft.

Further the main cam provides four strokes per shaft revolution instead of the two strokes per shaft revolution obtained with those of the crank. The result is that the six double ended pistons produce 12 power strokes per shaft revolution instead of the three power strokes obtained with the crank. Fig. 4 shows how the torque impulses of our cam engine overlap and obtain a relative uniform torque and how the torque impulses of a similar H. P. six piston engine drops practically to zero three times per shaft revolution.

A better appreciation of the importance of this feature can be noted on examining Fig. 4, which illustrates the stress path back and forth from piston to propeller in both the crank and cam engines. Fig. 4 does not reflect the tremendous increases in material stresses and bearing loads due to the torsional vibration of the flexible crankshaft.

VALVES ARE IN THE HEAD

Like nearly all modern engines the valves of the cam engine are in the head. The combustion chambers are of such a shape recognized as best for reduction of detonation. Fig. 4 shows the location of the valves, roller tappets and actuating valve cam.

CARBURETORS AND INTAKE MANIFOLD

The two Stromberg carburetors are mounted on opposite sides of the en-

(*Continued on Next Page*)

HERRMANN ENGINE

(*Continued from Preceding Page*)

gine. Both are connected to the annular manifolds in the front and rear cylinder block. Fig. 4 shows an intake valve and its port connection with one of the annular manifolds. Fig. 1 shows the double loop connections from carburetors to the valves.

COOLING

The liquid coolant is circulated under pressures up to 6 pounds. Separate sections of a duplex pump supply each cylinder block with coolant from a common cooler.

The coolant enters internal passages in the cylinder head and is directed around the exhaust valve ports from which it reaches the cylinder barrels through metered holes. Fig. 4 shows the scalloped intake manifold and ports, the exhaust ports located in the scallops and the metering hole to the cylinder barrel.

ELECTRICAL SYSTEM

The engine shown is equipped with dual ignition. Each cylinder is fired with standard battery and distributor system consisting of two six cylinder Electric Auto-Lite units entirely independent of each other.

In addition to the battery ignition, where necessary as in aircraft, another complete magneto system is installed. This consists of two independent magnetoes, one for each bank of cylinders.

The whole provides a completely independent battery and magneto system for each bank of cylinders. The result is easy starting.

Fig. 1 shows the Delco-Remy starter and generator installation.

PRODUCTION COSTS AND MAINTENANCE

"How is the main cam made?" This is usually the first question asked concerning production and equipment costs. All other parts obviously can be made by the several well known methods.

The main cam is made from a rough forging and all except the cam path is machined on standard machines. For the cam path a simple generator, is used. The master cam is essentially one-half revolution of the main cam; and therefore it is geared two-to-one to the main cam. A bed holding the above equipment is moved by an arm held against the master

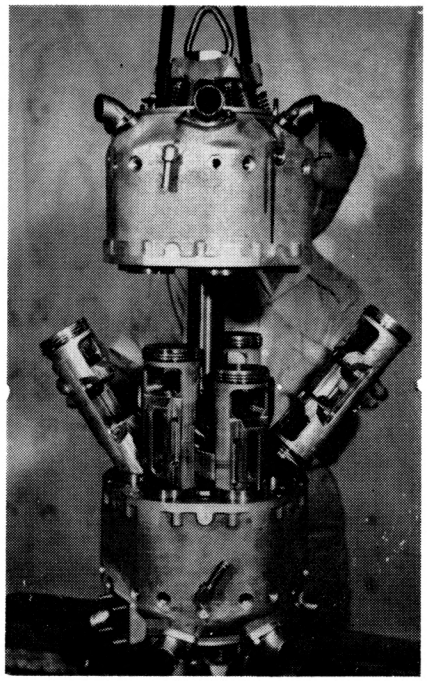


Figure 5

cam. As the master cam rotates, the whole bed moves axially to the rotation. A fixed grinding wheel removes the excess material from the main cam. After one side of the cam is ground, the grinding wheel is moved radially until it clears the side of the

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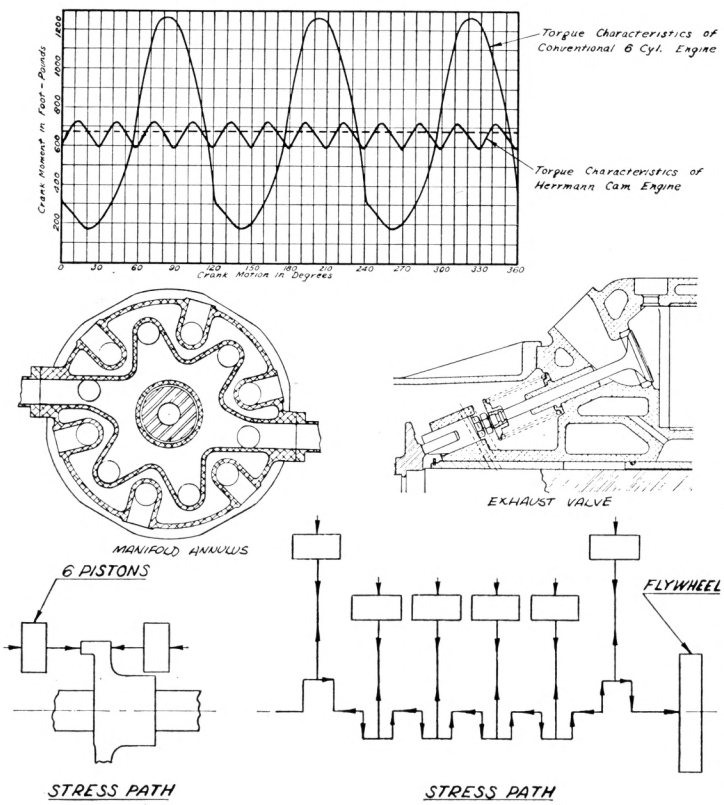

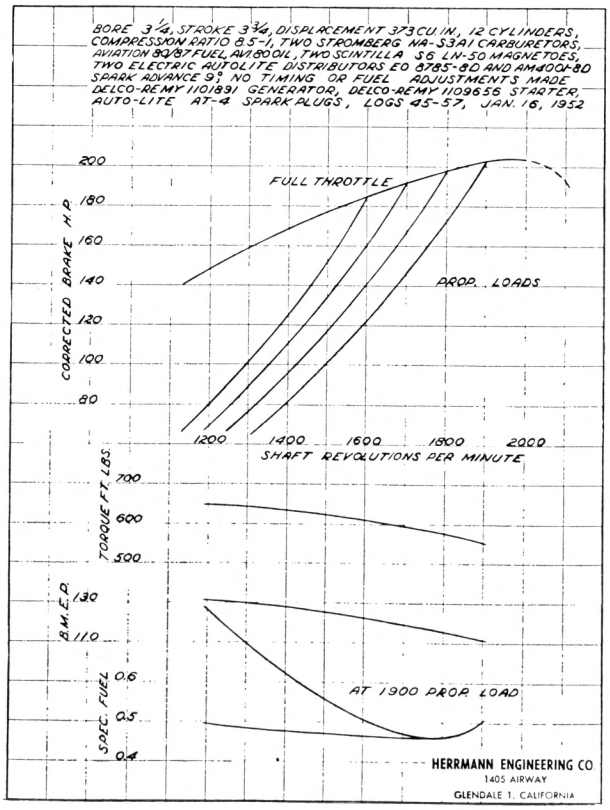

Figure 4

EINSTEIN: SPECIAL THEORY OF RELATIVITY

By PETE GALE, E.E. '54

"Only God and Einstein are able to understand Einstein's Theory of Relativity; God has now forgotten." This saying was believed true some thirty years ago. Today anybody that will take the time to do a little reading and ask a few questions will be able to get a rough idea of what relativity is about. In this paper I will try to explain Einsteins Theory in the simplest words. I will try to keep from using mathematical and physical formulae and I will refer to such with adequate explanation. Einstein's theory, although generally accepted today, has many holes in which a person well versed in this science could bring forward some very substantial arguments. It will not be possible for me, in this paper, to deal with these arguments.

The whole of science, from the time of Aristotle until a comparatively few years ago had been based on the supposition that an interval of time or an interval of space between two happenings was always the same. This was thought true no matter where the observer might be located. As they thought this true, they thought also that time and space were independent of each other. I will use the following examples to try to illustrate what is meant by time and space.

If I were to meet a friend outside the library and told him that I would meet him there at the same place the next day, I would be asking him to do the impossible. It is true that the next day I might see my friend outside the library; it might even be the same place in relation to the library and to the whole world. The little spot in space where we had been standing the day before will have been left behind by the world as it races round the sun in its orbit. That same spot would be left behind by even the sun and all its stars as they all go racing around in some other universe. It is now obvious, that if we want to specify the position of a body traveling in the universe we will have to tell of its position in relation to some other moving thing. This is somewhat similar to the positioning of an airplane. We have to give its longitude, its latitude, and its height; three dimensions.

This next example shows how time would vary for different observers. Let us think of the time when an atom bomb exploded in New Mexico in 1950. Now let us recall the time that a star was seen to explode in the heavens in 1800. To the people on Earth the two events were separated by 150 years. Think of an observer on another planet who saw both of the events. To him both explosions happened at the same time. Another observer on yet another planet also saw these happenings. To him it seemed as though the star exploded 150 years after the exploding of the bomb. These phenomena are easily explained. We all know that it takes a certain time for a light beam to travel from one place to the other. To the first observer the Earth was the same distance away as the star. This meant that the light would take the same time to travel the distance and give the effect that these two events had happened at the same time. To the

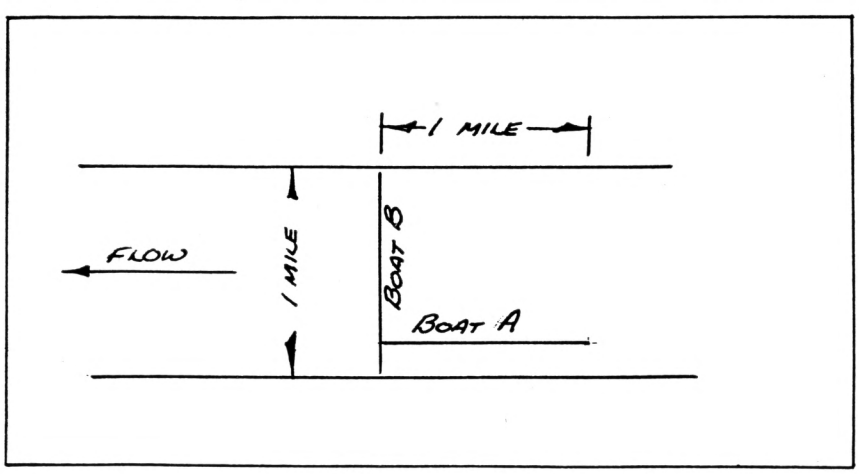

Figure 1

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EINSTEIN

(*Continued from Preceding Page*)

second observer the Earth was much closer than the star. This meant that the light from the Earth would reach the observer first, giving the effect that the bomb had been exploded first.

It was on the belief that time and space were independent of each other that Galileo and Newton developed their formulae for moving bodies. These formulae held good for such relatively slow speeds as were known in those days. In recent years, however, it was found that when a particle was accelerated up to a speed approaching that of light, it did not seem to behave as it should, or at least it did not obey the laws for moving bodies. It was thought that these laws were good for any speeds, but it was shown by many experiments that as soon as the speed was increased to a high velocity a particle would not obey these laws. It was apparent to the scientific world that something had to be done about it, as the whole of science had been based on these laws which were now found to be false.

While most scientists were worrying about this great upset, there was one man, named Michelson, who was conducting various experiments with light beams. It was on the results of the Michelson experiment that Einstein started to formulate the theory of relativity. In fact, these experiments of Michelson's were so important that it is worthwhile for us to take a look at what he was trying to do.

It is a well known fact that light travels through the empty space between the stars and the sun and the Earth. We know this because we can see these stars and sun with our own eyes. Physicists long ago concluded that these light beams travel in a medium that is devoid of mass and inertia, is infinitely elastic and offers no resistance to the movement of material bodies into which it penetrates. They called this medium Ether.

It was the astronomer named Bradley who discovered the fact that when the light beam from a star traveled the length of his telescope the beam was deflected a small amout by the time it reached the eyepiece. On Bradley's findings, scientists believed that the ether did not share the motion of the earth. It could be seen that, as the telescope moved with the earth, it seemed to leave the light beam behind. As the light beam was traveling through the ether it was decided that the ether was not carried along with the Earth. Michelson was in doubt of these findings and set out to find if the ether really was carried along with the Earth or if the Earth moved through the ether like a ship moves through water.

Michelson compared light beams to boats on a river and set out on his experiment with this assumption. He found that if two boats, comparable in weight, physical dimensions, and power, were to set out from a point on the bank of a river, one going up-stream, the other going across, it would take the one that went up-stream longer to go one mile and turn and come back to the start than it would take the one that went one mile across the river and came back to the start.

The reason one boat takes longer to go one mile is that the boat that goes up-stream has to go against the current of the river. Michelson now argued that if two light beams were sent out, one against the ether and one across the ether, one would take longer to cover the distance than the other, just like the boats did. This difference would be extremely small, but Michelson devised a way in which it could be measured very accurately.

Although Michelson's apparatus had been constructed so that if any lengthening of the path did occur it would be measureable to 1% of the expected distance, try as he might he could not detect any lengthening of the paths of the light beam. Michelson was forced to come to the conclusion that the ether moved along with the Earth and with his apparatus. When these results were made public there was great concern over the two conflicting theories. One said that the earth moved through the ether. The other one said that the Earth, as it moves, carries the ether along with it. It was imperative that some one should come up with an explanation of these two conflicting theories.

The Dutch Physicist Lorentz put forward a hypothesis from which Einstein started working. This hypothesis states in part: There was no difference in the length of the path of the light beam through Michelson's apparatus, because the arm that was pointing in the direction of the rotation of the Earth was shortened, and that would have shown a difference. This shortening was due to the speed at which the arm was traveling. It must be remembered that the apparatus was traveling with the Earth as it rotates around the sun.

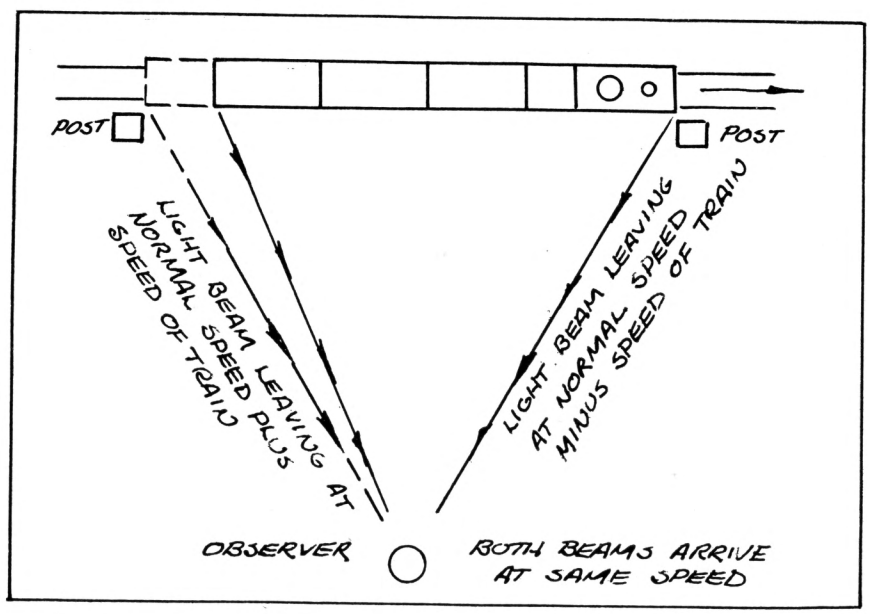


Figure 2

The other arm of the apparatus was not shortened as it was going side ways to the motion of the Earth.

The fact that the arm was shortened seems hard to believe. We might compare the flattening of a rubber ball against a wall to the shortening of this arm as it pushes against the ether at a high speed. The faster the object moves the more it is shortened. The contraction in the arm of the Michelson apparatus was so small that it would be hard to measure. If the length of the arm were to be 8,000 miles long, the arm would only be shortened by about 3 inches. That is, if the Earth still moved at the same speed. Even this much shortening could not be measured, as the measuring rod would also be shortened by the same amount. For example, if somebody were to walk in front of a distortion mirror at a fair ground and tried to measure how tall he was in the mirror, he would find that he still came up to the same mark on the ruler when he looked in the mirror. If someone else were to measure the image in the mirror the true shortening could be found as his view would not be effected by the mirror.

Einstein sets out to explain this phenomena. First he pointed out that light always has the same velocity. No matter how fast an observer might be going, light will always reach him or leave him at the same speed. This fact was given by the astronomer De-Sitter, who proved that although some stars are moving away from the Earth at anything from 10 to 100 miles a second, the velocity of the light that comes from them is always the same. This fact is different from every other physical movement. For example, if we throw a ball toward a truck that is moving away from us the ball will hit the truck with less speed than it would if the truck were coming toward us. This is the same for sound waves and for shells shot from a gun. Light is the one exception. So let us now accept the fact that whatever the speed of an object might be, a light beam will always leave this object at the same speed, relative to itself. This same beam of light will always be seen by a stationary observer to have its normal speed, 186,300 miles per second, or about 3 x 10 meters per second.

Let us imagine a train on a railway track with a post on the embankment marking either end. The train is pulled back along the track from between the posts and then comes back, at some unheard of speed past the posts again. To our surprise, the train seems to have been shortened; it does not fill the gap between the posts like it did before. The reason of light that comes to us from the front of the train leaves the train for this, Einstein tells us, is: The beam at its normal speed, minus the speed of the train, relative to the post. The same happens to the light that comes from the back of the train. Only its speed, relative to the post, is its normal speed plus the speed of the train. Therefore it would take longer for the light to come from the front of the train than it would for the light to come from the back; although the light reaches our eye at the same speed. In this way it is easy to see that by the time the beam of light, that left the front of the train, reached our eyes, the back of the train would have moved past the post and appear to have moved closer to the other post. This would mean that the train would seem to be shorter than the distance between the two posts.

In a similar way to the train, it can be seen that any object that moves will appear, to an observer that does not have the same motion, to be shortened. Similarly it can be seen that the time taken for the train or any points will seem different to a person observing the movement than to a person who was moving with the object. The train, for example, would seem, because it looked smaller to us, to take a longer time to pass between the two posts than it would seem to a person who was riding on the train.

Now since we see that an object's size depends on the speed that it is going—that is, the time it takes one object to move from one place to another—we find that we cannot define space without time being a factor. This led Einstein to develop four-dimensional space, where there is length, breadth, depth, and time.

Let us now imagine a body moving along a straight line. Its speed is being doubled every second. If we let this speed continue to double, according to Newton, the speed would get faster and faster till soon the speed would have exceeded the speed of light and would still be getting faster. Einstein, taking into consideration what Lorentz had said about a body that moved, developed an equation which showed that a body could not go faster than light. He showed that if a body was given such an acceleration, one that would double its speed, the speed would not double but would increase a smaller and smaller amount, as its speed approached that of light. Einstein evolved this equation by going through many complicated mathematical processes. This equation, given

(*Continued on Page* 38)

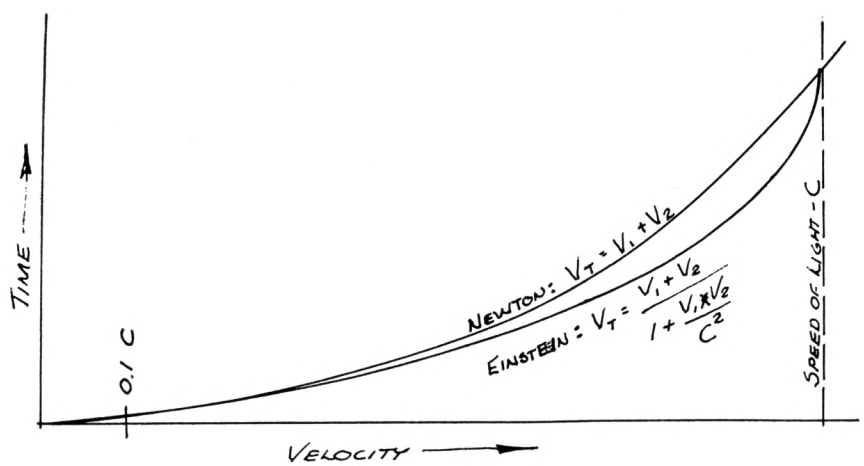
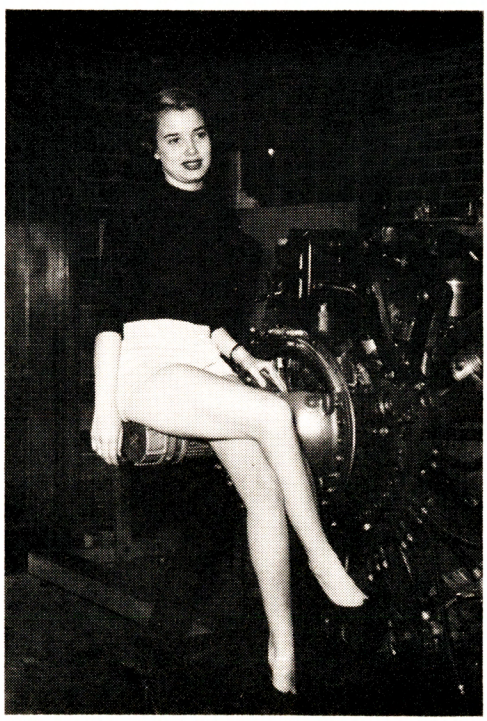


Figure 3

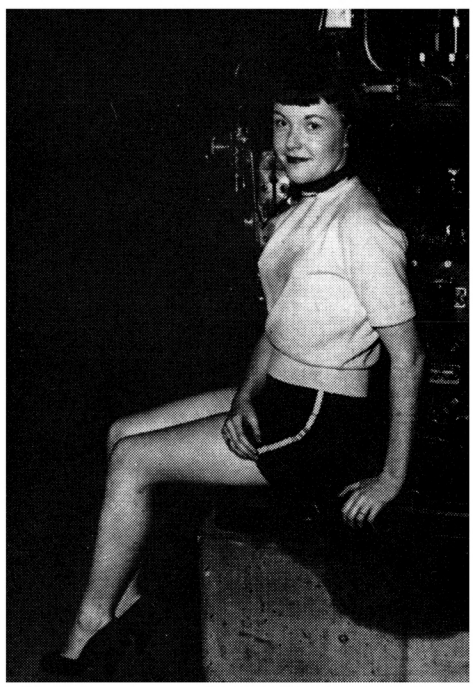
QUEENS IN REVIEW



Lee Blount—Queen of Love and Beauty —5' 3", 115 pounds, 19 years old—Chi Omega.



Dottie Burger—5' 2"—105 pounds—20 years old—Kappa Kappa Gamma.



Barb Faris—5' 1"—98 pounds—20 years old—Pi Beta Phi.



Mary Ann McKinstry—5' 3"—119 pounds—18 years old—Delta Delta Delta.



Norma Umlauf—5' 4"—110 pounds—21 years old—Kappa Alpha Theta.

THE MUSEUM OF TRANS

By TOM NOEL, M.E. '54

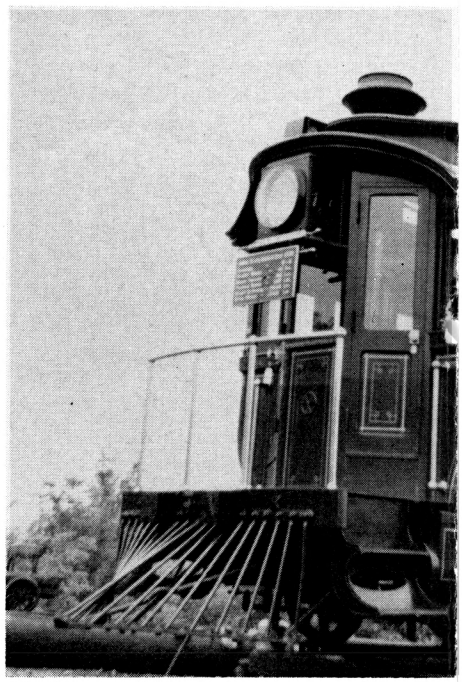
Photos Courtesy Mu

The Museum of Transport is one of the projects of the St. Louis Railway Historical Society. This society came into being in 1946 as a result of the work of several St. Louisians and has as its purpose the study of the history of the railroads and other forms of transportation. Many railroads in the St. Louis area have shown considerable interest in this project by donating old equipment to the museum.

The museum is located at Barret's station near Kirkwood in St. Louis County. The members of the society have laid the track needed for the railway equipment and have done all the repair and maintenance work. Since the museum is a continually expanding project, the society members work on it on weekends the year around.

One of the main reasons for locating the museum at Barret's station is the historical significance of this area. The museum occupies land along the original route of the Pacific Railroad (now Missouri Pacific). The first railroad tunnels west of the Mississippi were bored on this line in 1851 and were in use until 1944. One of these tunnels, the West Barret's tunnel, is on the museum property and track has been relayed through it by the society.

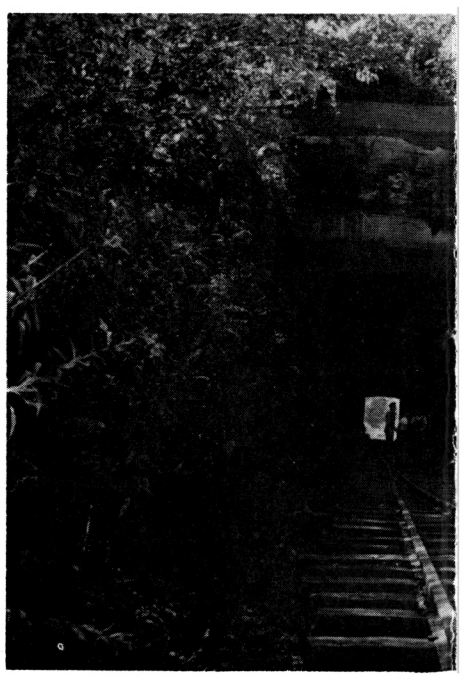
The museum contains railroad equipment exhibits, street railway exhibits, and automotive exhibits. Some of the museum's railroad and street railway exhibits are shown in the accompanying pictures. A Chicago & Northwestern locomotive (No. 1015), which set a speed record of 127 mph in 1905, is one of the museum's most valued exhibits. The street railway exhibits include many early types of streetcars and the automotive exhibits are made up of early model cars and buses.



One of four inspection locomotive presented to Museum in 1949.



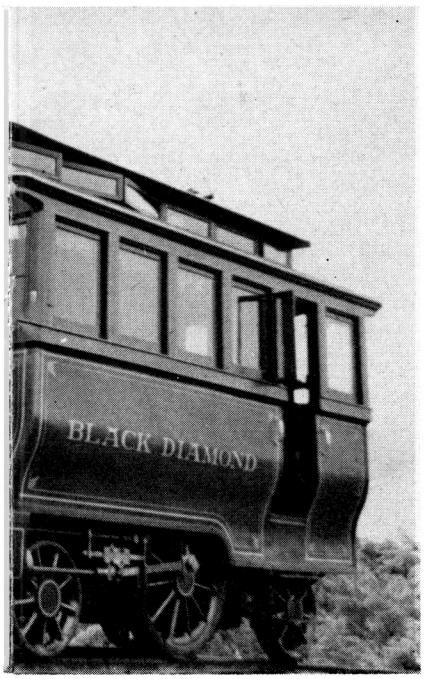
Horse-drawn street car built in about 1880, presented to museum by St. Louis Car Company.



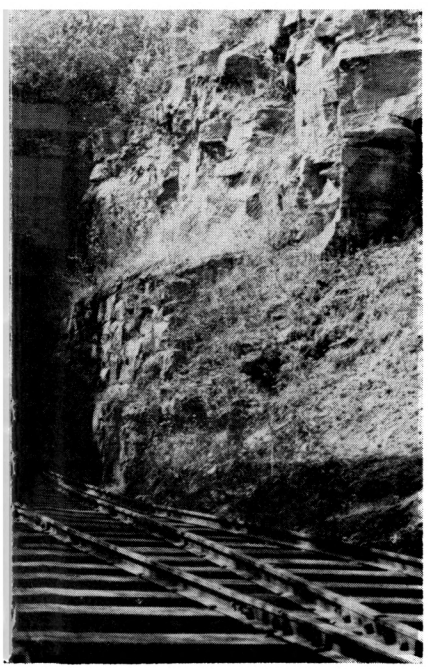
Old Missouri Pacific tunnel on the Barret's tunnel.

PORT

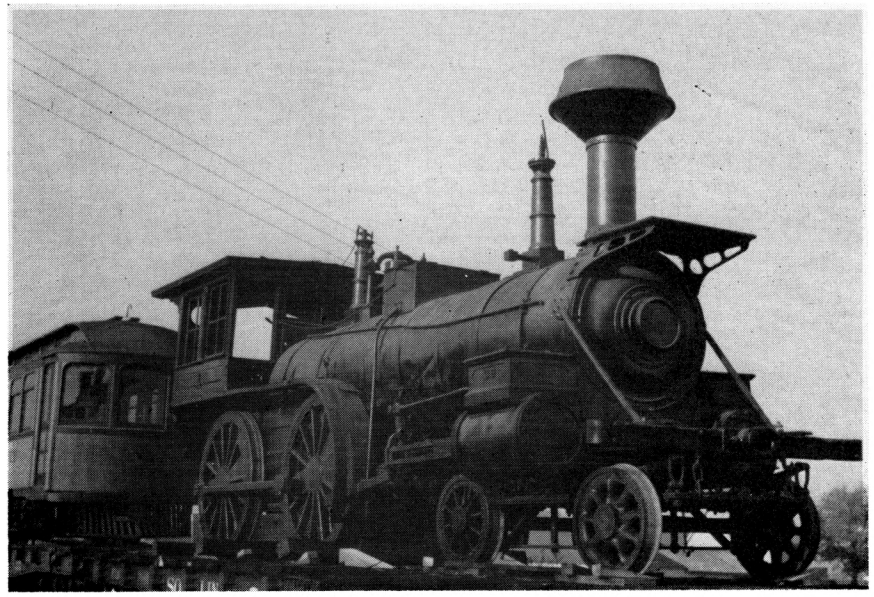
rim of Transport



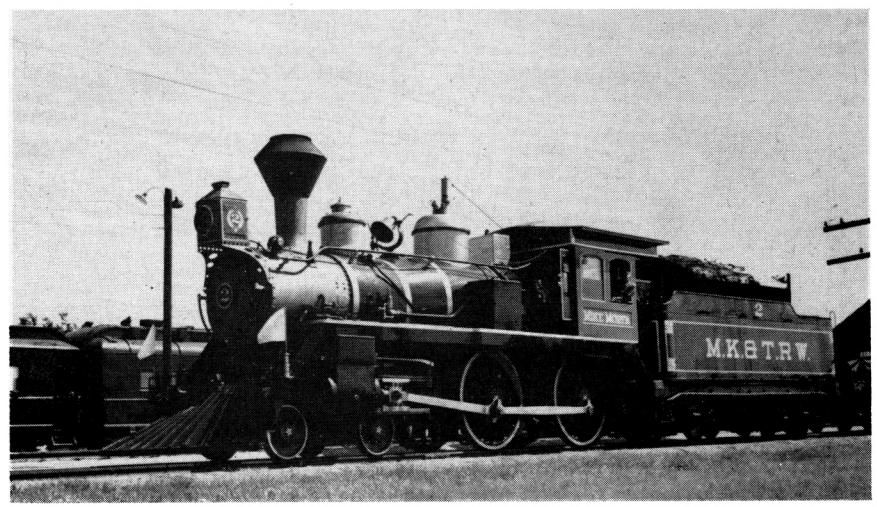
for built for Reading Lines in 1882,



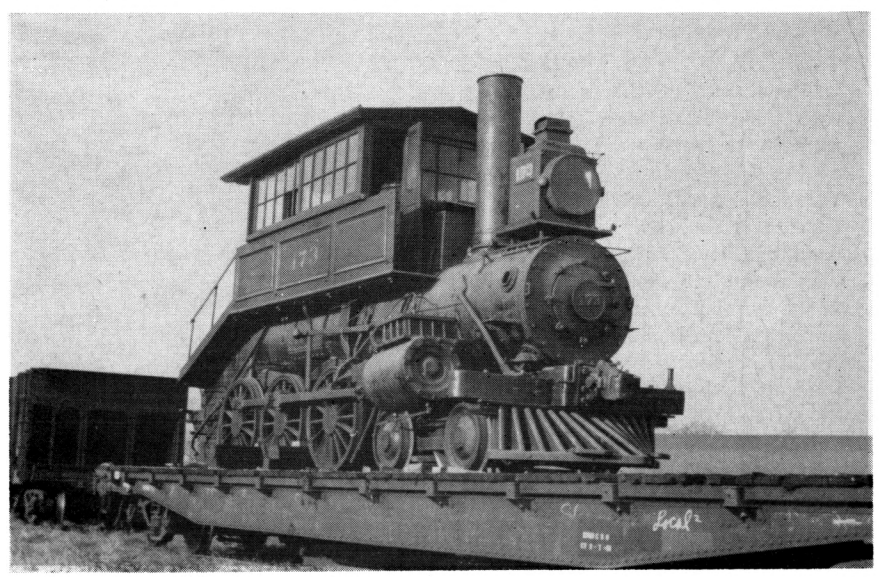
nuseum property, known as the west



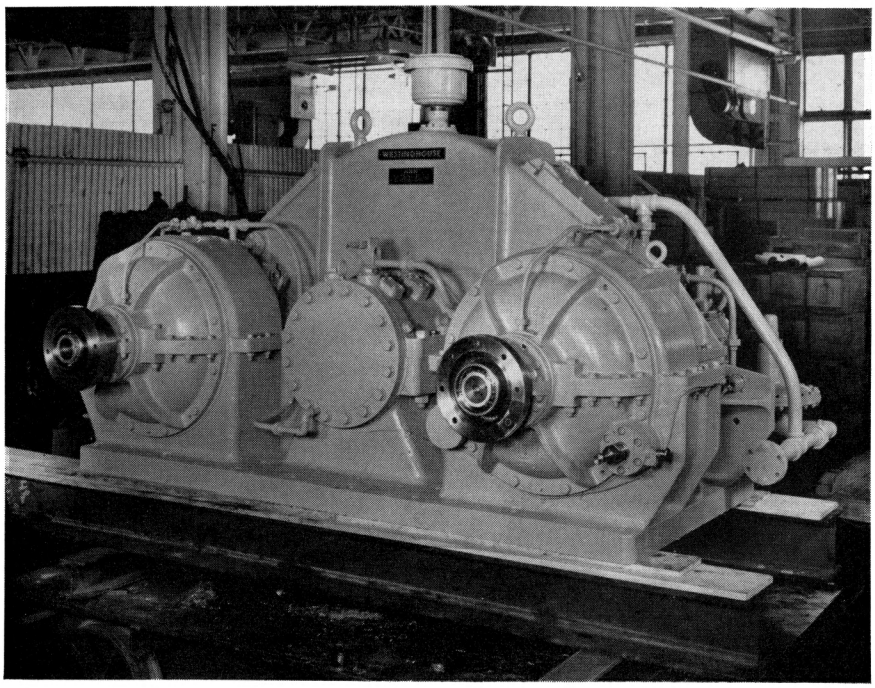
Boston and Albany, No. 39—Built about 1870, according to a design by Wilbur Eddy, known in its day as an "Eddy Clock" because of its smooth running; also obtained from Purdue in 1950.



M. K. & T., No. 200—This American standard type locomotive was in service for the Katy about sixty years, went on display at the museum in 1952.



Baltimore and Ohio No. 173—This camel-back type locomotive was built in 1873 and was obtained for the museum from Purdue University in 1950.



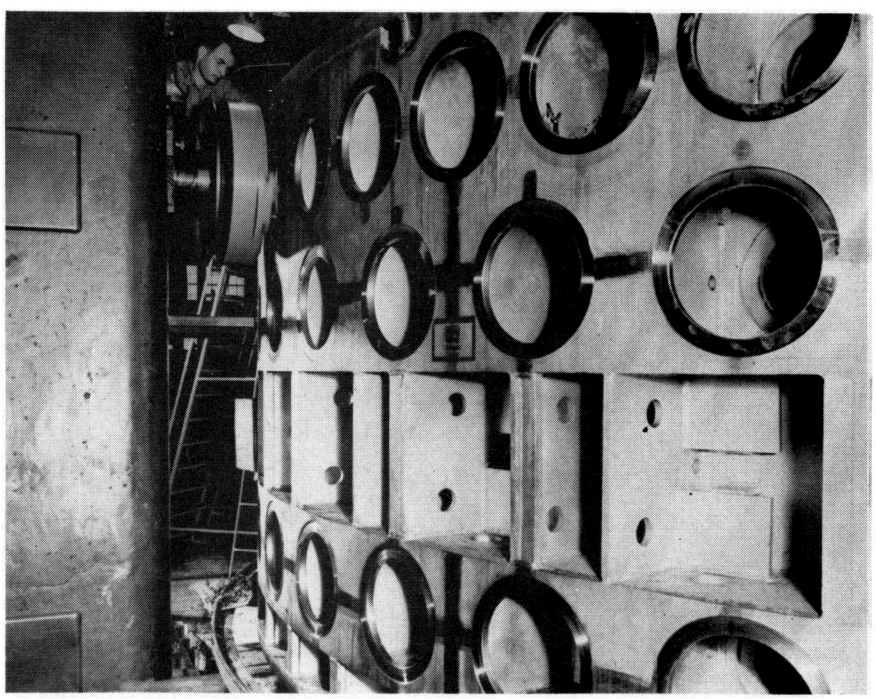
—Cut Courtesy Westinghouse

For the manufacturer of reduction-gear units to transmit power from engines to propellers of non-magnetic mine sweepers, Westinghouse Electric Corporation is using non-magnetic alloys. These include Discaloy, Ampcoloy, and stainless steel of the non-magnetic type.

Use of these materials, all having different thermal coefficients, created problems not usually encountered in industrial applications.

SINGLE SHOTS

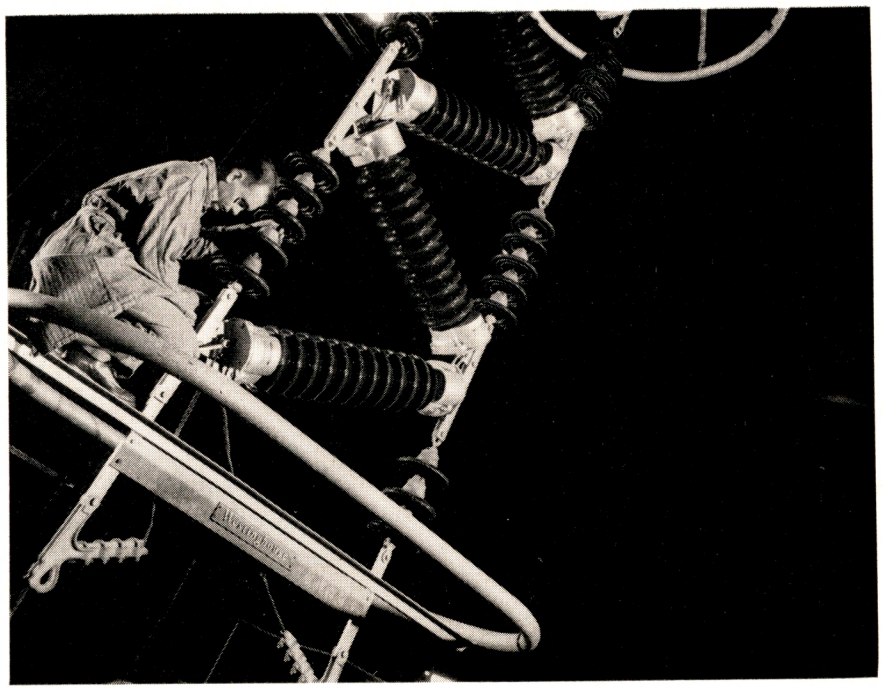
OF ENGINEERING INTEREST



—Cut Courtesy Westinghouse

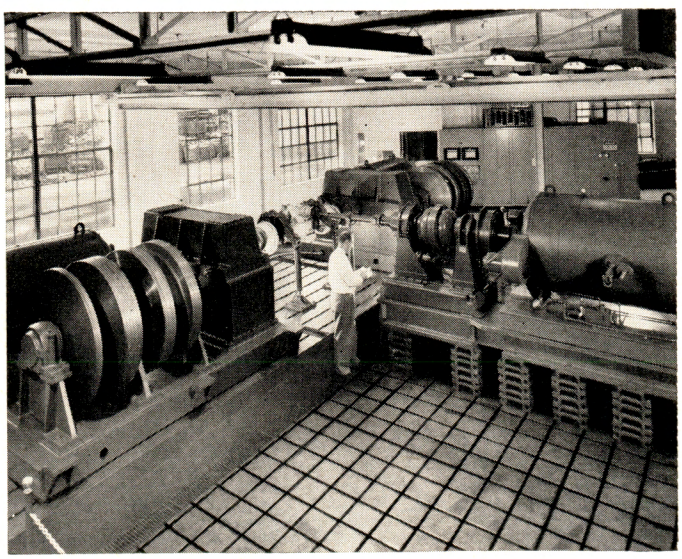
"Portholes" in this giant stator section for an Air Force Wind-tunnel compressor are being bored at the Sunnyvale, Calif. plant of Westinghouse Electric Corporation. After each hole is bored, hydraulic jacks ease the 120-ton steel ring around to the next position. The holes will receive forged-steel housings for bearing inserts in which six-foot-long controllable blades will be mounted.

KWIK PIK



—Cut Courtesy Westinghouse

Right: This arrester, designed by the Westinghouse Electric Corporation, will protect 330-kv systems from lightning strokes. Designed to operate at 258 kv (line-to-ground), the unit consists of seven standard arrester units (Type SV) zig-zagged between supporting insulator columns. The arrester is designed for suspension mounting and therefore is erected easily.



—Cut Courtesy General Electric

View of new axle-testing machine at Alden Indoor Proving Ground of the Timken Detroit Axle Company, Detroit, Mich., showing test stand in foreground with one output dynamometer on left and the input dynamometer on the right. The dynamometers, supplied by General Electric are the largest ever used for testing axles and can exert speed, torque or load to simulate actual road conditions.

NEWSTUFF

By MIKE McDANIELD

One of the headaches of trucking is the delivery of perishable goods such as ice cream, meat, milk, frozen foods and flowers. These must be kept constantly at low temperatures, but truck refrigerating systems generally operate only when the truck is in motion.

General electric has now developed and field tested an "around-the-clock" system for cooling trucks. The system operates independently whether the truck is running or idling. If the motor is shut off it will operate on standard house current by means of an extension cord.

The new system operates off the truck crankshaft and requires no battery power. Also, because it operates on high voltage, no extra motors or transformers are required when standby power is used. The system uses fewer and lighter components, making larger payloads possible.

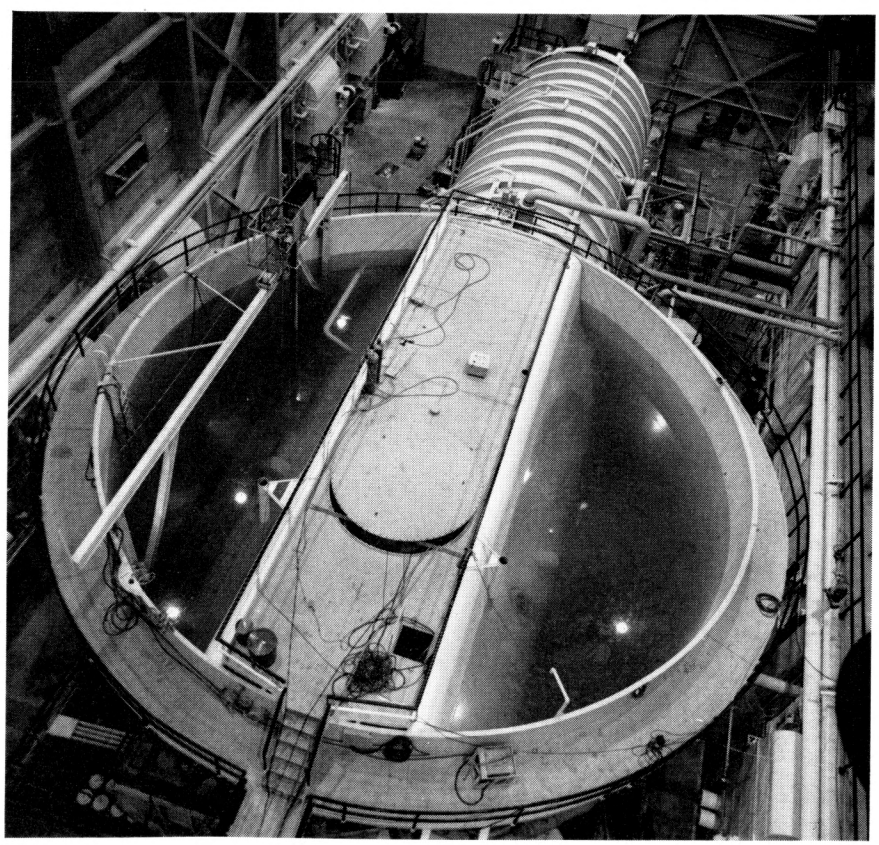
Truckers using the new unit will be able to load in the afternoon for the next days deliveries, eliminating night shifts and making better delivery schedules possible. In addition, packing houses may be able to increase warehouse cooling space as well as the radius of their distribution territory by using in-transit refrigeration.

On May 31, the first atomic engine in the nation's history turned the propeller shaft of a "dry land submarine" built in the middle of an Idaho desert.

This history-making engine, built by Westinghouse Electric Corporation under contract with the Atomic Energy Commission and in cooperation with the AEC's Argonne National Laboratory, was the land-based prototype (Mark I) of the nuclear power plant (Mark II) that will propel the first atomic submarine, U.S.S. Nautilus. The Nautilus was launched on January 21, 1954, by the Electric Boat Division of General Dynamics Corporation at Groton, Conn.

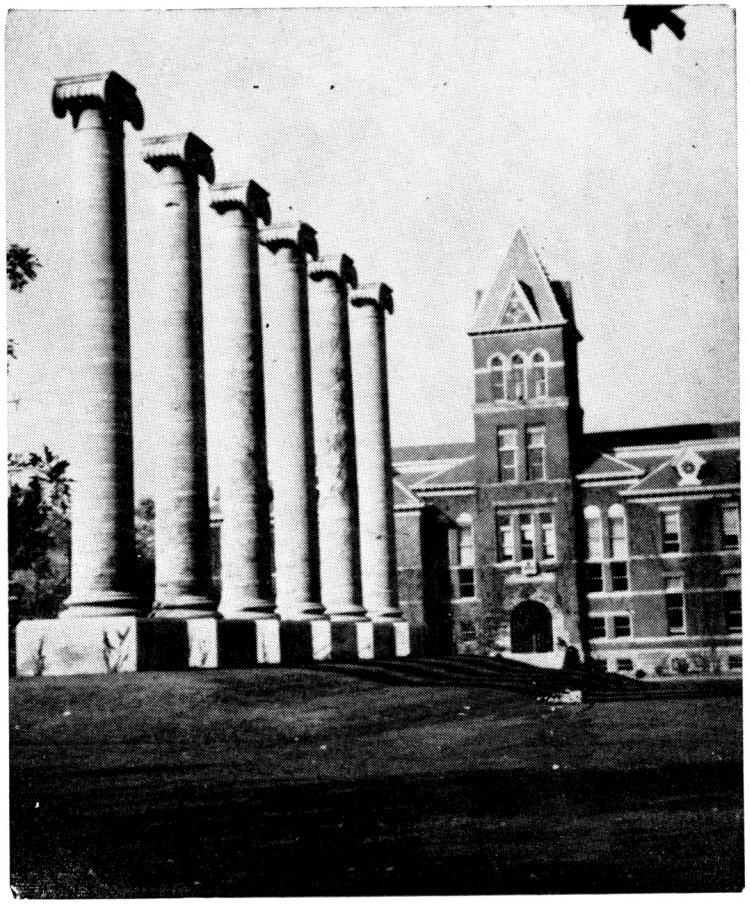
The desert-bound atomic engine is a full sized power plant installed inside two sections of a submarine hull. The reactor compartment is surrounded by its own private ocean—a large sea tank full of water. This sea tank, shown in the photograph, is about 50 feet in diameter and almost 50 feet high. The hull passes through the tank so that the reactor compartment is located within the tank and completely submerged in water. The tank's water capacity is about 385,000 gallons. The Mark I power plant, with its associated propulsion equip-

(*Continued on Page* 34)



—Cut Courtesy Westinghouse

MIZZOU MEMOS



By DAVE BRADLEY

While most of us are "wearing of the green" along about this time of year, there are a couple of last year's grads who are "wearing of Uncle Sam's colors". JOHN COLSTON, B.S. in ME, has been stationed at Keesler A.F.B. for some time studying ground electronics and radar. He left around the last of February for Germany.

GRANT WILLIAMS, B.S. in ME, '53, is heading for Foley, Alabama where he will be studying gunnery and carrier landings. He has been stationed at Corpus Christi, Texas in big plane training and ground training, where, according to his Mom, his engineering training did him a lot of good.

JACK RECK, B. S. in ME, '39, is with the International Shoe Co. where he is Chief Engineer of the Tanneries. His daughter, Holly, is now six years old. They live at 412 Woodlawn in Webster Groves, Missouri.

TOM FULSHAW stopped in last month and reported that he is a Project Engineer with the American Machine and Foundry Co. Tom lives in Greenwich, Conn. Tom found himself engaged to Bonny Pannell of Kirkwood, Mo. He says, "It took a long time to propose, and don't know when I'll get nerve enough to get married."

Also with the American Machine and Foundry Co. is C. KASSEL, who also happens to be a Project Engineer. He lives at 170 53rd St. in Brooklyn.

ELDRED W. BOWEN, B. S. in EE, '39, has recently been made Chief Engineer of the Pet Milk Company. His office address is 1401 Arcade Bldg., St. Louis, Missouri.

JOHN CARROLL is living at 3309 Jackson in St. Joseph, Mo. John is Assistant Chief Engineer at radio station KFEQ there in St. Joseph.

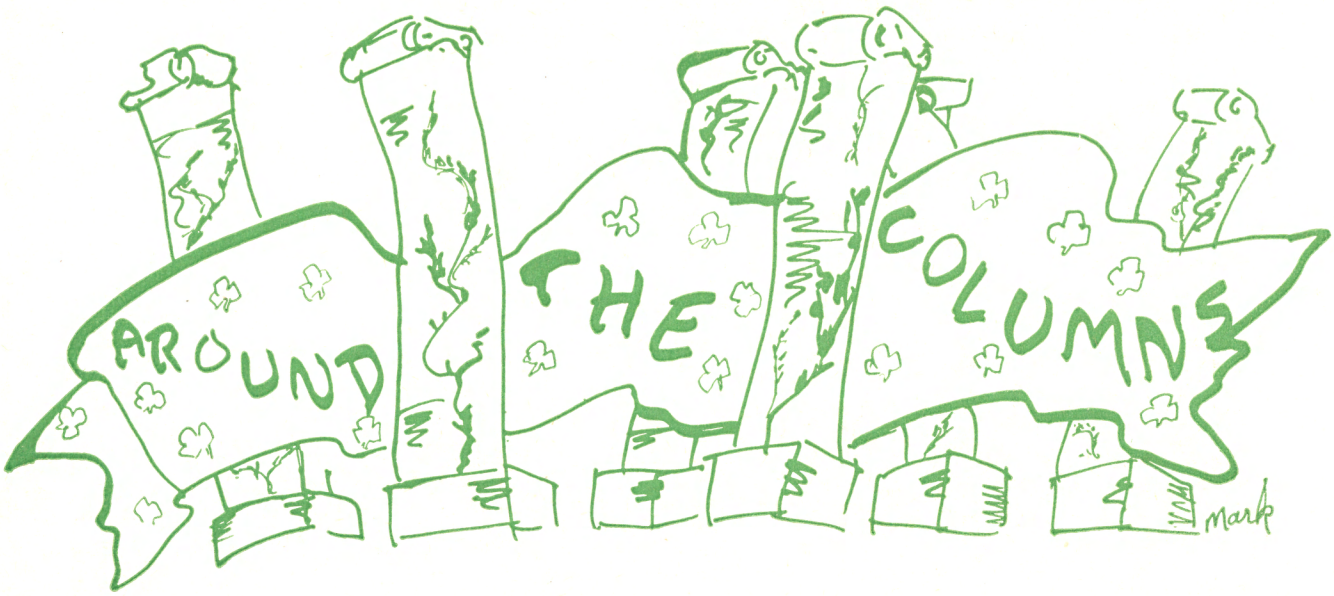
Two alumni who have been with the Kansas City Power and Light Co. since their graduation, have recently received promotions.

F. C. PAYNE, B. S. in EE, '29, has been promoted to Superintendent of Overhead Construction Department. Under his supervision will now come the construction, operation, and maintenance of all overhead transmission and distribution lines for the company. Mr. Payne started with the company in June of 1929.

S. H. POLLOCK, B. S. in EE, 1928, has been promoted to Assistant Manager of Engineering in direct charge of construction estimates, standards and specifications, mapping and the research laboratory. Mr. Pollock started with the company in June of 1928.

PAUL LANDTISER, M. E. '46 is with the Engineering and Construction Department, Equipment Research, Atlantic Refining Company, Dallas, Texas. Paul has had quite a siege of illness over the past few years and has only recently taken up the old slide rule after a long rest. And just to prove that it never rains but it pours, about the time Paul recovered his wife Dottie became ill. Things may be brighter since the latest report (which came in at Christmas time). The Landtisers live at 5215 Capitol Ave., Apt. C, Dallas, Texas.

ART ISEMOTO C. E. '46 has fired in a suggestion from way out in the Pacific. He wants to know why the "best" voices in the Engine Club don't cut a record or two of the Club's songs and the Alma Mater. Is anyone else interested? Art has two children now—Karen, 4 years old, and Marc, about 2. The home address of the Isemoto's is 484 Kanoelehua Ave., Hilo, Hawaii. Thanks, Art, for the scale you sent us.



Hear ye, Hear ye, all you generous partakers of knowledge, we are about to enter that time when the hearts of young girls flutter and men flex their muscles and everything turns that glorious color; green. 'Tis the coming of our favorite Saint, Patrick of Erin. Let all be prepared for this joyous occasion, 'tis that time of the year when your blood runs hot, and the beer runs cold, and the unmarried women run for shelter. Enough of the superfluous verbosity, what I'm trying to say is, GET HOT JACK, THE OLDE MAN'S HERE TO STAY.

♣

What were all those bugged eyeballs for the night of February 1, Wow, where did all the women come from! 'Twas the judging of the girls for the finals for Saint Pat's Queen. If there is one thing Engineers like more than women, it's more women! It's too bad though, that we could only choose five gals out of that luscious crop of girls for Queen Contestants.



♣

Man, everything has been really crazy around Engine School these last couple of weeks. Displays, work on the stunt and increased activities, really spell out the energy everyone is putting into this year's Engine Week. May it be the best ever. Erin Go Brah.

♣

If you have seen these bearded or fuzzy people walking around Engine School lately; we are not being invaded by a band of gypsies, it is just the annual Beard Contest. I think some of the guys have been fertilizing their beards to make them grow. this should be a good contest.

♣

Say, did the Civils build a float for Saint Pat's Week, I hope? That crazy C_2H_5OH by Gorrah.

♣

It's been said that the Hamburg Show was held in the Student Union Ballroom. Went formal for this elite social gathering.

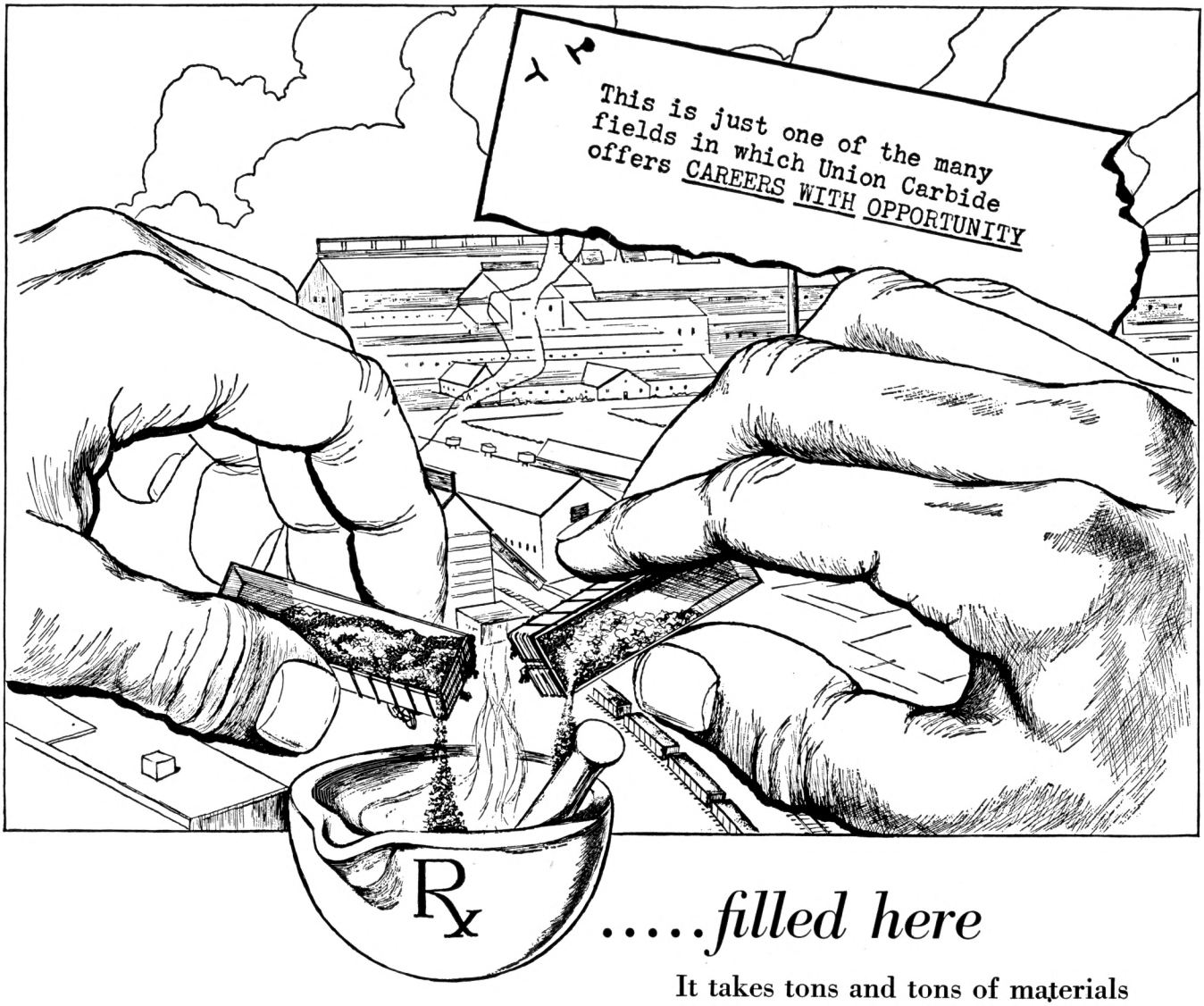
♣

Let's all observe that old custom about the Shamrock on the Clinic side of the Engine School. It proves very interesting to watch the expressions of the girls being kissed. The greater percentage just have a puzzled expression saying "What happened". There are those cases of the active reactionists who leave a neat red hand print upon the kisser's kisser. Tradition has it that there are more girls kissed over the Shamrock than any other rock on campus. (Excluding the Hink).



If any of you remember Michael Chiarottino who used to be one of the boys, and now works for Union Electric in St. Louis, well he was down for a short visit about a month ago, and to his surprise Dean Croft asked him to be Saint Pat. To our dismay, he had to refuse because of his bald head. Just goes to show—when you

(*Continued on Page* 34)



.....*filled here*

It takes tons and tons of materials to fill the prescriptions that give strength and stamina to the steel you use

THE STEEL that's everywhere—in your automobile, in trains, machines, and buildings—is stronger and more enduring because it has been treated with special "vitamins and tonics."

STEEL GETS ITS VITAMINS from the industry's "drugstores"—the plants where alloying metals are made. Here, prescriptions usually call for ingredients by the ton. Their huge "mixing bowls" are white-hot electric arc furnaces, in which temperatures reach over 3,500 degrees Fahrenheit.

These alloying metals are refined and concentrated forms of both rare and common metals. Among them are chromium, boron, silicon, tungsten, columbium, and vanadium. Individually, or together, they give steel durability, toughness, hardness, rust and corrosion resistance, and other special qualities. Chromium, for example, is the secret of making steel stainless.

VARYING COMBINATIONS of these and other alloys are added to every ton of molten steel produced today. Without them we wouldn't have the hundreds of different kinds of steel that do so much for all of us in so many ways.

MORE THAN 50 ALLOYS—The people of Union Carbide pioneered in the development and production of alloying metals. They produce more than 50 different alloys for steel and other metals that go into products that serve you.

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DYNEL Textile Fibers
UNION Carbide
PRESTONE Anti-Freeze
NATIONAL Carbons
LINDE Oxygen
SYNTHETIC ORGANIC CHEMICALS

HERRMANN ENGINE

(*Continued from Page* 16)

cam, and then moved back into position for grinding the other side. The cam path grinder costs a small fraction of the price of a crankshaft grinder.

Fig. 5 shows how the engine is assembled without the use of a tool, bolt or nut until the cylinder blocks are bolted to the center section.

It is estimated that the cost of the cam engine is less than 60% of the cost of the conventional engine when produced in similar volume and horse power.

CAM ENGINE SPECIFICATIONS

210 Horse Power at 1900 RPM
12 Cylinders, 3¼ bore, 3¾ stroke
373-746 Cu. in. displacement
8.5 to 1 compression ratio
2 Stromberg Model S3A1 carburetors
2 Bendix Scintilla magnetoes
2 Electric Auto-Lite distributors
1 Delco Remm Model 1109656 starter
1 Delco Remm Model 101189120A generator
Length 50½"
Height 18"
Width 20"
Weight with battery ignition only and without starter or generator 264 pounds.
Weight with battery ignition only and with starter and generator 312 pounds.
Weight with dual ignition and without starter or generator 300 pounds.
Weight with dual ignition and with starter and generator 337 pounds.

See Fig. 12 for performance characteristics.

Because in the cam engine we have four strokes per shaft revolution instead of two strokes as in the conventional engines, the displacement per shaft revolution is 746 cubic inches instead of the 373 indicated above. However the effect is not to double the power. The torque is doubled and the speed is halved. The effect is the same as though there were a two to one reduction to the propeller without gears.

The performance and economy of the cam engine will be found equal to or better than the most recently designed and produced engines of similar proportion.

APPENDIX

A detailed examination of the parts shown in Fig. 2 will indicate that the cost of equipment required for the production of the cam engine is less than 60% of that required for a crank engine of similar capacity and produced in similar volume. For example: Production executives will readily agree that equipment for the main cam and shaft of the cam engine will cost less than 5% of that required for forging dies, hammers, milling, turning, grinding, and balancing equipment for the conventional crank shaft.

There are no connection rods and vibration dampers, their equipment cost is entirely eliminated.

Less than 5% of the equipment necessary for valve cam shaft and its timing gears will make the two disc cams replacing them in the cam engine.

The two cylinder blocks are identical and include the cylinder head for a valve in the head engine without rocker arms and push rods. The foundry and machining equipment for the cam engine block will cost less than 10% of that required for equivalent parts of the crank engine.

An examination of labor and material requirement will indicate that the cost of the cam engine is well under 60% of the cost of the crank engine.

We welcome an opportunity to review any details concerning our cam engine with competent manufacturers who may be interested in its production or use.

We offer a consulting service to manufacturers and expect to assist in the development of engines for use in marine, stationary, automotive and Diesel services and it is our plan to remain in the development field of internal combustion cam engines.

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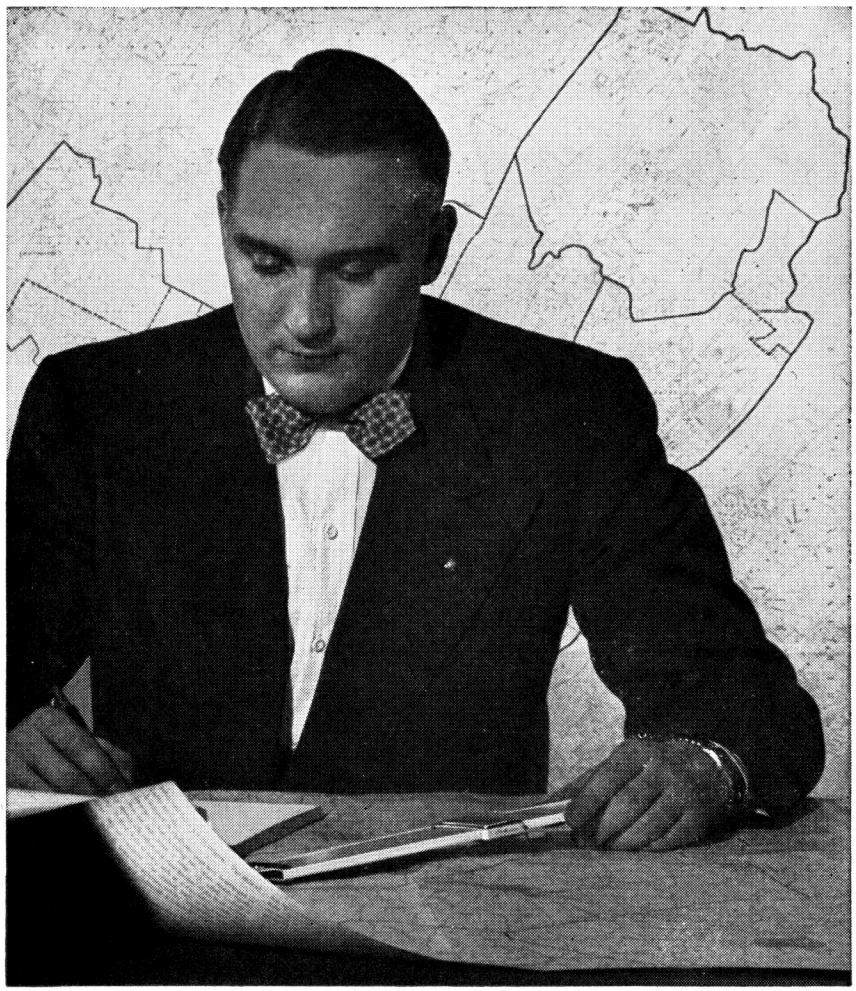
A Second Education



What makes a job hold its interest? After working for three years, Wylie Borum, E. E., '50, tells us what has kept his interest alive.

(*Reading time:* 38 *seconds*)

He graduated from the University of Pennsylvania in 1950, but Wylie Borum's education still hasn't ended. His job, he explains, has become his second education. And this continuing process of learning has kept his job interesting.

Wylie's first year at Bell Telephone Company of Pennsylvania was spent as a student engineer, which he feels was not only educational but extremely worth while. For it was while he took this course that he glimpsed the complexity of the business in considerable detail. He worked in all departments – ran switchboards, climbed poles and even did a stint in the Accounting Department.

Wylie discovered that there were many spots in the telephone organization for engineers besides the General Engineering Department. Even in Accounting – which today is highly mechanized with things like Centralized Automatic Message Accounting Machines.

Training finished, Wylie was assigned to the Manual Equipment Section of the General Engineering Department. His education continued. He found out, he reports, that the dollar is an important part of engineering. In writing equipment specifications, he had to be sure of reasonable cost as well as efficient operation. There's a big difference, he discovered, in doing a theoretical job in school and doing a job in which costs are an important consideration.

Now Wylie has been promoted to the Plant Extension Engineering Group and still is learning. His present job is co-ordinating plans for replacing the last manual central office in Philadelphia with a dial system. The cost will be approximately $1,500,000.

It's a big responsibility. But the Telephone Company puts capable young men on their own quickly.

• • •

Wylie Borum's job is with an operating company of the Bell System. But there are also job opportunities for engineers in Bell Telephone Laboratories, Western Electric, and Sandia Corporation.

BELL TELEPHONE SYSTEM

BULLARNEY



By Gray

First Lady: "Do you always look under the bed?"

Second Lady: "Always."

First Lady: "Do you ever find anything?"

Second Lady: "Only in old-fashioned hotels."

♣

Oriental Wisdom: "Football season great stuff . . . Only time man walk down street with blonde on one arm and blanket on other without encountering raised eyebrows."

♣

"I can't get along with my wife. All she does is ignore me."

"Ignore you?"

"Yes, and if there's anything I dislike, it's ignorance."

♣

As one old engineer put it: "The old narrow trails where two cars could barely pass without colliding are happily being replaced by six or eight lane highways where six or more can collide at one time.

♣

Now I lay me down to sleep,
The lecture's dry, the subject deep.
If he should quit before I wake
Someone kick me, for goodness sake.

♣

A woman phoned her bank to arrange for the disposal of a thousand-dollar bond. "Is the bond for redemption or conversion?" a clerk inquired.

There was a long pause, then the woman asked: "Am I talking to the First National bank or The First Baptist Church.

♣

A drunk opened the doors and fell to the bottom of the elevator shaft. Staggering to his feet and brushing himself off he indignantly muttered, "I said up."

Sign in machine shop: "Girls, if your sweater is too large for you, look out for the machines; if you are too large for the sweater, look out for the machinists."

♣

First coed: "Why are you straightening up the room?"

Second coed: "I read in the paper that two girls were arrested for keeping a disorderly house."

♣

Two Indians had watched the building of a lighthouse on the rocky west coast with much interest. When it was finally completed they sat and watched it every night. A thick fog came rolling in one night and the siren blew continuously.

"Ugh," grunted one Indian to the other. "Light shine—bell ring—horn blow—but fog came in just the same."

♣

College man finishing a letter to a friend. "I'd have sent you the dollar I owe you, but I've already sealed the envelope."

♣

Professor (To student who is half an hour late): "You should have been here at nine o'clock."

Student: "Why, what happened?"

♣

A kiss is a peculiar proposition. Of no use to one, yet absolute bliss to two. The small boy gets it for nothing, the young man has to lie for it, and the old man has to buy it. The baby's right, the lover's privilege, and the hypocrite's mask. To a young girl, faith; to a married woman, hope; and to an old maid, charity.

♣

Prof: "Tell us all you know about nitrates."

Engineer: "I don't know much about them except that they're cheaper than day rates."

Knowledge—Knowing what to do next.

Skill—Knowing how to do it.

Wisdom—Not doing it.

♣

The motorist had just bought a tankful of gasoline and the station attendant was going through his little ritual.

Attendant: "Check your oil, sir?"

Motorist: "No, it's o.k."

Attendant: "Got enough water in your radiator?"

Motorist: "Yes, filled up."

Attendant: "Anything else, sir?"

Motorist: "Yes, would you please stick out your tongue so I can seal this letter?"

♣

The maharajah of an interior Indian province decreed that no wild animals could be killed by the populace. Soon the country was overrun by man-eating tigers, lions, panthers, elephants, and boars. The people could stand it no longer and gave the maharajah the heave-ho. And this was the first instance on record where the reign was called on account of game.

♣

An Indian ordered a sandwich at the local lunch counter. When it arrived, he picked it up and peered between the two slices of bread.

"You slice um ham?" he asked the waiter.

"Yes," answered the surprised waiter.

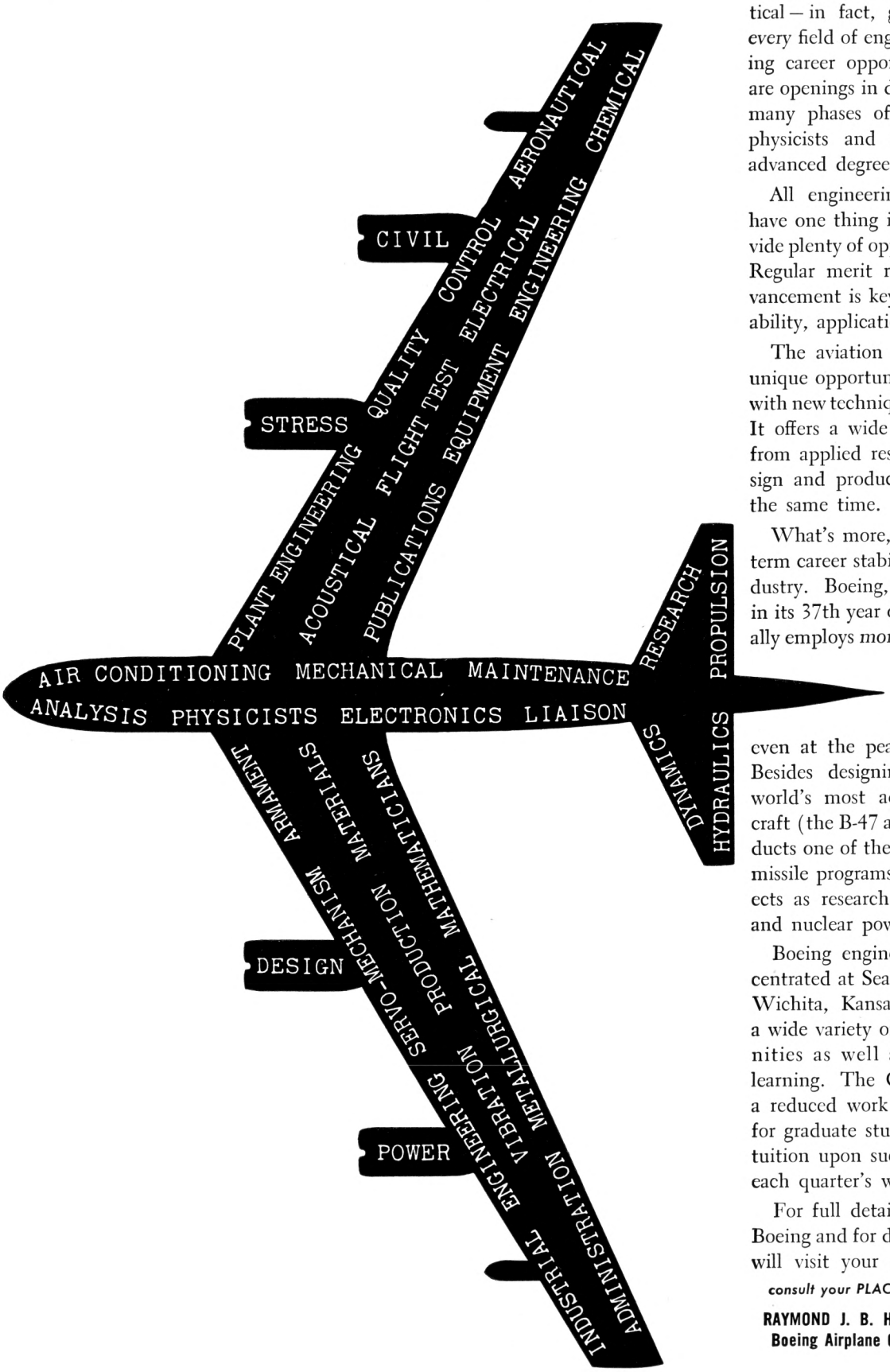
"Ugh," grunted the Indian, "you pretty near miss him."

♣

Notice in a small Scottish church: "Those members of the parish who are in the habit of putting buttons in the collection plate instead of coins —please put in your own buttons and not those from the cushions in the pews."

MISSOURI ENGINEERS ERIN GO BRAU

Engineers of virtually EVERY type are needed on the Boeing team



Mechanical, electrical, civil, aeronautical – in fact, graduates in virtually *every* field of engineering–find rewarding career opportunities here. There are openings in design, research, in the many phases of production, and for physicists and mathematicians with advanced degrees.

All engineering careers at Boeing have one thing in common: they provide plenty of opportunity to get ahead. Regular merit reviews are held. Advancement is keyed to your individual ability, application and initiative.

The aviation industry offers you a unique opportunity to gain experience with new techniques and new materials. It offers a wide range of application, from applied research, to product design and production, all going on at the same time.

What's more, you can expect long-term career stability in the aviation industry. Boeing, for instance, is now in its 37th year of operation, and actually employs *more* engineers today than even at the peak of World War II. Besides designing and building the world's most advanced multi-jet aircraft (the B-47 and B-52), Boeing conducts one of the nation's major guided missile programs, and such other projects as research on supersonic flight, and nuclear power for aircraft.

Boeing engineering activity is concentrated at Seattle, Washington, and Wichita, Kansas – communities with a wide variety of recreational opportunities as well as schools of higher learning. The Company will arrange a reduced work week to permit time for graduate study and will reimburse tuition upon successful completion of each quarter's work.

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Boeing Airplane Company, Wichita, Kansas

BOEING

AROUND THE COLUMNS

(*Continued from Page* 28)

get out of school you lose your hair, or visa versa?

♣

What's this about Sangster teaching the hardest course in the school last semester. I hear it was Statistics, C.E. 50. How about that Willie.

♣

Rumor has it that the E.E.'s backed down on the challenge by the Civils to a big hairy basketball game. Could it be that they heard the Civils were importing some of the faculty from their famous team, the "Fast Breakers." Starting lineup is as follows: *Miller* at *Guard; Burcham* at *Forward; Mumbles* at *Center; Scorah* at *Forward;* and *Croft* at *Guard.* Sounds like quite a team, huh?

♣

Man, I tell you, there just aren't too many women in the Engin School as it is, but when one of these necessary creatures leaves us, it is almost too much to bear. The gal I am talking about is Barb Wasser. She was the best looking Engineer olde Sam has seen in a long time. I can say for the rest of the Engineers that this is a bad omen. I guess that we will have to take some courses in the outside world, so we can mingle with the opposite sex.

♣

I think that Big Ed Wetterstrom and his partner in crime, Leonard Howard, must own a part interest in Topic cafe. Oh, well, when you gotta go (for coffee), you gotta go.

♣

For any of you that are interested in heavenly bodies, and I mean stars, we of the star gazers anonymous suggest that you take M.E. 210 under Easton Smith. It seems that he blasts off into outer space for the majority of the period and then returns to earth, just in time for the assignment (drats).

♣

Just like all birds, I gotta migrate North, see you next month.

Sam

NEWSTUFF

(*Continued from Page* 26)

ment, has been assembled in this hull in much the same way the Mark II engine is installed in the Nautilus.

———

A new method which, for the first time in history makes it possible to convert atomic energy directly and simply into small but usable quantities of electrical energy sufficient to operate a transistor, has been developed by the Radio Corporation of America.

Brig. General David Sarnoff, Chairman of the Board of RCA, says, "the atomic battery is likely to be applied first to miniature devices such as portable and pocket-size radio receivers, hearing-aids, signal control, and similar devices that require reliable power sources with great length of service . . . Both the battery and the transistor have the potential advantages of compactness, ruggedness, and long life."

The new type of battery consists of a radio-active source to which is coupled a wafer of semi-conducting crystal (germanium or silicon). An impurity material has been alloyed into the crystal to form a junction. The junction is similar electrically to those used in a junction transistor, but is considerably larger, with an area of 1/20th of a square inch.

Strontium-90, one of the most abundant of the materials resulting for the fission of uranium in a reactor, is a highly active source of beta particles—high speed electrons—and is one of the long-lived beta-emitting substances. Its half-life is roughly 20 years.

In the battery, 1/300th of a cubic centimeter of radioactive strontium is spread in a thin layer against the junction wafer. The layer of strontium bombards the semi-conducting crystal wafer with several billion electrons per second. As the electrons penetrate the wafer they release many more electrons, an average of 200,-000 for each bombarding electron. These released electrons flow across the wafer's junction producing a voltage which can be applied to an electronic circuit and cause a current to flow. The electron action within the crystal wafer is known as the electron-coltaic effect, a phenomenon of solid-state physics which heretofore has not been put to any practical use. Although in theory, virtually any radio-active material could be the source of an atomic battery, strontium-90 was chosen to activate the RCA device because of its high energy beta radiation, its relatively long life, its low shielding requirements, and its availability in experimental quantities from the U.S. Atomic Energy Commission. An aspect of atomic batteries that has yet to be determined accurately is the extent of the effect of the beta radiation on the crystal wafer. It is known that the crystal structure of many substances is gradually damaged by bombarding electrons. Further research is in progress to minimize these effects so as to make them negligible for the structures used in the atomic battery.

———

The sloughing of rocks from rocky cuts, which were made for Washington State Highways, have long been a menace to motorists of that state. Highway engineers now believe they have solved the problem with the placing of a giant spiderweb of No. 9 wire mesh over the faces of the slopes.

In an installation near Kelsom, Washington, rocks frequently plunged down the 170-foot slope into the four lanes of the highway below. With 2,700 feet of the slope now covered by the net the rocks are eased down to drop harmlessly into the ditch or are

(*Continued on Page* 40)

"So you asked Geraldine to marry you?"

"Yes, but I didn't have any luck."

"Why didn't yo utell her about your rich uncle down at Coronado?"

"I did, and now Geraldine is my aunt."



Brig. General David Sarnoff, Chairman of the Board, Radio Corporation of America

Sees No. 1 wish come true!

Television Tape Recording by RCA Opens New Era of Electronic Photography

In 1956, RCA's General Sarnoff will celebrate his 50th year in the field of radio. Looking ahead to that occasion, three years ago, he asked his family of scientists and researchers for three gifts to mark that anniversary: (1) A television tape recorder, (2) An electronic air conditioner, (3) A true amplifier of light.

Gift No. 1—the video tape recorder—has already been successfully demonstrated, two years ahead of time! Both color and black-and-white TV pictures were instantly recorded without any photographic development or processing.

You can imagine the future importance of this development to television broadcasting, to motion pictures, education, industry and national defense. And you can see its entertainment value to you, in your own home. There the tape equipment could be used for home movies, and—by connecting it to your television set—you could make personal recordings of your favorite TV programs.

Expressing his gratitude for this "gift," Gen. Sarnoff said it was only a matter of time, perhaps two years, before the finishing touches would bring this recording system to commercial reality. He described it as the first major step into an era of "electronic photography."

Such achievements as this, stemming from continuous pioneering in research and engineering, make "RCA" an emblem of quality, dependability and progress.

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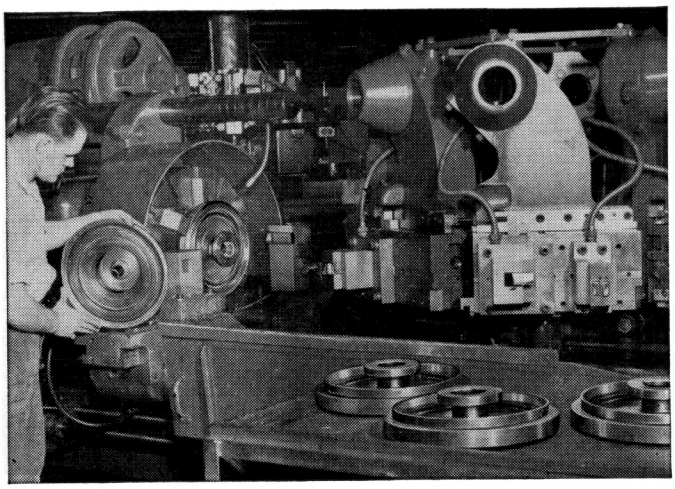
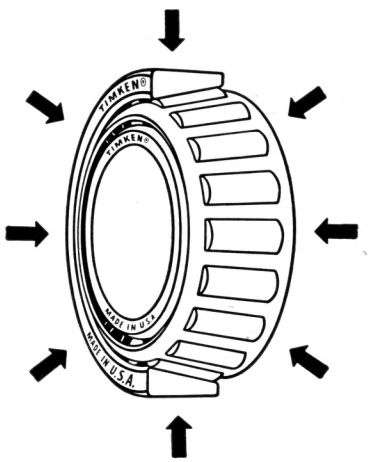


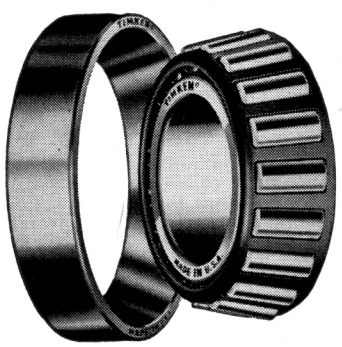
How to speed production of high precision jet engine parts

Engineers had the problem of designing a turret lathe that would machine a stainless steel jet engine part having a very complicated shape. And the part had to be produced in volume—yet with extreme precision. Naturally, they had to be sure the lathe spindle would be held rigid. To solve their problem, they mounted the spindle and gear train on Timken® tapered roller bearings, eliminating spindle vibration and chatter, insuring high precision.

Here's how TIMKEN® bearings maintain spindle rigidity

Timken bearings hold spindles in rigid alignment because line contact between rollers and races gives spindles wide, rigid support. Because the tapered design of Timken bearings lets them take radial and thrust loads in any combination, deflection is minimized, end-play and chatter eliminated. Spindles maintain their accuracy, year after year.





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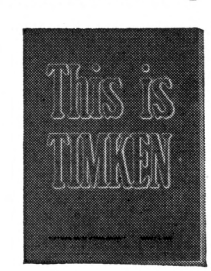

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EINSTEIN

(*Continued from Page* 19)

graphically in Fig. 2, forms a part of his Theory of Relativity.

By looking at the graphs in Figure 3 it is easy to see how, until a few years ago, it was thought that Newton's equation held good for all moving particles. It can be seen that, for the velocities that were known in those days, i.e. less than 1/10 that of light, a body would behave practically the same for both equations. It is only when a body has a velocity of more than 1/10 that of light that it begins to behave differently.

Let us now see how the qualities of a body alter when it is given a high velocity.

Physicists tell us that every body has mass. The more mass the body has, the more inertia it has. A football made of leather has less inertia than one made out of lead. This means that it is easier to move a leather ball than one made out of lead, by kicking it, for example. This is to say that inertia is "a measure of mass. We also know that a football with a small inertia can be moved at a higher speed than one with a big inertia, by the same kick. So we can say, the smaller the kick the smaller the inertia must be, if we are to move the ball at the same speed.

As we have seen, when a body, according to Einstein, a c c e l e r a t e s through space, it cannot gain speed at a constant rate, on the contrary, it gains less as it approaches the speed of light.

(*Continued on Page* 42)

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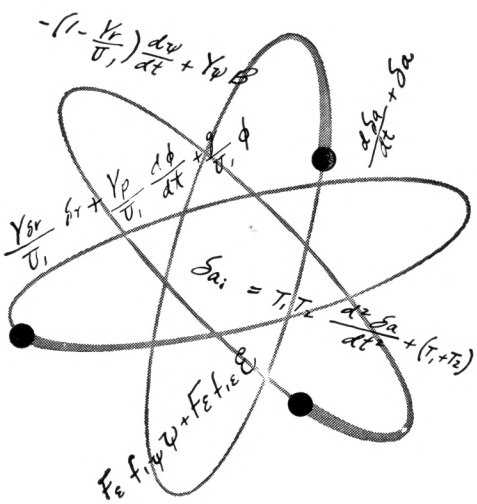

As science advances, and as our country continues to develop its industrial might, the business of automatic control gets bigger and increasingly important.

For the prime force behind the 20th century revolution has been and will continue to be *automatic control.*

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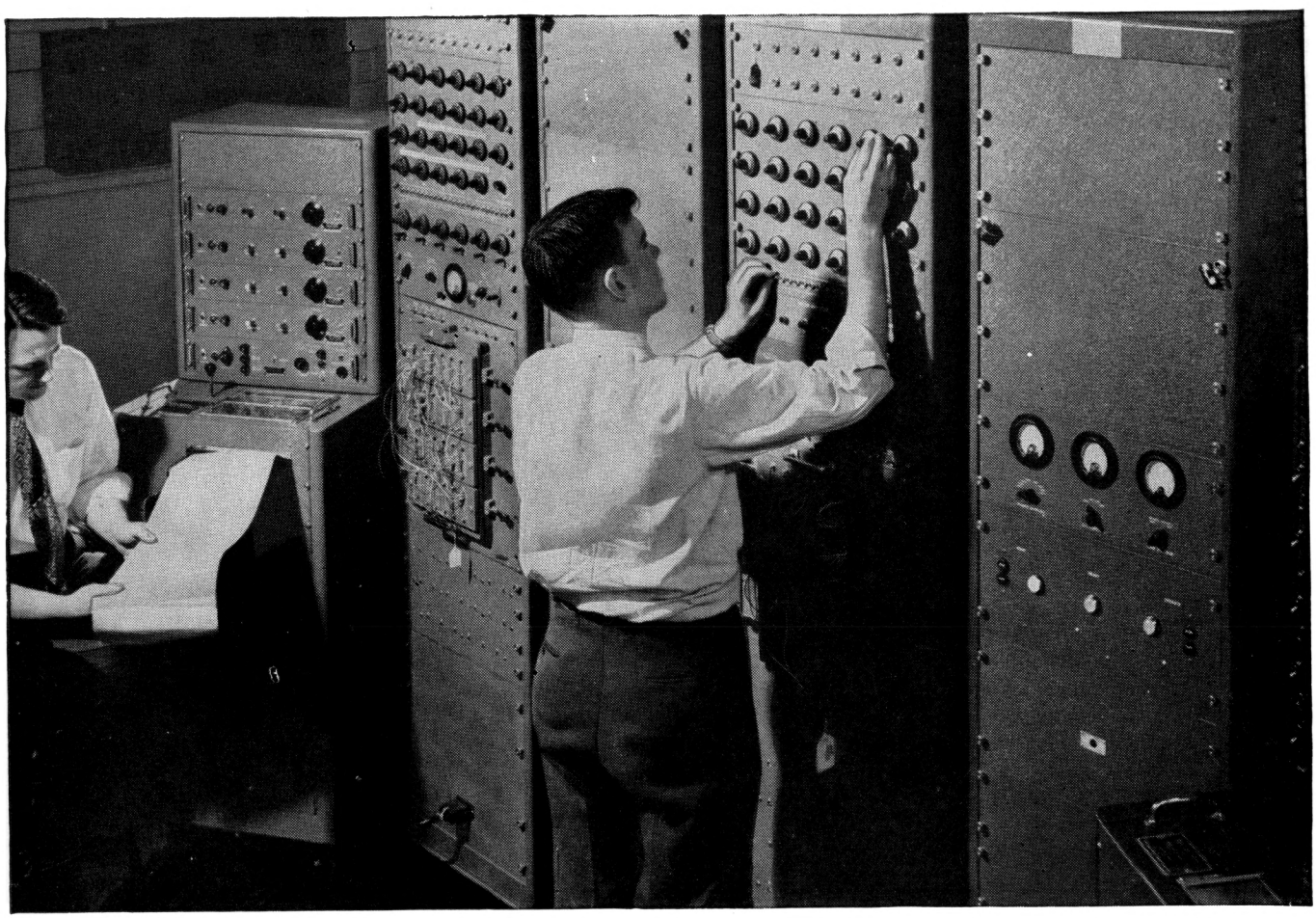
So if you're an engineer or scientist and like to use your imagination freely in such fields as electronics, hydraulics, mechanics, chemistry, physics, and a wide variety of others, be sure to send in the coupon below.



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Here, for example, is how one resourceful engineer put these qualities to work:

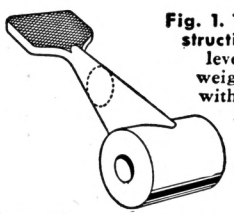

Fig. 1. Traditional Construction. Machine foot-lever, 10 inches long, weighs 6 pounds. Cost with broached keyway is $1.15.

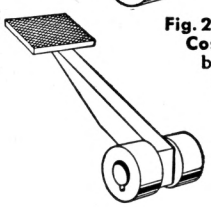

Fig. 2. Simple Steel Design Costs 41% Less. Can be built by the shop with only saw and shears. Weighs 2.7 pounds. Costs 68¢ complete with keyway.

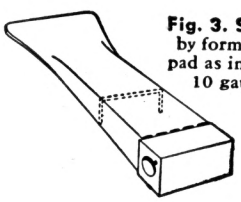

Fig. 3. Saves 53% Cost by forming lever arm and pad as integral piece from 10 gauge metal. Weighs 2.5 pounds. Costs 54¢.

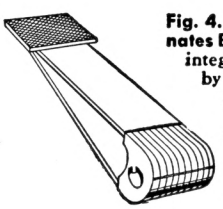

Fig. 4. Saves 73%, Eliminates Broaching. Hub with integral key is produced by stacking stampings in assembly. Arm is 10 gauge, brake formed and welded to hub. Cost is only 31¢. Weighs 2.2 pounds.

Back up your engineering training with latest information on welded steel construction. Bulletins and handbooks are available to engineering students by writing

THE LINCOLN ELECTRIC COMPANY
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THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

NEWSTUFF

(*Continued from Page* 34)

held against irregularities of the slope, thus being prevented from traveling more than a few feet.

General Electric announced recently that it had developed and produced the world's largest and most impressive artificial light source.

A 75,000 watt incandescent lamp bulb, it is half again as large as the previous largest bulb. It was developed as a feature of GE's observance of the 75th anniversary of Edison's most famous invention.

The lamp was conceived, designed and assembled by GE lamp development scientists and engineers at Nela Park, headquarters of GE's land Division. Its glass bulb, largest ever made, was handblown by the Corning Company, first producer of bulbs for Edison.

The lamp produces 2,400,000 lumens. To produce this amount of light would require 2,874 60-watt household bulbs, all burning simultaneously. This single light bulb uses enough electric energy to light 83 American homes as they are normally lighted today. Twenty-three of them could illuminate a major league baseball stadium according to modern standards.

The lamp's filament alone weighs 217 pounds, which is enough tungsten to make the coiled-coil filaments for 67,500 60-watt lamps. The filament is made of a tungsten ingot, hammered to a diameter of three-sixteenths of an inch. It is 12 and one-half feet long.

The huge lamp is so bright and hot that observers are advised not to look directly at it or stand close to it when it is burning at full brilliance.

ENGINEERS!!

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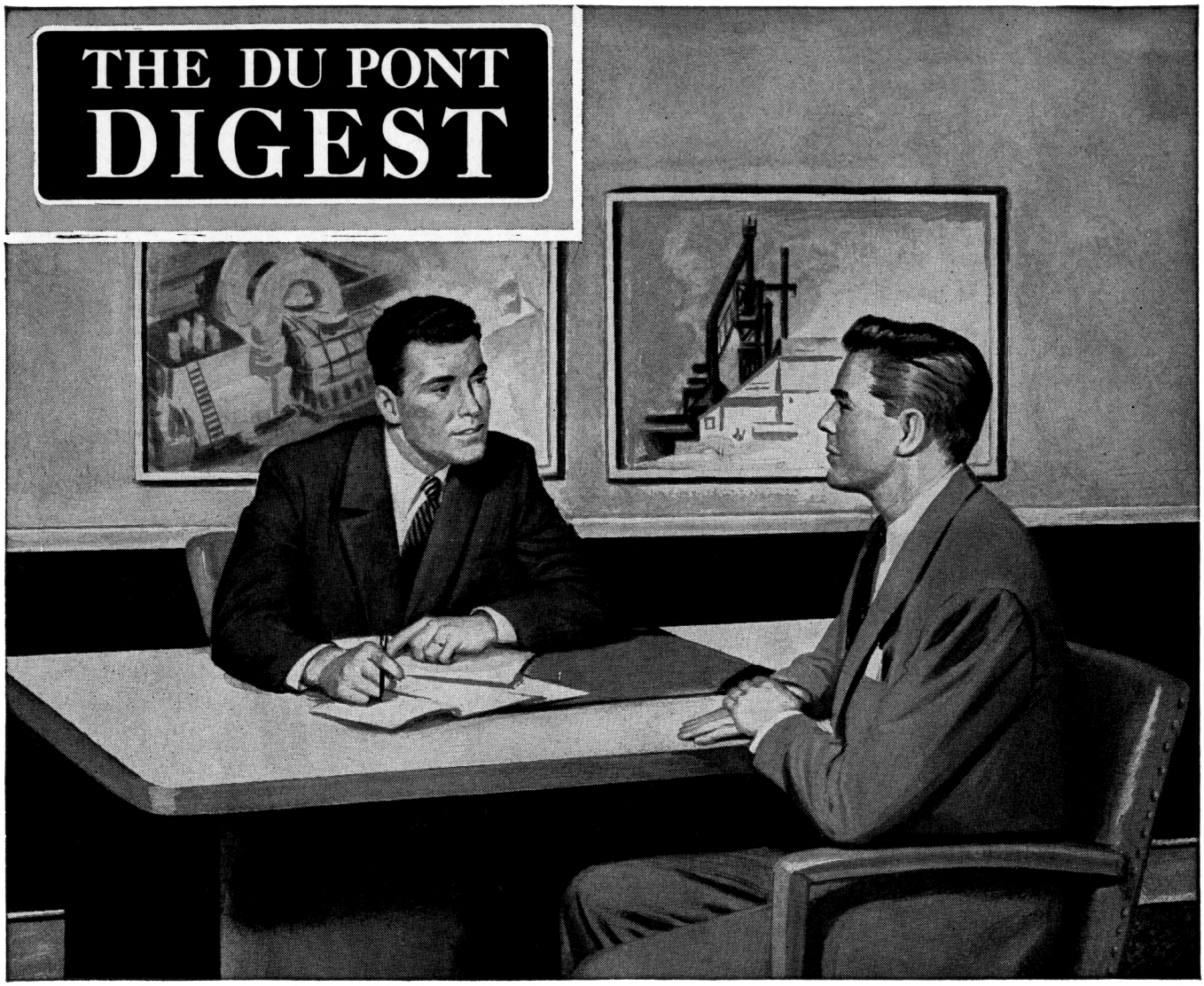

What do YOU look for in an employer?

Undoubtedly, you'll want most of the following characteristics:

1. Job satisfaction—the chance to do work you really enjoy.
2. Recognition—the assurance that good work will be noticed, appreciated, and properly rewarded.
3. Opportunities for advancement—a growing company can provide them.
4. Security—the knowledge that a company is both stable and progressive.
5. Pride—a feeling that your company is respected by the public and produces goods which contribute to a better way of life.
6. Good companionship—a factor which contributes greatly to happiness on the job.
7. Good pay—not in salary alone, but also in terms of vacation plans, pensions, and other benefits.
8. Safe working conditions.

How can you obtain this kind of information in advance?

One of the best ways is to discuss the matter with an acquaintance already working for the company you are considering. You will also find it helpful to consult your college placement officer, your professors and company representatives visiting your campus.

The selection of an employer is one of the most important decisions you'll make. It justifies considerable thought and effort.

SOON AVAILABLE for student ASME chapters and other college groups, a 16-mm. sound color movie—"Mechanical Engineering at Du Pont." For further information, send post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware.

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Watch "Cavalcade of America" on Television

EINSTEIN

(*Continued from Page* 38)

Now if we were to imagine ourselves traveling at the speed of light and we saw the body that we have been talking about approaching us, it would seem to be going slower and slower. We would be led to think that this body was gaining in inertia. In other words, the faster this body would go the more its mass would increase. Einstein considered such a situation as this, and it led him to develop another equation. This equation could be used to compare the speed of a body with its mass. The graph of this new equation looks quite similar to the graph in Figure 3, except the axis for "time" would be replaced with an axis for "mass."

The significance of this equation and the results that it would bring were not fully realized until a few years ago. Some scientists were working on an experiment with a cyclotron and were experiencing a lot of trouble. When they tried to accelerate an electron up to near the speed of light, they found that the machine went out of control. Although the mass of the electron is very small, when its speed is brought up to approach that of light its mass increases enough to disrupt the mechanism of the cyclotron.

In the previous pages I have tried to explain some of the various phenomena that brought Einstein to develop his Special Theory of Relativity. In concluding I would like to summarize the exact differences between the Einstein Mechanics and those of Newton. It must be remembered that these changes, although they occur at all speeds, are not noticeable at the ordinary speeds to which we are accustomed.

SPACE

Newton's: Independent, Absolute.

Einstein's: Dependent; connected and involved with time.

TIME

Newton's: Independent, Absolute. Same everywhere and under all conditions.

Einstein's: Dependent upon space. Varies with position and motion of body.

TIME INTERVAL

Newton's: Identical everywhere and under all conditions.

Einstein's: Varies with the position and motion of body.

SPEED OF LIGHT

Newton's: Constant in space.

Einstein's: Appears the same to every observer whatever his motion.

RIGID BODIES

Newton's: Keep same dimensions and shape under all conditions.

Einstein's: Varies with time and motion.

French Prof: "What is the difference between "madame" and "mademoiselle?"

Youngster: "Monsieur."

♣

Sherlock H: "Ah, my dear Doctor, I see you have donned your long winter underwear."

Watson: "Amazing! How did you deduce that?"

Sherlock H: "Elementary. You have forgotten to put on your pants."



● LEROY* Lettering equipment is standard in drafting rooms everywhere. No special skill is needed for perfect, regular lettering and symbol drawing. There are LEROY templates in a variety of alphabets and sizes, as well as for electrical, welding, map, geological, mathematical and other symbols that the draftsman needs. *Trade Mark®

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NEEDED--- A NEW APPROACH!



HE HAD ONE

McDonnell engineers have again demonstrated their pioneering spirit. The problem—how to land a speedy, transonic airplane—normally requiring a mile or more of runway—in the short space available on an aircraft carrier deck. This is but one of the many complex problems successfully solved by M. A. C. engineers in developing the new Navy F3H Demon, now in production.

Youthfulness is another characteristic of this progressive engineering team, the average age being under thirty. Engineering graduates find working with men of their own approximate age group greatly facilitates getting acquainted and gaining that "feeling of belonging" more quickly.

If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when our representative will visit your school. Ask him about the McDonnell Graduate Study Plan.
You may also write to:

Technical Placement Supervisor
Box 516, St. Louis 3, Missouri

VERNON E. NETHERTON
Design Engineer—Airplane Division
B.S.A.E. U. of Illinois 1947

Vernon had a fresh approach to the problem of landing high-speed jet aircraft on carrier decks and was responsible to a large degree for an improved landing hook now being used on McDonnell airplanes.

Starting his engineering career "on the board" as a Draftsman in 1947, Vernon is now a key member of a design group concerned with the F-101 Voodoo airplane.

If your interests lie in the field of airplane development, a challenging career awaits you at McDonnell. We need more young men like Vernon Netherton—*engineers with a new approach.*

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Manufacturers of AIRPLANES AND HELICOPTERS ★ ST. LOUIS 3, MO.

SHAMROCK

SEZ



YE ED

ST. PAT'S WEEK being here and just about over—what did you think of it? Nice to cut classes, sure; but did you get any special kick out of it? You know, next year this all is going to be up to YOU, and you might do some thinking right now, about just what you'd like to do—and what to leave out. The campus stunt, for instance, is something that needs a lot of thinking over, both on the novelty side and from the dollar angle . . . got any old rusty spaceships lying around your back yard? Or did you have a "feelthy" dream after the barbecue Wednesday nite—might be a skit for the Hamburg Show! So's next year you'll have a head start—or whatever it's got to do with heads and brains in Ol' Engine School.

A BEARD STORY just leaked out. Seems that every year the military gripes about engineering rotcees not shaving during St. Pat's Week, especially because it happens for a month or so. Well, not so this year. "They" were real nice about it, even about the duration of the contest. But then good ol' Dean Croft suddenly thinks, that maybe it isn't such a nice idea after all, and cuts down the length of the contest. Which all goes to show, that people are still people, and a dean is still a dean, no matter how nice a dean he is.

JOB INTERVIEWERS around campus usually arrive with trunks full of application blanks, or so it seems. And they, the blanks, are all different. By the time you're used to spelling your first name first, someone else will want to know where you got that middle initial. But most of the info required is just routine. So wouldn't it be nice to have a standard form by the University with a picture and all, that could be run off on a lithograph machine and handed to each interviewer. If then he still wants to know why your grandfather was born in Lower Slobovia, he can add that on another sheet. You at least have saved time for studying . . . well, you've saved time, anyway.

SAM, the Society for Advancement of Management, finally got itself a chapter. The president of the national SAM itself was here for the event, plus dignitaries from the Kansas City Senior Chapter. And our SAM here is going full blast now; meetings every second Thursday of the month, and inspection trips and all. Congrats from Ol' SHAMROCK!

OL' SHAMROCK went out and found himself a new editor for next year. Aldag thinks he may graduate yet, and besides, nobody really likes to be an old editor. So Tom Bolner, the new editor, is going to have his hands full next year, and may need all that luck that Ol' SHAMROCK is wishing him. Might be interesting reading next year, too—Tom claims he is not afeared of McCarthy or Doc's third credit row. So what, if his wife is a friend of the Truman's . . . Suppose this kind of publicity will double the circulation next year.

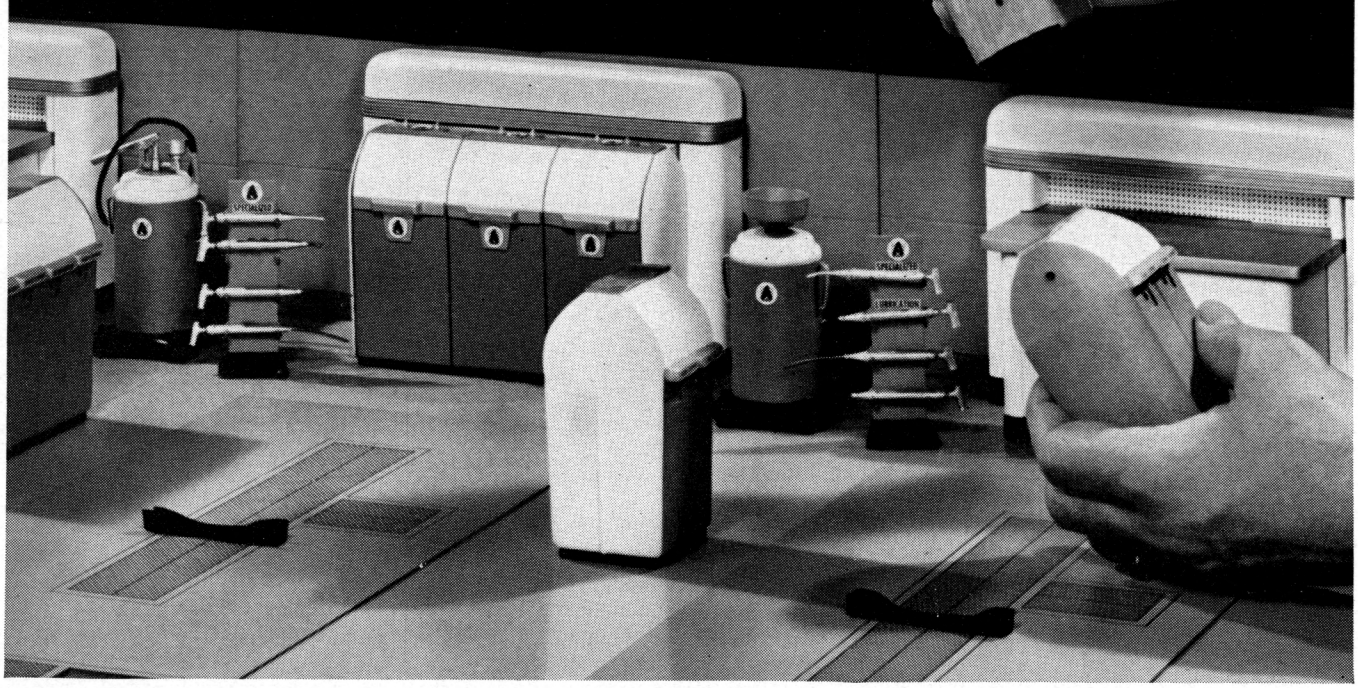
ASSOCIATED WOMEN STUDENTS are a campus organization that ordinarily has nothing to do with engineering, but this time a word is going to be said about them. Seems that when the St. Pat's elections got started some boys from the M.E. 1 classes wanted to petition a girl from their class. The catch—she was a Stephens girl, partially enrolled at Ol' Mizzou. Nothing was ever done about it, except that some engineers talked the matter over at a Student Union coffee session. And Ol' AWS wiretapped this conversation from the next booth, and then called up Bill Ellis to inform him of the following: if any other girl than a Mizzou girl will be a queen candidate, no Mizzou girls will be permitted to enter the contest. As said before, nothing whatsoever became of the matter, but it would be appropriate to keep this in mind for next year. Probably the song entitled "Oh Woman" will still be in style next year, and maybe then the man's version could be played also.

PHOTOGRAPHY AT WORK—No. 8 in a Kodak Series

Kodak
TRADE-MARK

Photography shows prospects

how their new service stations are going to look and operate



Alemite sets up scale models of their service station equipment on the customer's own floor plan—photographs them—and portrays the new custom-built station ready for action

SALESMEN don't just pull lube racks, grease pumps and other service station equipment out of a sample case. They're far too big—far too bulky. Besides, final location and arrangement count heavily in how well they are going to work out.

The Alemite Division of Stewart-Warner solves the problem with photography. Prospects see new service station equipment virtually right in their own premises.

It works this way. The salesman sends in a rough sketch of the space available, with windows and columns marked. Experts fit exact replicas of racks, lifts, and other equipment to the plan, then put the camera to work. The customer pictures his new station—modern, efficient, handsome—and the sale is well on its way. It's an idea for any company with bulky products to sell. Photography is a great salesman for any business, large or small. And it's very much more. It works in all kinds of ways to save time, cut costs, reduce error and improve production.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Eastman Kodak Company, Rochester 4, N.Y.

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Career opportunities with a bright future await the college graduate who joins General Electric. To help him toward early success, G.E. offers these ten programs—each including both challenging work assignments and broadening classroom studies.

If you are interested in building a career with General Electric, consult your placement officer for the date of the next visit of the G-E representative on your campus. Meanwhile, for further information on the career programs described here, write: College Editor, Dept. 2-123, General Electric Co., Schenectady, N. Y.

ENGINEERING PROGRAM

This program gives engineers a sound foundation for professional careers—in research, development, design, manufacturing, application, sales, installation and service, or advertising.

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Offered to men who have completed the Engineering Program, this program develops young men who can combine engineering knowledge with sales contact to sell G-E industrial products.

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Open to technical and some non-technical graduates, this three-year program provides leadership training in manufacturing supervision, manufacturing engineering, purchasing, production control, or plant engineering.

BUSINESS TRAINING COURSE

BTC's purpose is to develop business administration, economics, liberal arts, and other graduates in accounting and related studies for leadership in G.E.'s financial activities and other activities which require business training.

PHYSICS PROGRAM

For Bachelor and Master graduates, this program gives industrial training and orientation in many fields of physics at G.E.—and offers great diversity in placement openings.

MARKETING TRAINING

Open to MBA graduates, and to young men who have shown special ability in marketing, this program develops men for future managerial positions through training in all seven primary functions of marketing.

CHEMICAL AND METALLURGICAL PROGRAM

Open to chemists, metallurgists, chemical, ceramic, and metallurgical engineers at BS and MS level. Assignments extend from process development to plant liaison —from research and development to sale of process instruments.

EMPLOYEE & PLANT COMMUNITY RELATIONS TRAINING

Open to technical and non-technical graduates, this leadership training program provides assignments in engineering, manufacturing, marketing, finance, and employee and plant community relations.

ATOMIC "TEST"

Open to science and engineering graduates, this program is conducted in the Hanford Atomic Products Operation at Richland, Washington to train men for positions in the atomic energy field.

ADVERTISING TRAINING COURSE

This program combines on-the-job training with integrated classwork courses and offers the opportunity to learn all aspects of industrial advertising, sales promotion, and public relations.

GENERAL ELECTRIC

MISSOURI SHAMROCK



April, 1954

25c

Features:

Capacitors for Power Systems
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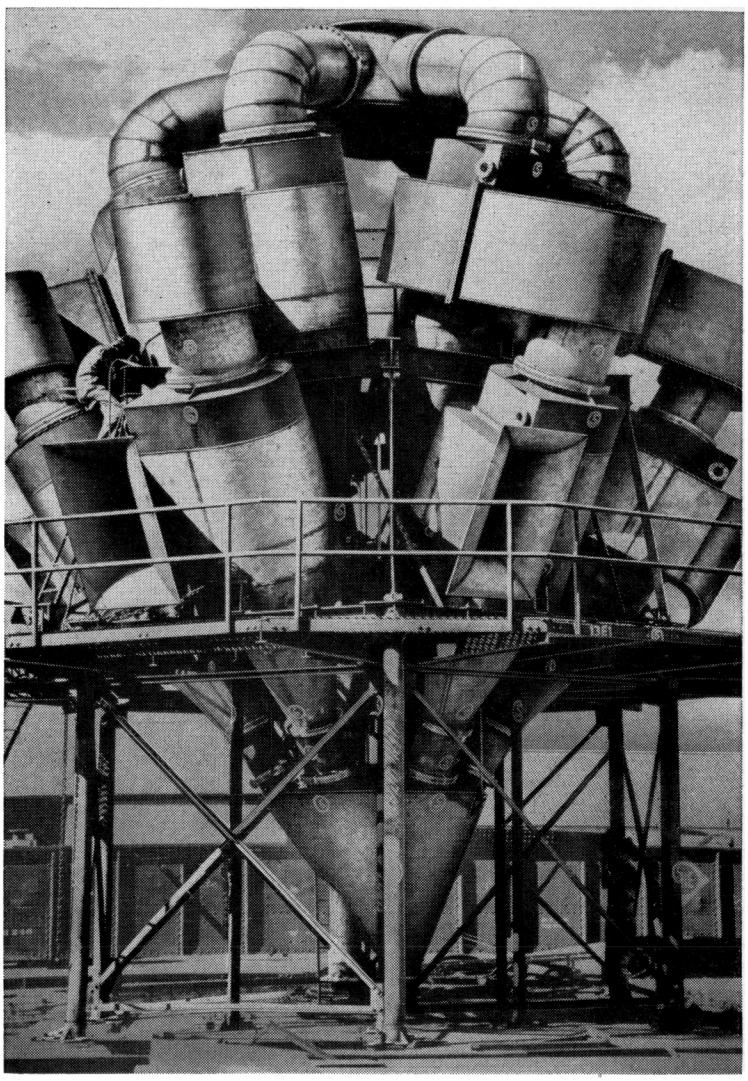
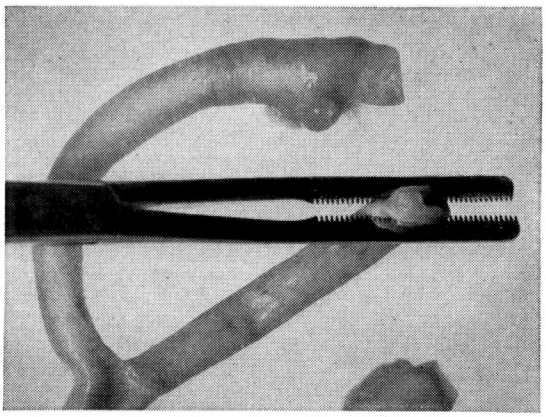


Visitor from Outer Space? No, despite its strange, other-worldly appearance, this is no product of extra-terrestrial intelligence, no flying saucer. It's a perfectly practical, very down-to-earth catalyst collector in a large petroleum refinery. Noteworthy, however, is the extensive use of USS Stainless Steel in its fabrication . . . to provide corrosion resistance combined with great strength.



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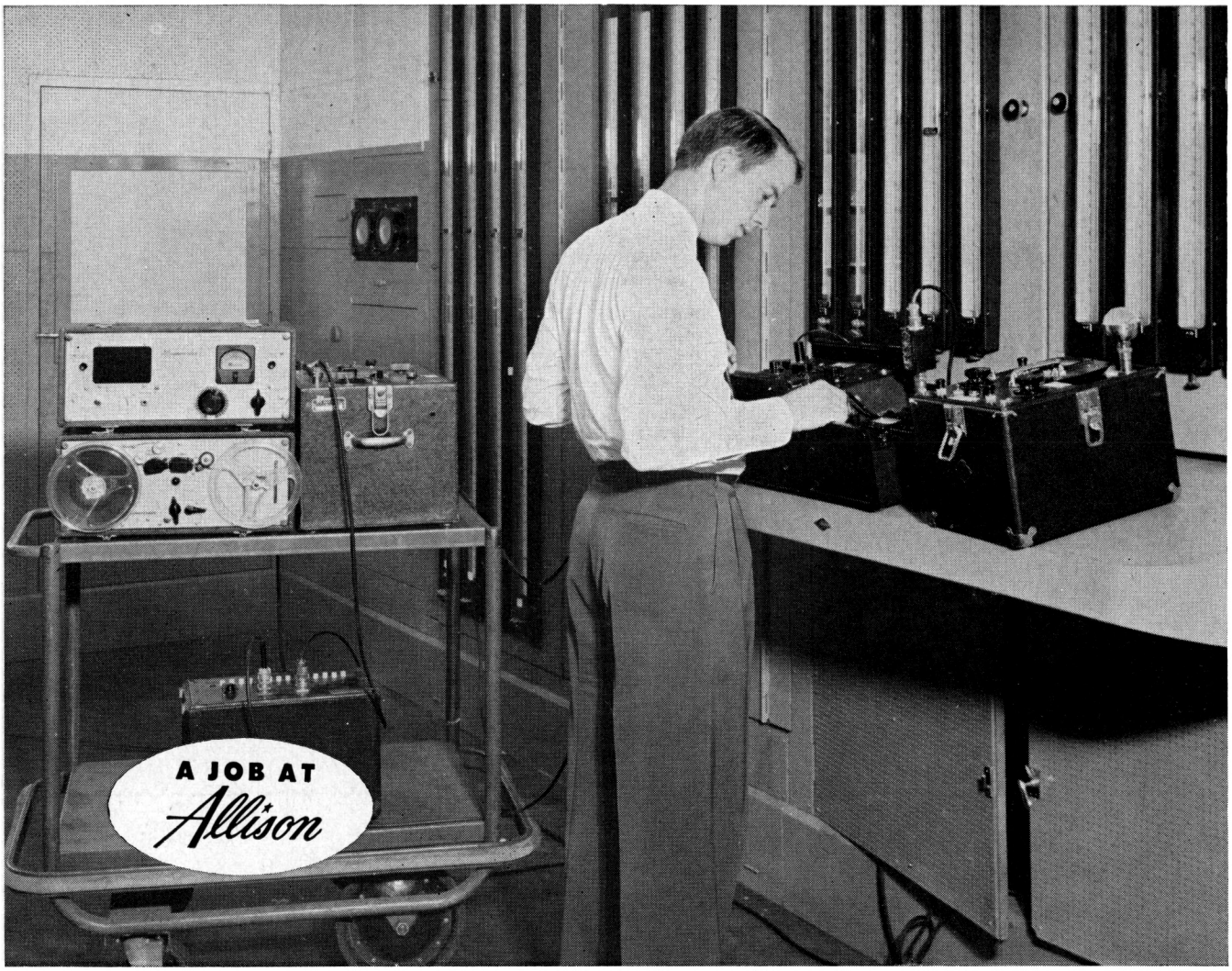

● Robert (Bob) McNew was graduated from Purdue University in 1950 with a B.S. in "double E."

He came to Allison the next year and currently is in the Instrumentation group, Electronics and Parts Test Department.

It's partly through his efforts that Allison has enjoyed considerable success in reducing noise conditions affecting both in-plant employes, as well as residents living in the vicinity of the Allison plants in Indianapolis. For example, noise coming from turbo-jet engines while on test stands now is being reduced in intensity by a ratio of 100,000 to 1 before it reaches the outside of the test cells.

In the photo above, Bob is adjusting the sound level indicating and recording instruments in preparation for measuring the silencer attenuation of a turbo-prop engine test cell. Equipment includes the latest type of general radio sound-level meter and octave-band noise analyzer, and the magnecord tape recorder.

The Allison equipment for instrumentation and testing is of the best. These complete facilities offer the young graduate engineer every opportunity for applying—and expanding—his technical training in his chosen field of engineering.

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For further information about YOUR engineering career at ALLISON, discuss it with your Placement Counselor and arrange for an early interview with the ALLISON representative the next time he visits your campus. Or, write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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Before You Accept Any Position, Ask Yourself These 3 Questions:

1. "Am I looking for a place at the top?"

The graduate in Engineering or Chemistry who wants to get ahead needn't expect a "9-to-5 job." It takes hard work and plenty of it to make a place for yourself in a fast-moving organization. Yet if you answer "yes" to this question, it will pay you to talk to Spencer Chemical Company, often called "America's growing name in chemicals." Spencer has frequent openings in basic engineering, research and development, technical service and technical sales.

2. "Is this company interested in getting bigger?"

Some firms, like some men, are content to sit still. Before you pick a company for your future, make an investigation. Ask questions. Find out how that company's sales and assets of ten years ago compare with those of today. It's interesting to note that sales of all manufacturing companies are up 80%, 1952 over 1942. The chemical industry, in the same period has risen 156%. Spencer sales show an even steeper curve.

3. "What about the long pull?"

Regardless of the financial weather ahead, the chemical industry looks good. That's one thing on which economists seem to agree. We don't have a crystal ball, but we think Spencer Chemical Company will keep pace with the group. A dominant producer of agricultural nitrogen, Spencer also makes ammonia, formaldehyde, methanol and hexamine for industry. Dry ice, another basic product, has a wide variety of uses. And down in Orange, Texas a $14,000,000 plant to produce polyethylene, the "wonder plastic," is under construction. Meanwhile, a many-phased Research and Development program is looking into new products and new uses for established products. We believe that this, too, is insurance for the future of Spencer and Spencer people.

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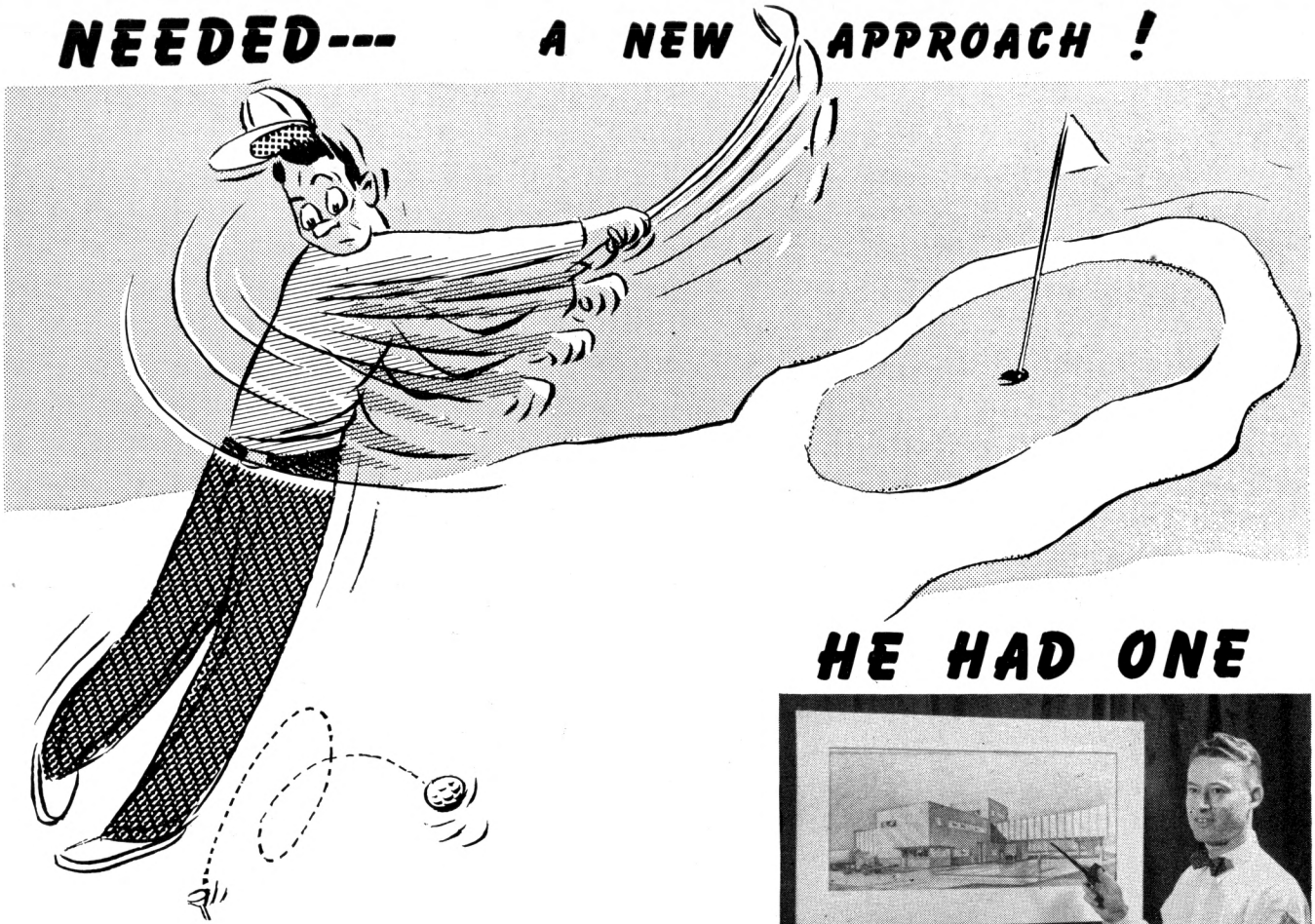

HE HAD ONE

LAMAR A. RAMOS, JR.,
Sr. Design Engineer—Airplane Engineering Division
B.S.P.E. Lousiana State U. 1941
B.S.A.E. Georgia Inst. of Technology 1947

Seen here examining the architect's sketch of our recently completed Wind Tunnel, Lamar's approach in solving complex and often unique aerodynamic problems has marked him as an engineering asset to M.A.C.

In 1947, he was first assigned to the XF-85 "Parasite" fighter, model of which he is holding above, and has since contributed his aerodynamic talents to most of our airplane engineering projects. He is presently a Group Leader concerned with the aerodynamic design of aircraft proposals. We need more young engineers like Lamar Ramos, *engineers with a new approach.*

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ON THE COVER

The result of one Arts and Science kid's "dying" effort to paint the Shamrock is the tonsorial work of art shown on his head. He was cocky to the last minute with "Let's hurry, I gotta lead a charge on the columns."

—Photo by Henn Liiv

MISSOURI SHAMROCK

VOL. XV NO. 7

APRIL, 1954

♣

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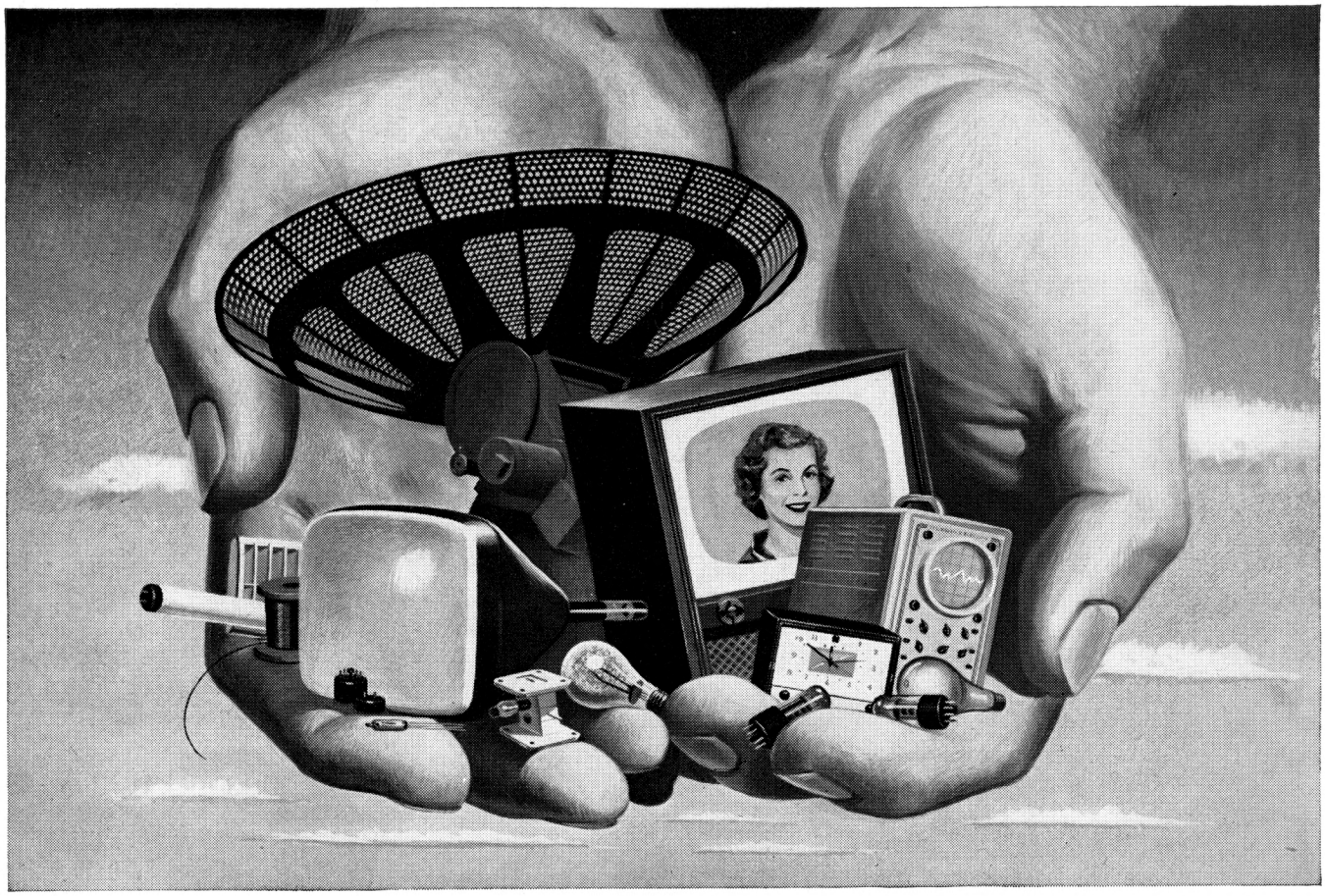

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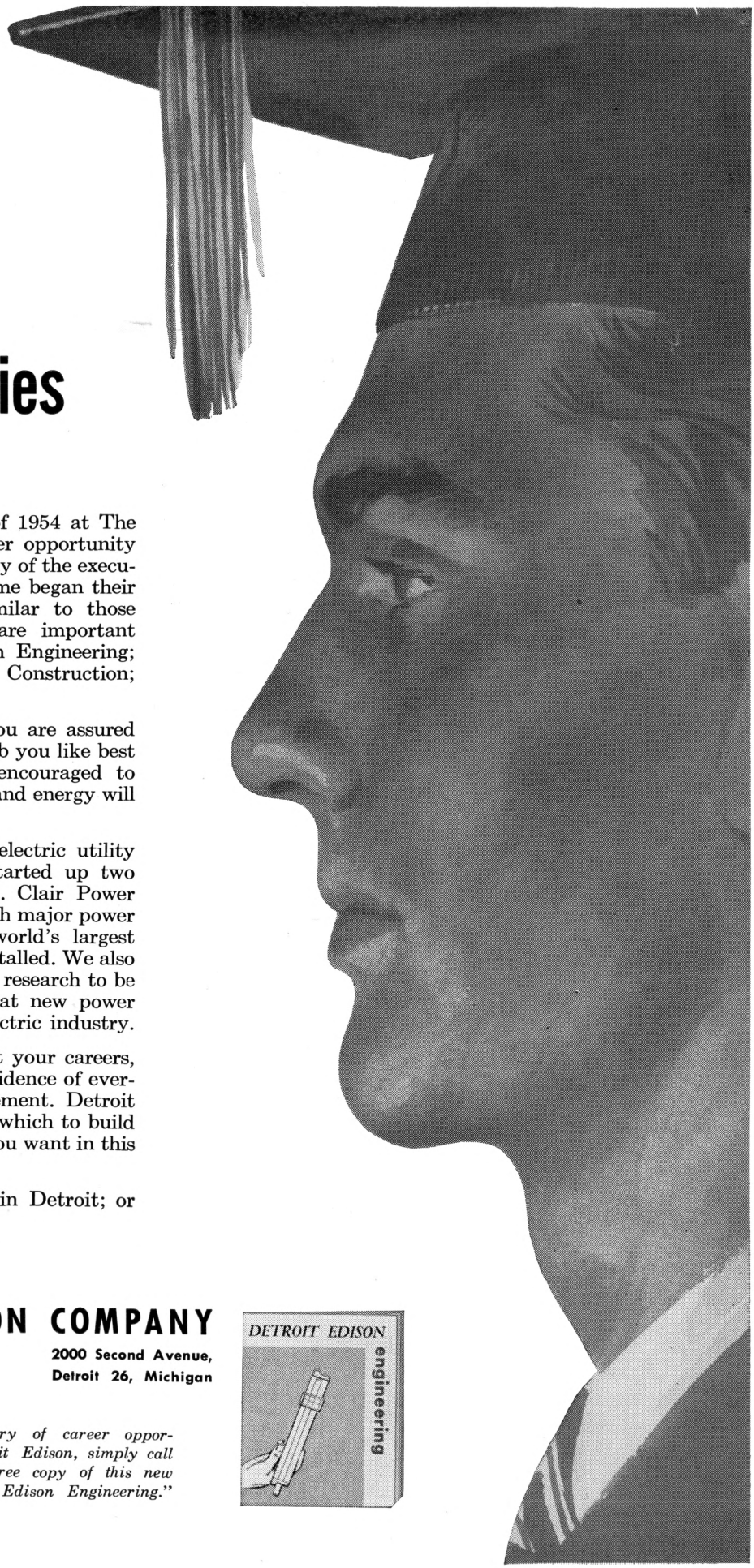

Career Opportunities

There's a future for you seniors of 1954 at The Detroit Edison Company—a career opportunity best described by the fact that many of the executives in the organization at this time began their climb to success in positions similar to those offered graduates today. There are important jobs to be done in Power System Engineering; Engineering Planning, Design and Construction; Research.

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Detroit Edison is a fast-growing electric utility company. In the past year we started up two turbine generators at our new St. Clair Power Plant and broke ground for our sixth major power plant, River Rouge, where the world's largest steam turbine generators will be installed. We also moved forward with atomic energy research to be ready for the time when this great new power resource can be utilized by the electric industry.

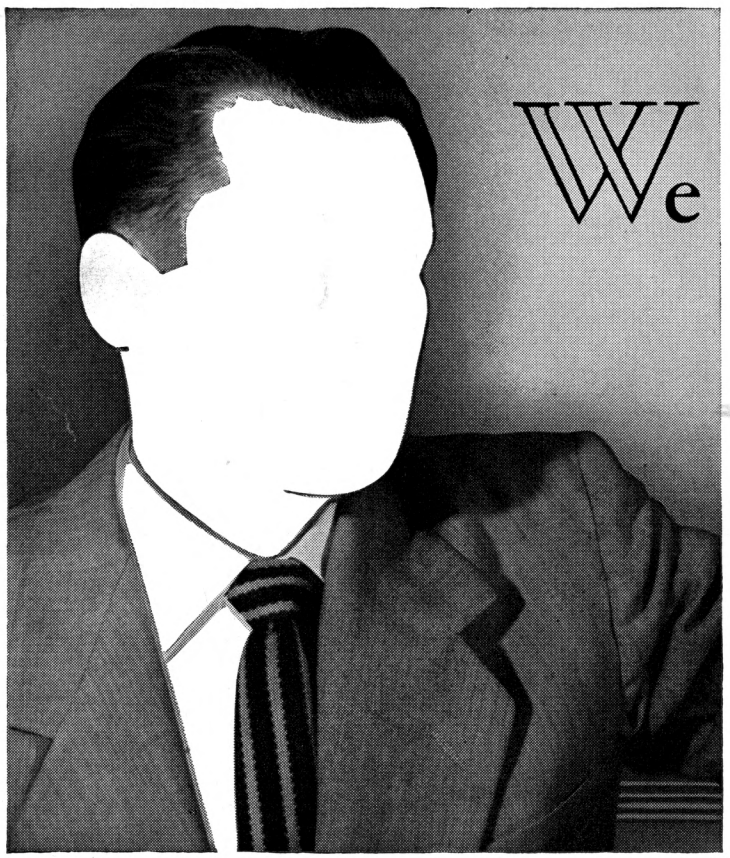
To you young men thinking about your careers, expansion like this is heartening evidence of ever-growing opportunities for advancement. Detroit Edison offers a firm foundation on which to build a career. You may find just what you want in this thriving electric company.

Drop in and see us when you're in Detroit; or write . . .

THE DETROIT EDISON COMPANY

2000 Second Avenue,
Detroit 26, Michigan

For the full story of career opportunities at Detroit Edison, simply call or write for a free copy of this new booklet, "Detroit Edison Engineering."



We are looking for men who can GROW

To a young man looking for opportunities, perhaps the most important fact about a company is its rate of growth, present and prospective. In a company which has become static, advancement is largely dependent on vacancies occurring through death or retirement. In a *growing* company, new openings for able men are being created constantly, and advancement is restricted only by ability.

Since 1925 the chemical industry has grown at an average rate of about 10% a year, compared to 3% for all industry. Future growth, at a more rapid rate than the rest of industry, is predicted by authoritative studies.

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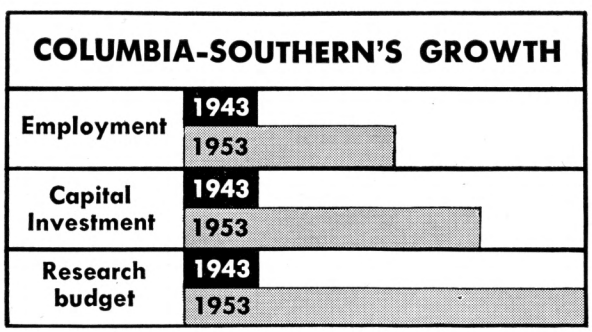
Columbia-Southern's growth is an open-end process; as goals are reached, new goals are set. Even now new products and processes are in every stage of evolution, from nebulous ideas in the minds of research chemists to pilot plant operations and production plant designs. That's why Columbia-Southern needs men who can grow with it.

For further information, write now, Dept. P at our Pittsburgh address or any of the plants.



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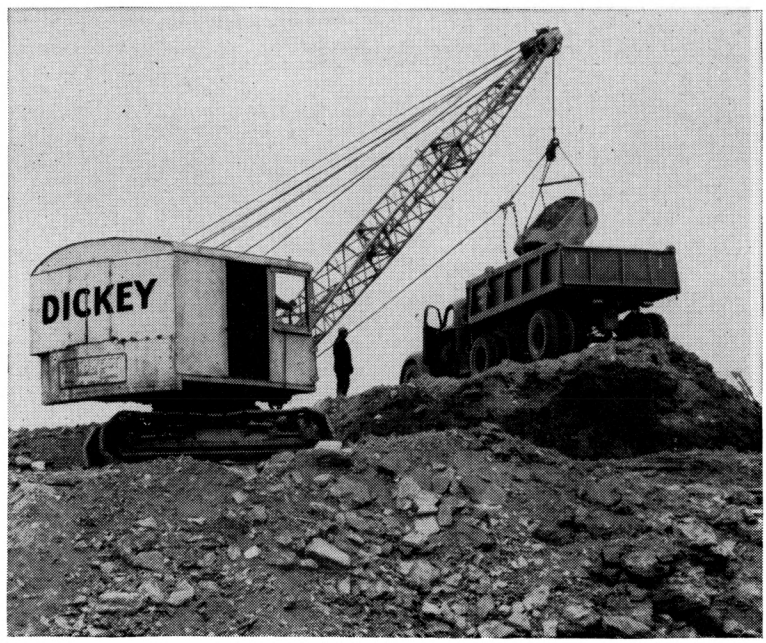

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A picture is worth one thousand words, and this one needs little explanation. On the left is Owen Hornkohl, winner senior division, and right is Marvin Werner, junior division winner. Both are being pledged by the House of David fraternity.

What Now . . . . .

We, the Aggies, and the Lawyers, and the Engineers are in trouble with the Administration. They have looked upon the extra curricular activities of St. Pat's Week with alarm, and are afraid of possible disastrous activities like gunfire. They have frowned upon this year's rivalry both as acts of vandalism and as a preposition to gunfire. And their idea is this: remove the reason for rivalry and nothing will happen, no vandalism or bloodshed. Remove St. Pat's Week, and we will have no trouble. They have the right to do this immediately, but we have received a grace period. If nothing happens during Farmer's Fair Week, our St. Pat's Week stays. It is then our duty to keep ourselves and any one else out of trouble during Farmer's Fair Week. Remember that one man can do the harm. If one man does the harm, he will ruin one of the oldest traditions on this campus that is still active. Others have expired naturally, we don't want ours stabbed to death with one bit of horseplay.

D.B.A.

CAPACITORS FOR POWER SYSTEMS

By CHARLES C. BURKS

If some portion of a power system supplies an inductive load with a low power factor, capacitors may be added in parallel with the load to increase its power factor. Many other desirable effects are obtained as a result of this addition of capacitors.

This practice was started about 1914, but the use of shunt capacitors was very limited until 1938 because of their high cost, large size, and heavy weight. In 1932, advances in capacitor construction and the substitution of chlorinated aromatic hydrocarbon impregnating compounds for oil as the di-electric brought about large reductions in size and weight. In 1952, electric utilities were using ten times more capacitance than they did in 1938.

Fundamental Effects

Capacitors connected in parallel with a lagging power factor load supply the lagging current required by the load; therefore the total current in the transmission line between the capacitors and the source is decreased. This reduction in current causes reduced I^2R loss in transmission; increased voltage at the load, due to decreased IZ drop in the line; and decreased KVA loading of the source generators. Since the limiting factor in loading a generator is the amount of current carried by the windings and not the KW output, additional KW loading may be placed on the generators if the turbine can supply this increase in power.

Capacitors used for power factor correction are usually rated by the reactive kilovolt-amperes (Kvar) which they can supply. As an example of how capacitors can relieve an overloaded circuit or increase circuit capacity for more load, consider a load of 10,000 KVA at 70 per cent power factor. The load is then taking 7000 KW and 7150 Kvar. If 4000 Kvar of capacitors are placed in parallel with the load, the KVA will drop to 7645. Then the 70 per cent power factor load can be increased until the circuit load is again 10,000 KVA and the KW supplied are 8700. The power factor at this load point is 86.2 per cent. If the load is still further increased until a 70 per cent power factor is again reached, the circuit load will be 12,400 KVA. The use of shunt capacitors is two-fold. The addition of capacitors releases circuit capacity for more load, or it relieves over loaded circuits.

This technique of increasing cir-

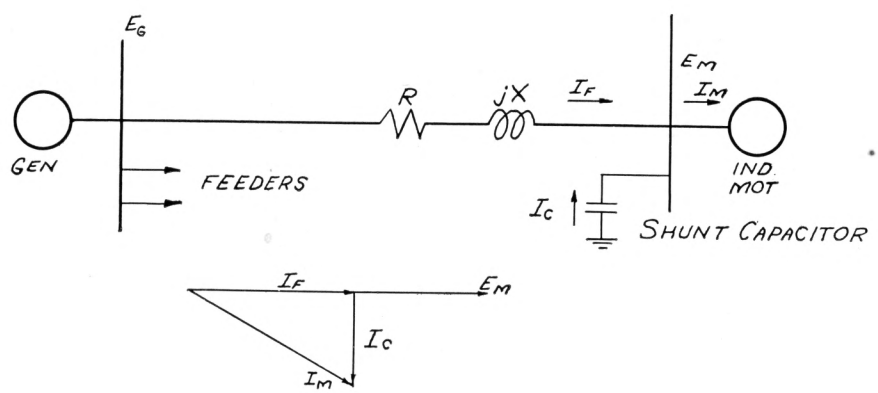


FIG 1 - SHUNT CAPACITORS SUPPLYING KVAR REQUIRED BY AN INDUCTION MOTOR

cuit capacity for low power factor loads is often cheaper than other means, such as increasing transformer capacity. Also in other cases where current might be the limiting factor, such as generators, regulators, cables, and transmission and distribution lines, the economy of capacitors is apparent.

Location of Capacitors

Capacitors can be connected in shunt with a motor to supply its magnetizing current or they may be connected at the service entrance of an entire plant. Still more centrally located banks of capacitors might be at substations; they could be connected either on the primary or secondary sides of the transformers. The selection of location and size of capacitor banks depend on the need for them. This need will vary widely with power rates and local conditions.

Capacitors At Substations

Shunt capacitor banks applied at substations usually range in size from 5,000 to 10,000 Kvar. These banks are usually provided with an automatic or manual switching arrangement in order to vary the Kvar to be supplied. This switch gear is necessary to prevent excessively high voltages from occurring at light load periods. It is common for the capacitors to be switched in several steps depending on the magnitude of the load.

Although large capacitors are more economical from the standpoint of cost per Kvar, they fail to remove the magnetizing current from all secondary feeders and lines on the load side of the capacitor bank. This failure sometimes warrants the purchase of several smaller banks to be connected nearer the load instead of the purchase of one large central bank.

Group Correction At A Plant

Group corrections at the service entrance of an entire plant are usually desirable when loads within the plant shift radically from one feeder to another and when motor voltages are as low as 230 volts. With the demand for power shifting abruptly from one feeder to another, correction may be needed first in one part of the plant

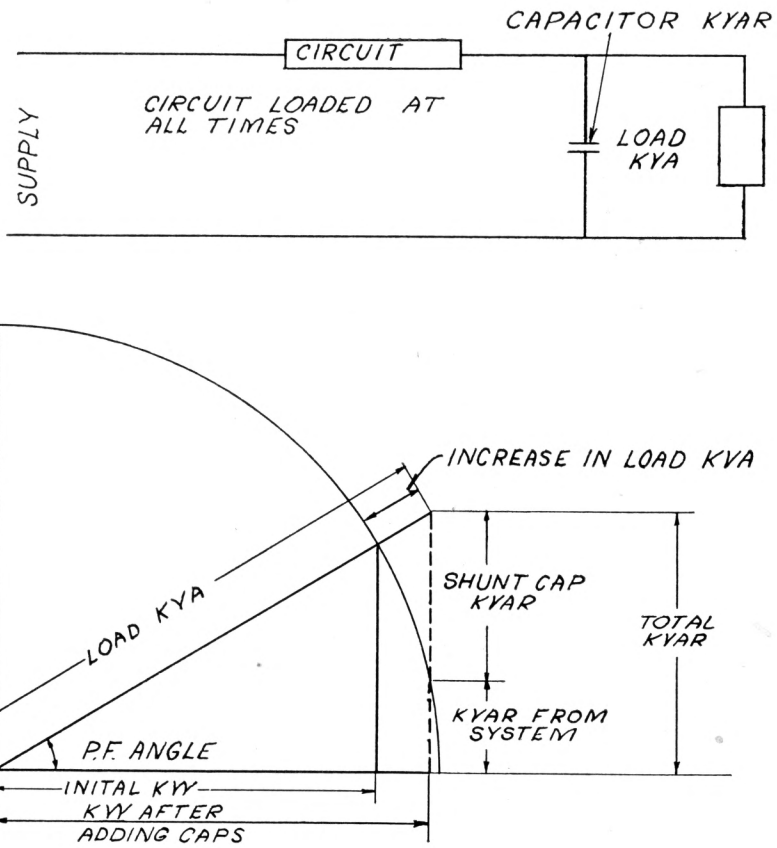


FIG 2 INCREASED LOAD EFFECT OF SHUNT CAPACITORS ON POWER CIRCUITS

and then in another. In this case a centrally located group capacitor would be advantageous because it would tend to be the same distance from the load at all times. Also 230 volt capacitors placed on feeders at various spots in the plant may cost twice as much as a group capacitor placed in the 2400 or 7200 volt primary of the plant distribution transformer.

However, capacitors placed in shunt with the primary of a distribution transformer do not benefit the transformer because they do not release any transformer KVA as they would if they were placed in the secondary of the transformer. Also in cases of long 230 volt feeders supplying a relative high load it may be advantageous to place a 230 volt capacitor across the load terminals to reduce the high current in the feeder.

Capacitors Versus Synchronous Condensers

If large units of Kvar are to be supplied to a system, the synchronous condenser should be considered as a competitor of the shunt capacitor. The synchronous condenser is merely a synchronous motor operating at no load. Its power factor can be varied by the adjustment of the magnitude of its d.c. field current. By increasing the field current its power factor can be made leading and by decreasing the field current the power factor can be made lagging. Most synchronous condensers are capable of supplying Kvars equal to their rating as well as absorbing Kvars to an extent equal to 50% of their rating.

For some applications a synchronous condenser's characteristics make it more desirable than a shunt capacitor bank. For example, a synchronous condenser has fineness of control which cannot be realized with a capacitor bank which has several switching steps; synchronous condensers have a greater stabilizing effect upon voltages and also tend to maintain synchronism between the generators of the system. Synchronous condens-

(*Continued on Page* 34)

COMMON CLAY

By National Clay Pipe Association

Vitrified clay pipe was first made by machine in this country in 1854. No one knows how much has since been made and used. It is estimated that in the last four decades over 1,000,000,000 feet of clay pipe have been used in this country alone.

Raw clay must have certain qualities to be ideal for pipe making. It should be coarse-grained and uniform, and free from an excess of organic material and free metals. It should have a long firing range, meaning that heat can be applied to the pipe for a long time period to soften the clay grains to a fusing point, without actually melting the grains. When deposits of clay with these qualifications are obtained, pipe manufacturers then employ modern mining and earth moving machinery to get the raw material to the plants for processing.

At a typical clay pipe plant the clay is pulverized and mixed with water to form a uniform doughy mass. Forced by tremendous pressure, this is pressed through a die and shaped into pipe. The pipe is formed under a vacuum which draws all air from the clay as the pressure is applied. Elimination of air bubbles results in greater strength, truer dimensions, decreased absorption, and elimination of flaking.

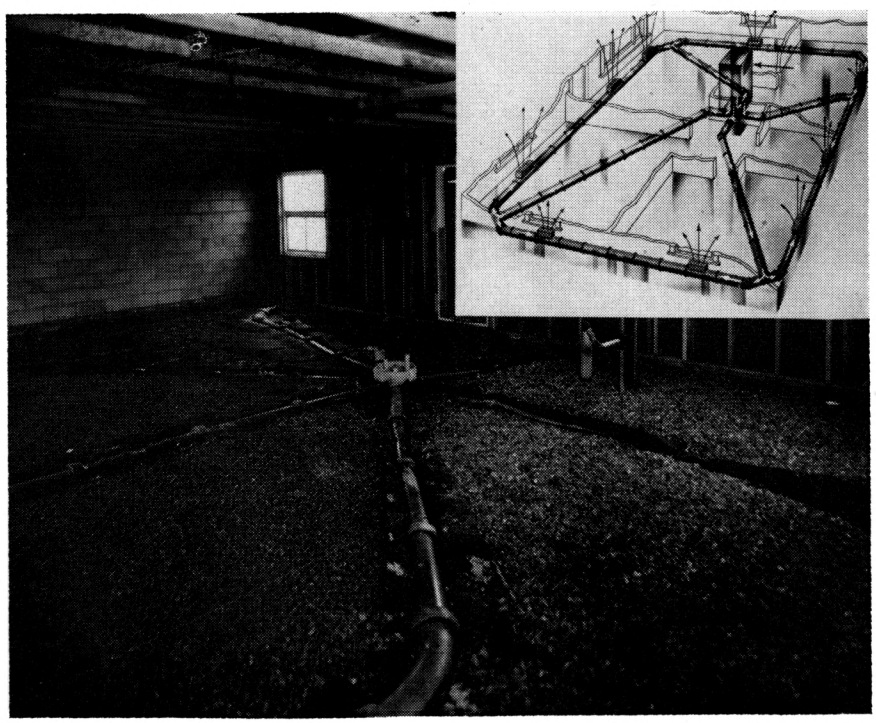
The "green" or unburned pipe is dried in temperature-controlled rooms through which hot air is blown for four to seven days. This must be done to "set" the pipe before it can be "burned" or vitrified at high temperatures.

From the drying rooms, the pipe goes to big oven-like kilns, where it is "burned" to a temperature higher than the melting point of iron, 2,000 F. This burning, known as vitrification, fuses the clay grains into a hard, impervious structure which resists the penetration of any foreign substances.

Two main types of kilns are used by clay pipe producers—the "beehive" kiln and the "tunnel" kiln.

The beehive kiln is so called because of its remarkable resemblance to a beehive. It is a round-roofed structure 30 ft. to 40 ft. in diameter, and 16 ft. from floor level to the roof peak.

Tunnel kilns look just like the name implies. The pipe, after it comes from the drying room, is piled on cars about 12 ft. long. These cars move through the kiln on tracks. Heat, from combustion of oil, gas, or coal, in tunnel kilns is maintained at a constant temperature. Heat is applied direct with flame from burners playing on the pipe itself. Slow heating and cooling of the pipe is accomplished by moving the pipe load from the tunnel entrance, through a central fire zone, and on out to the tunnel exit.



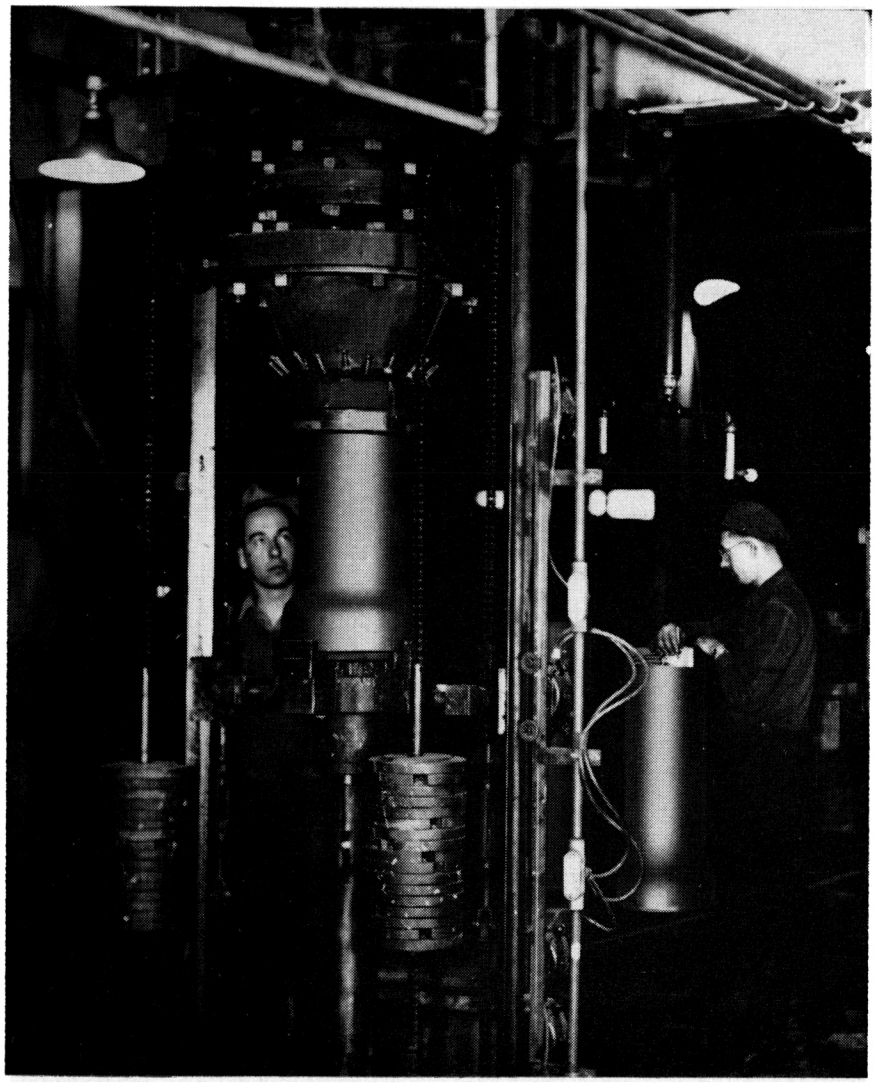
Many home builders are now using this new and revolutionary system of duct heating for basementless homes. Vitrified clay pipe is used as ducts to distribute warm air.

Research activities for the clay pipe industry are conducted in their own laboratory in Los Angeles under the direction of Dr. Harvey House, nationally famous research chemist. In the years that Dr. House has been supervising this industry's research, he has assembled facilities and equipment without duplicates anywhere, and all specifically designed to study vitrified clay pipe and kindred products. Much of this equipment, Dr. House designed himself.

For sewage and drainage work, certain piping has inherent advantageous characteristics. Research determines what these are. For example, in non-pressure installations such as building sewers, vitrified clay pipe is permanent as it is resistant to chemical action of all products of sewage decomposition. It is also resistant to alkaline or acid ground water and to disintegration by chemicals and spent waste.

To substantiate findings of the Los Angeles research laboratory, tests were made at various universities on sections of vitrified clay pipe immersed in sulfuric acid. In Chicago, where additional testing was forwarded, acetic, hydrochloric and nitric acids were used and in none of these tests was the vitrified clay pipe affected.

Because of these outstanding characteristics, engineers are teaching an old product new tricks. For example, the new Health Sciences Building at the University of Washington, which has been called by medical authorities the finest of its kind in the world, contains a unique system of vitrified clay pipe for venting chemical fumes from the medical and dental laboratories. In various phases of their study and research, students and researchers find it necessary to cook hydrochloric and nitric acids and other substances which emit powerful fumes. This is especially true of their work with radioactive isotopes. Hoods catch the fumes in the laboratories and direct them into clay pipe ducts. Acid proof fans pull fumes up to the roof and disperse them harmlessly into the upper air. Vitrified clay pipe was chosen for the ducts because it is completely immune to the disintegrating action of acids and other chemicals.



Pulverized and mixed with water into a uniform, doughy mass, clay is die-pressed into pipe shape under tremendous pressure with either steam or hydraulic press.

Many home builders are now using this new and revolutionary system of duct heating for basementless homes. Vitrified clay pipe is used as ducts to distribute warm air. This heating method economically combines the favorable factors of radiant heat with forced warm air perimeter heating. Clay pipe is the ideal duct material. It is inexpensive and easy to install and never wears out.

Another outstanding clay pipe installation was made by the Village of Monsanto, Illinois. Though a village, Monsanto is no sleepy country settlement. It contains some of America's heaviest industries—and hence it puts unusual demands on its sewers. Most recent project at Monsanto is a twin industrial sewer which will serve the following companies: American Zinc, Darling Fertilizer, Lewin-Mathes, Monsanto Chemical, Midwest Rubber Reclaiming, and Socony-Vacuum.

In specifying pipe, the engineers realized that the line would be carrying weak acids and other chemical wastes. Hence, they chose vitrified clay pipe, which is proof against chemical attack.

There was a complicating factor, however. Clay pipe is made no larger than 36 inches in diameter, and the volume of wastes to be carried here required more capacity than this. Yet rather than consider other pipe materials which are available in larger sizes, the engineers preferred to use multiple clay pipe lines.

Further research is being carried on to see that clay pipe continues to be a modern safeguard of the nation's health.

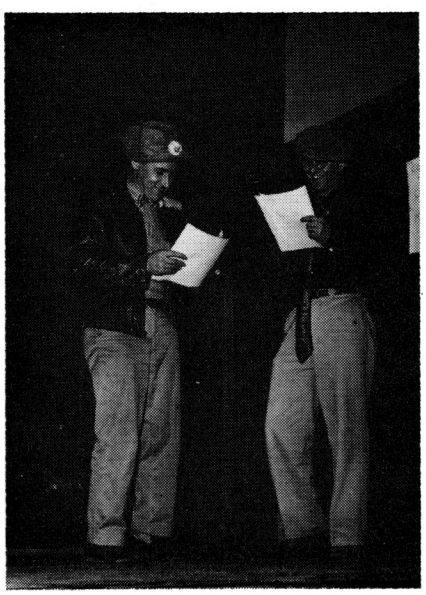
WITH SMOKE THERE'S FLAME

Or: *Rembrandt Wears a Straw Hat . . .*

By "SMOKE" M.E. '55

The story you are about to read is true, certain things however, have been changed to prevent further stimulation to the already ensuing investigation.

Sunday—Engineers week started off serenely enough when a goodly amount of engineers congregated on the front steps of ye old engine building at 10:30 A.M. with intent on going to Burrall Class. It occurs to me that perhaps the attendance was so good that it was supposed to take care of the events of the week.



Anderson and Graham display their political talents at the Hamburg show.

Monday—On Monday evening the week was immediately gotten into high gear by serenading all the candidates for the queenship.

After an assembly at the engine building at 10:00 P.M. the group (?) strolled down to T.D. 3 where Mary Ann McKinstry, a Tri Delt pledge is residing. From T.D. 3 the serenade moved to the theta house to serenade Norma Umlauf. Among the numbers rendered there were "My Wild Irish Rose" and "Let Me Call You Sweetheart." From the Theta house the next stop was the Chi Omega house. There such songs as "St. Patrick was an Engineer" and " Engineers Sweetheart" were sung, much to the enjoyment of Lee Blount. After the Chi Omega house the contingent ambled through the streets to serenade Barb Faris, who lives at the Pi Phi House.

As a final fling at singing our leather lunged cohorts went across the street to finish the serenade by singing to Dottie Burger at the Kappa House. Although the serenade was in earnest it sure was hard for the group to stay on key when singing the second line of "Engineers Sweetheart".

With the serenade over there was a motion to adjourn to the Uptown theater for the midnight show. By 11:15 P.M. there was a small group of engineers gathered in front of the Uptown theater. The theater was not as well attended as Burrall Class was however as everyone knows that engineers prefer church to the cinema. As I recall the name of the movie was "Saskatchewan" with Shelly Winters but I cannot say for sure as I never did hear or see more than two minutes of film in any five minute section.



Pat arrives for the knighting ceremony.

After the show word got around that the annual rivalry between the Aggies and the engineers had started off already and that everyone was to meet at the Ag pond. Upon arrival a group of engineers were found with a one inch pump going full blast endeavoring to have the Ag pond drained by sun-up. When it appeared that this

effort would be in vain several other suggestions were brought up such as a drainage ditch and/or "soup."

Faced with the possibility of ridicule for the inability to complete the desired task our friends decided to devise a way to dye the ag pond green and leave it go at that. As the crowd was moving off the scene, who should appear on the scene but "John Law" who apparently had been summoned by some fictitious person who claimed that the noise was disturbing his sleep. All I've got to say is that this chap has to have awfully good ears unless, of course, he was sleeping in the gutter.

Although most of the participants were successful in evading the "issue", one car was stopped which seemed suspiciously to have been involved in the incident. This particular car had hoses draped on the fenders and through the windows. After a brief lecture on disturbing the peace all occupants were allowed to go home.

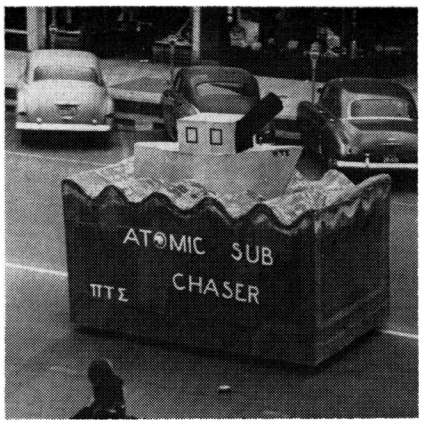
Tuesday—The only scheduled event for Tuesday was a tea honoring the queen candidates. This event was held at the home of Mr. and Mrs. George Elliott.

There did seem to be, however, a few unscheduled events that took place on Tuesday evening. Rumor has it that the University possesses the only red sheep in the world. Undoubtedly these sheep were imported for people who get tired of counting the same old white sheep every night.

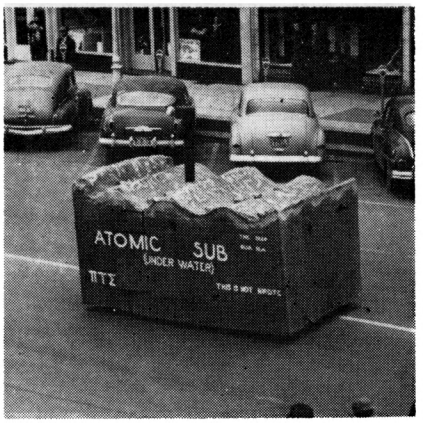
Other than a few uncalled for remarks that were painted on the barn by someone who thought it was funny, Tuesday was uneventful.

Wednesday—On Wednesday the Society for the Advancement of Management held its charter banquet at the Student Union. After the banquet the Hamburg Show got under way.

The show started off by Bill Ellis being shot (I always suspected as much). After the body was carted off there were a few selections that were sung by the quartet. With G. Harris on the uke, M. Fogelsong on the harmonica, Bill Marshall on the guitar and D. Aldag as lead tenor they all blended nicely into great discords. Also there was group singing and other things too numerous to mention.



CHASER . . .



AND SUB . . .

With the Hamburg Show over, the Bar-B-Q was the next item on the agenda. With the weather reasonably nice there was a good turnout and everyone there had his share of the Bar-B-Q. From there a small group went over to the stables to get a quick one to wash away the taste.

Sometime during the hours of the evening the lions in from of J School turned green. (With envy no doubt.) Apparently some people have the wrong impression that M.U. is housing a multicolored menagerie. Even the ole Shamrock saw the wear and tear of engine week.

Thursday—On Thursday the all night stand of column guarding took place. Probably all would have come off all right had not a few elements decided to stir up the aggies by their rowdy tactics. During the course of the evening one of the points of interest was a haircut administered by Barber Bill to a boastful Shamrock painter. About 1:00 A.M. a police car was almost waylayed by a group of hopeful aggie hunters.

At sun-up a portion of the defenders went home figuring the night was over and the job well done. At 6:07, however, pandemonium broke loose when the ag fraternities descended en masse for the main event. The remaining defenders, although outnumbered, decided to really clean up, so the logical thing to do was to break out the fire hose and really have a blast. By the time the brawl was over the front vestibule of the engine building could have easily passed for the pool in the women's gymn.

Considering that the foray was over in five minutes, events at this point took place rapidly. When the smoke had settled and the water had been shut off the score appeared to be, a few black eyes and cut lips, three columns splattered, the front steps painted and everyone thoroughly drenched.

Friday—After the all night stand the next scheduled event was the dedication of the campus stunt. The stunt this year was the release of a weather balloon to which a small box was attached. A time fuse exploded a dynamite cap which was attached to the lid of the box. After the cap exploded, the contents, complimentary tickets to the lab exhibits, were blown all over Boone County. It was a good idea though.

The part of engine week which always draws a crowd is the judging of the beard and this year was no exception. To an uninformed observer this group of "scroungy bums" could pass for anything from a group of guys that had an awful long hangover to the annual meeting of the House of David.

To determine who should be King of the beard growers, three judges were employed. These judges and the

(Continued on next page)



Oh, these modern conveniences.

SMOKE—

(*Continued from preceding page*)

part they judged was as follows: Ralph Scorah, length; Edward Vredenburgh Jr., quality; and Robert S. Daniels, style.

The winner of the senior division was Owen T. Hornkohl and the winner of the Junior division was Marvin J. Werner.

Tuesday afternoon came and according to the bulletins and rumors being passed around engine school St. Patrick was supposed to land in the middle of Francis Quadrangle in a helicopter but Erin's eggbeater must have gotten lost in all the excitement as it never showed up. But not to let his loyal subjects down he rubbed his magic lamp and, lo and behold, there on the front steps of engine school stood old St. Pat. Immediately he was whisked away in a cloud of Model T smoke.

With St. Pat and two guards in the lead the parade got underway. All was going fine until, at one one point, an impatient aggie jumped the gun by not waiting for the smoke bomb, which was the signal to go into action. It seems that careful plans had been made to kidnap St. Pat, but as usual, brains and creative genius triumphed over brawn, for as "Schnack" floored the accelerator, the car fairly leaped ahead leaving two would be assailants hanging on by their sore fingertips. Although three got away one stopped long enough to take a swing at an intruder. The only trouble was that the intruder turned out to be a plainclothesman. Oh well, it's nice in the pokey and just think, no finals, no nothing.

In the confusion Pi Tau Sigma copped first place for the best float. That's the one that had the Atomic sub and Atomic sub chaser.

Following the parade St. Pat reigned over the knighting ceremony in which he knighted 23 knights of St. Patrick and one lady of St. Patrick. As usual the Balarney stone appeared in a cloud of steam from out of nowhere and after all knights and ladies kissed the stone it disappeared in the same manner.

Friday evening and Saturday morning the lab exhibits were opened for the inspection for all the uninformed to see.

Saturday—On Saturday, in the morning mind you, practically every engineer in the university turned out to hear works of wisdom from our guest speaker and witness the presentation of awards.

At noon the alumni luncheon was held in the Student Union followed by the lab exhibits from 1 to 4 P.M. and the Green Tea which was held in the engine library from 2 to 4 P.M.

At 6:30 P.M. the engineers banquet was held in the Student Union and at 9 P.M. the St. Pats Ball got under way at Rothwell Gym.

The gym was decorated with green and white crepe paper and the music was supplied by Geo. Kratz and his orchestra.

In the center of the gym was a waterfall decked with a wide variety of multicolored flowers and the entire setting was surrounded by a white picket fence in the shape of a Shamrock.

At 10 P.M. the queen of love and beauty was crowned. That person, which we are all proud to have reign over us, is Lee Blount. A secondary highlight of the evening occurred when the beard contest winner, Owen Hornkohl, was bestowed with a kiss by the queen. You would think he hadn't kissed a girl in a year. (Don't mind me I would have liked to have been in his shoes.)

With the knighting of the Magna Cum's the curtain of St. Pat's week was brought down for another year. Thank Heavens.

A few miscellaneous events that were almost overlooked were the dying of the Ag pond to a bright green hue and the painting of the law barn door to a similar color. A sure cure would be for the University to leave the door green and change the color scheme of the rest of the campus.

As a parting note I would like to say that although this is a week long to be remembered, be it good or bad, I'm glad that the school spirit and rivalry is not completely dead.

In conclusion let me say that there are only 49 more weeks until St. Pat's week.

ERIN GO BRAGH!

HONOR AWARDS





In presenting the medals, Dean Croft cited the Du Pont de Nemours Company for its "long-standing and exemplary policy of promoting the professional development of its young engineers and scientists, and of advancing them in its management; for its emphasis on research as a proper major activity, and its policy of including basic and fundamental research projects in its programs; its enlightened policy of publishing important contributions to engineering and scientific literature; its services over the years to our country in carrying out many defense projects of great magnitude; and its intelligent advertising to the general public of the importance of science and engineering for the lives of all of us."

Mr. Read, who accepted the honor for Du Pont, had a leading part in the enormous war construction program of the company, including responsibility for the design and construction of the huge Hanford Engineering Plant in Washington, and under Du Pont's new contract with the Atomic Energy Commission, he is again playing a major role in a vital National defense project.

The distinguished service award to Mr. Reynolds is one more in a long and impressive list of honors heaped upon this venerable patriarch of levee engineers, known for a half a century as the man who has made agriculture possible and profitable in Southeast Missouri.

Mr. Reynolds was cited in recognition of his "outstanding service and leadership in the construction and maintenance of one of the world's largest levee and drainage systems; and his nearly sixty years of continuous engineering responsibility, dating from the inception of the St. Francis Levee District and the Little River Drainage District of Missouri until well past his ninetieth birthday."

Mr. Reynolds was born November 9, 1861, in the little village of Boydsville, a few miles southwest of Fulton, Mo. Following preparatory work at Westminster College in Fulton, he entered the University of Missouri in 1878, and graduated with a Bachelor's degree in Civil Engineering in 1883.

After teaching in a private school near Gray Summit, and in a College at Woodland, California, Mr. Reynolds moved to the lead district of southeast Missouri to assume management of a mining venture. When the great financial panic of 1893 drove the mines out of business, he went into the general engineering and surveying business.

It was about this time that levee and drainage districts were being organized in southeast Missouri, and Mr. Reynolds found his life work in this phase of the profession. In 1900

(*Continued to Page* 30)

Knights And Lady Of St. Pat

Mrs. Croft

Mrs. Huber Croft was born in Ralston, Pennsylvania, and attended grade and high school at Canton, Pennsylvania. She received a Bachelor of Fine Arts degree at the University of Syracuse, Syracuse, New York. Mrs. Croft later became Supervisor of Art at Tonawanda, New York, and at Norwood-Glenolden, suburb of Philadelphia.

Dean and Mrs. Croft met at the University of Illinois, where Dean Croft was then an instructor in the Mechanical Engineering Department. They were married in Chicago on June 8, 1927.

Mrs. Croft is very much interested in arts and crafts and last summer visited the Scandanavian countries where she obtained many typical examples of their arts and crafts such as textiles, china, and glassware.

Now, as the wife of the Dean of Engineering, Mrs. Croft takes an active part in campus activities. Of Engineers' Week she said: "I was very pleasantly surprised to have received the honor of being selected as a Lady of St. Pat. It seems to me that Engineers' Week is one of the outstanding events of campus life. This year the Green Tea was especially nice due to the wonderful help of the wives of Engineering students."

Mr. Lang

Mr. Howard Lang, the Mayor of Columbia, was born at Fulton, Missouri, where he attended grade and his first three years of high school. His last year of high school was at Hickman High in Columbia, where he was graduated.

He attended school for seven years at the University of Missouri. During that time he studied engineering, political science, and law. He received an A.B. with distinction in political science and an L.L.B. in law.

Mr. Lang's first employment was in Reynolds County as an agricultural economist for the Federal Government. He was next a member of the law firm of Clark, Boggs, Peterson, and Becker for a year. During World War II, he served in the Navy, spending 39 months overseas in the Asiatic-Pacific theatre.

Howard Lang was Prosecuting Attorney in Columbia for two terms, but resigned during his second term to work with the M.F.A. Mutual Insurance Company as Chief Claims Attorney.

Mr. Hill

Mr. Leo Hill, city manager of Columbia, attended grade school his first two years of high school in Potosi, Missouri, his hometown. He completed his last two years of high school at Pueblo, Colorado.

Mr. Hill completed his undergraduate work in the field of engineering and political science at Colorado College in Colorado Springs, Colorado.

He attended Wayne University at Detroit, Michigan as a graduate student to study public administration.

After graduation, he was first employed by the Detroit Bureau of Governmental Research where he did private research analysis of city government.

His next job was with the Colorado Public Expenditure Council at Denver, Colorado where he did research on the state and local level pertaining to taxing procedures and criticism of governmental practices.

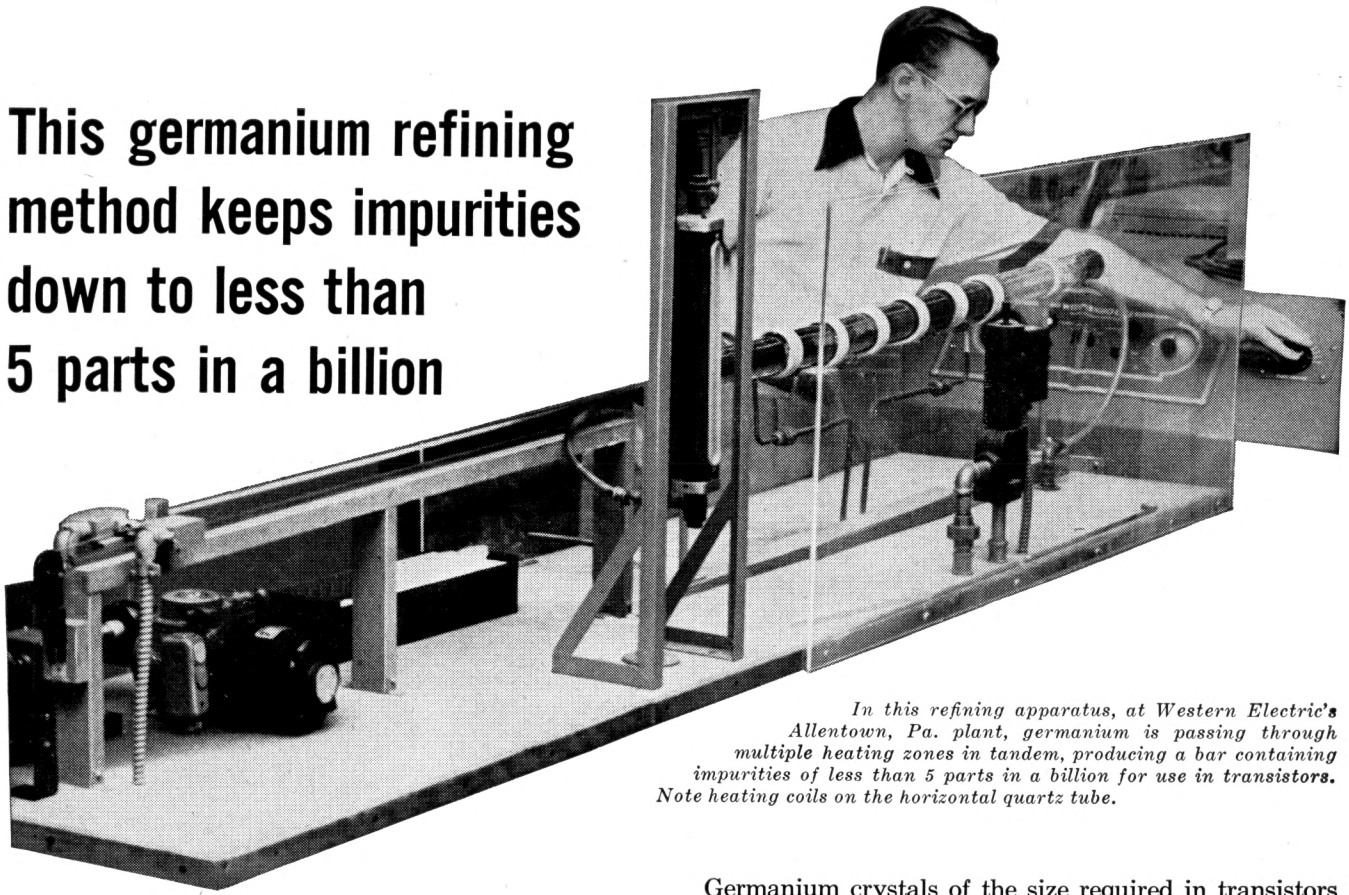
Mr. Burcham

Mr. Paul Burcham, Chairman of the Mathematics Department of Missouri University, was born at Fayette, Missouri, where he was graduated from grade and high school. He Spent four years at Central College in Fayette studying mathematics.

After his graduation from Central College, he was employed by a telephone company in St. Louis for one year. He then went to Northwestern University for four years where he received a Ph.D. in Mathematics. After graduating from Northwestern University, Mr. Burcham taught at Central College for about a year. He then served from 1942 to 1946 in the Army Air Force as a weather officer and pilot.

In the summer of 1946 he came to the University of Missouri to teach mathematics. He is a member of Sigma Xi, an honorary scientific fraternity.

This germanium refining method keeps impurities down to less than 5 parts in a billion



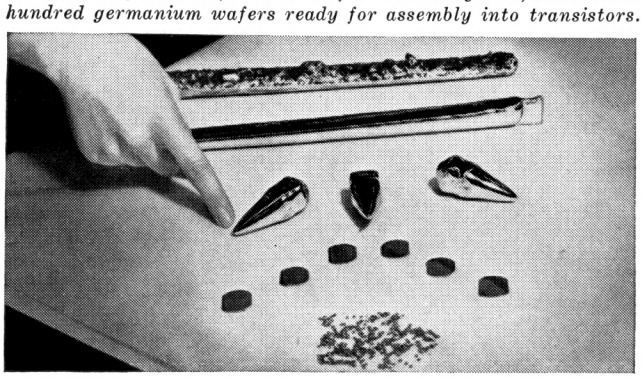
In this refining apparatus, at Western Electric's Allentown, Pa. plant, germanium is passing through multiple heating zones in tandem, producing a bar containing impurities of less than 5 parts in a billion for use in transistors. Note heating coils on the horizontal quartz tube.

A new method of metal refining, currently in use at the Western Electric plant at Allentown, results in the production of germanium that is better than 99.9999995% pure — the highest degree of purity ever attained in a manufactured product.

The need for germanium of such exceptional purity came about when research by Bell Telephone Laboratories in the field of semi-conductors led to the development of transistors, which are manufactured by Western Electric.

The transistor is a tiny crystal device which can amplify and oscillate. It reduces space requirements and power consumption to a minimum.

Various forms which germanium takes before being used in transistors are shown in this photo. Bar at top is an ingot of germanium after reduction from germanium dioxide. Next is shown the germanium ingot after the zone refining process used by Western Electric. Below the ingots are shown 3 germanium crystals grown by machine, 6 slices cut from these crystals, and several hundred germanium wafers ready for assembly into transistors.



Germanium crystals of the size required in transistors do not occur in nature; they are artificially grown at Western Electric. At this stage in transistor manufacture, other elements are introduced in microscopic quantities to aid in controlling the flow of electrons through the germanium. But before these elements can be introduced, it is necessary to start with germanium of exceptional purity, so that the impurities will not interfere with the elements that are deliberately added.

So Bell Telephone Laboratories devised an entirely new method of purification, known as zone refining, which was developed to a high-production stage by Western Electric engineers.

In zone refining a bar of germanium is passed through a heat zone so that a molten section traverses the length of the bar carrying the impurities with it and leaving behind a solidified section of higher purity. By the use of multiple heating zones in tandem, a number of molten sections traverse the bar. Each reduces the impurity content thus producing a bar which contains impurities in the amount of less than five parts per billion.

Because of the importance of the transistor in electronics, the zone refining process — like so many other Western Electric developments — has been made available to companies licensed by Western Electric to manufacture transistors.

This is one more example of creative engineering by Western Electric men. Engineers of all skills — mechanical, electrical, chemical, industrial, metallurgical, and civil — are needed to help us show the way in fundamental manufacturing techniques.

Western Electric

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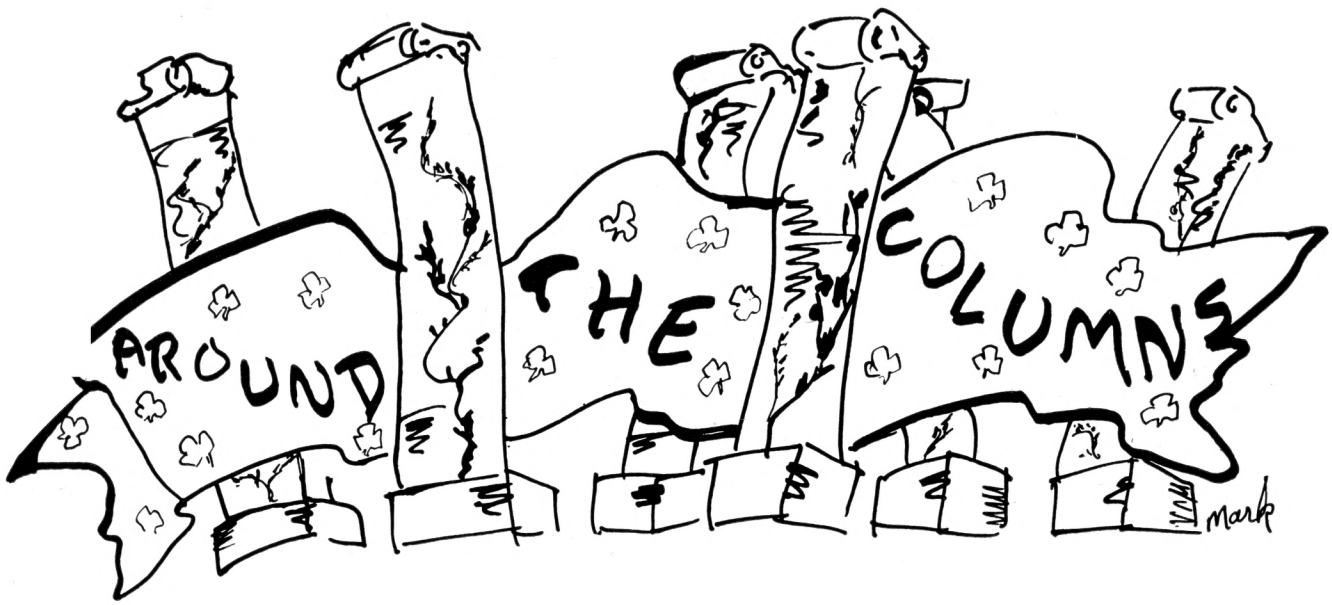

With SLIPSTICK SAM, B.S. '99

Hats off to Clint Starkey, Bill Ellis, Jim Sutherland, Dave Aldag and all the guys who made the Engineers Ball a success. It was, as any one who went knows, a great dance. The band and the decorations were completely out of hand. Thought Ole St. Pat was about to collapse there for a minute, on the stage, until I saw his argyles showing through the Green. I don't think we could have picked a more suitable queen, although it was a hard choice from the dollies that made the finals.

♣

Three cheers to the rumblin' monster of John Schnackenberg who leaped away from the would-be-kidnapers. I hear that car is a '32 Hazard, road hazard that is. How about that John?

♣

I'll say one thing, when the M.E.'s make a float, they really make a float. Why, the beer cans were lined up from thar to thar. Don't tell anyone, but that wasn't really beer in that water fall, it was, well you know.

♣

Hey! Have you heard about the new fun game around Engine School. It's called pop-hour-quiz-grab-your-goodie. It seems this jolly old pastime was originated by Mr. LaRue and Eastman Smith, when they walked into their M.E. 82 and M.E. 90 classes and gave a short pop hour quiz. "How to make friends and influence enemies."

♣

Did you see gool old Tom Skinker wandering around the Engine School during Engine Week. It seems it took Tom 4½ years to graduate and now he is a gas pump jockey for his dad. Just goes to show how far you can go with an engineering degree.

♣

I think the Ruf Nex who attended our dance and kept down the no smoking rule and guarded the decorations should be given a hearty thanx. They were extremely courteous and didn't once try to unveil St. Pat or blow up Rothwell Gym.



♣

The campus stunt was a good idea and all that, but the only thing wrong was that by time the gizzmo opened to drop the pamphlets, it was South of Kingdom City.

♣

As you read this, the time for the Farmer's Fair will be drawing near, and it is a general idea that the *smarter* fellows will keep their lily white pinkies clean from paint, and dye, and other such materials. If any more of the "pranks" that went on during Engine Week go on during Farmer's Fair, the students involved will no longer be with us at this institution where you gain a thirst for beer and knowledge.

♣

Seems like the old Spring Fever has got us all.

You don't want to do *too* much Hinkin'.

For as this semester draws to a close,

You had better be thinkin', not drinkin'.

♣

What is this stuff about 7:30 classes and 15 minutes off for Thanksgiv-

(*Continued on Page* 38)



Helping the "stars" to shine

A tiny off-stage "sun" brings you brighter and better movies

As YOU SEE the Hollywood "stars" on the screen of the darkened theater—perhaps in 3-D—you can thank a man-made miracle of light—the carbon arc.

This brilliant light comes from tiny carbons not much larger than pencils. Yet their light is brighter than the sun itself—enlarging the tiny pictures on the film as much as 300,000 times!

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NEWSTUFF

By MIKE McDANIELD

McDonnell Aircraft Corporation and the Air Research and Development Command of the U. S. Air Force have announced the development of the first military convertiplane—an aircraft which is capable of both vertical and horizontal flight. The XV-1, as the new aircraft is known, is equipped with a rotor which provides the power for vertical flight and wings and propeller for forward flight. Each of the three blades of the rotor is powered by a McDonnell developed pressure jet unit located at the tip of the blade. A Continental reciprocating engine is provided on the aft fuselage to supply air to the pressure jet units during vertical flight and power to the propeller during forward flight. Fuel is fed to the three pressure-jet burners through a governor driven from the rotor hub accessory drive. The pressure jets operate on the principle of ignition and expansion of the fuel gases, which exhaust rearward through nozzles to provide the thrust. The application of power directly to the blade tips eliminates the torque which in conventionally driven helicopters must be eliminated by the use of a second rotor or propeller. In vertical flight or hovering the rotor provides all the lift; in forward flight the wings provide essentially all the lift. This allows the rotor to autorotate at its lowest drag configuration. This avoids the speed limitation encountered by conventional helicopters due to stalling of blades when they must carry lift at high speeds. Since the wings do not have to provide the lift during take-off or landing, they are approximately half the size of the wings for conventional fixed wing aircraft. Thus the speed performance of the convertiplane is not greatly affected by utilizing both rotor and wing. The XV-1 is designed to carry three passengers in addition to the pilot. The craft is approximately 30 feet long, ten feet high and spans 26 feet in width. The convertiplane's tail assembly consists of two vertical fins and rudders attached to the extremities of two twin tail booms. The horizontal surface consists of a single stabilizer with tabs, mounted between the ends of the tail booms.

The crew compartment in the fuselage is equipped with large plastic windows which provide exceptionally wide range of vision. It is separated from the engine section by a structural firewall. Pilot and co-pilot observer sit in tandem, with removable dual controls provided.

Two non-retracting skids comprise the landing gear of the XV-1. The skid gear differs from previous skids in that energy is absorbed during hard landing by the yielding of replaceable stainless steel straps.

The first flight of the XV-1 will take place next summer and meanwhile an extensive research program will be required. This will include ground testing, careful instrumentation for the development of flight test data, and painstaking pre-flight test work. The full-scale model will be placed in a wind tunnel to test its aerodynamic characteristics. The XV-1 is also to be utilized for research into the possibility of applying the convertiplane principle to larger aircraft.

General Electric has announced the development of a revolutionary new type of infrared lamp, "of tremendous potential" for heating, drying, baking, and other uses.

The new lamp comes in a compact tubular shape, slightly larger in diameter than a cigarette, rather than in the shape of a conventional bulb. The tube is made of fused translucent quartz. The new lamp produces more than four times the energy concentration delivered by the popular 250-watt infrared bulb and the slender quartz lamp has the ability to withstand high temperatures and the shock of violent temperature changes. Even when the tube is heated to a cherry red, it can be doused in water or even touched by a piece of ice without cracking.

Two sizes of the new lamp are being introduced, 500 and 1000 watts, for use on circuit voltages of 115-125 and 230-250 respectively. The new lamps come in lengths of 6¾ and 11¾ inches. From each end extends a flexible six inch lead wire. As in all GE infrared lamps, the heating element is a coiled tungsten filament.

The physical properties of fused quartz—its high mechanical strength, low coefficient of expansion, high

(*Continued on Page* 32)



Brig. General David Sarnoff, Chairman of the Board, Radio Corporation of America

Sees No. 1 wish come true!

Television Tape Recording by RCA Opens New Era of Electronic Photography

In 1956, RCA's General Sarnoff will celebrate his 50th year in the field of radio. Looking ahead to that occasion, three years ago, he asked his family of scientists and researchers for three gifts to mark that anniversary: (1) A television tape recorder, (2) An electronic air conditioner, (3) A true amplifier of light.

Gift No. 1—the video tape recorder—has already been successfully demonstrated, two years ahead of time! Both color and black-and-white TV pictures were instantly recorded without any photographic development or processing.

You can imagine the future importance of this development to television broadcasting, to motion pictures, education, industry and national defense. And you can see its entertainment value to you, in your own home. There the tape equipment could be used for home movies, and—by connecting it to your television set—you could make personal recordings of your favorite TV programs.

Expressing his gratitude for this "gift," Gen. Sarnoff said it was only a matter of time, perhaps two years, before the finishing touches would bring this recording system to commercial reality. He described it as the first major step into an era of "electronic photography."

Such achievements as this, stemming from continuous pioneering in research and engineering, make "RCA" an emblem of quality, dependability and progress.

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BULLARNEY



By GRAY

Mary had a little skirt,
And it was very tight,
Who gives a damn for Mary's lamb,
With Mary's calves in sight?

♣

Father Rabbit: "What's Junior so elated about?"

Mother Rabbit: "He learned to multiply today."

♣

Two London charwomen were discussing the inconveniences of the black out. "But it's a necessary evil," one said, "else we're likely to be blasted into maternity." "'Tis so," said her companion, "but the *worst of it is*, we'd never know who done it."

♣

A young western Kansas lass was milking her cow when she saw a young man approaching. She called to her father, "Oh Father, there is a boy coming up the road."

Her Father retorted with, "Get in the house."

She called back, "But he looks like one of them Engineers."

"Then take the damn cow in too," answered the old gentleman.

♣

Prof. Yanosik: "Give me an example of an imaginary spheroid."

Lachs: "A rooster's egg."

Then there was the fellow that had a hobby of collecting stones and putting them in the bathroom.

He had rocks in his head.

♣

The meanest man in the world is the warden who put a tack in the electric chair.

♣

Concluding his lecture a college professor started to dismiss the class when a student called out:

"Professor, have you any documentary proof to support the things you've been telling us?"

Since the talk had been about life on other planets, the professor admitted that he hadn't.

"Until you do produce proof," said the brash student, "do you mind if I call you a liar?"

"Not at all, but tell me, were you born a human or an animal?"

"A human, of course."

"Have you your birth certificate with you?"

"No, but—"

"Well until you produce it, do you mind if I call you an impertinent jackass?"

♣

When the ventriloquist visited his friend on a farm it was only natural for the farmer to take him out to the barn at milking time. There the ventriloquist amused himself by talking to the cows and having them "talk" back to him.

It was amusing to say:

"Well, Brownie, and how are you?" and have a voice seemingly come from the old cow in reply:

"Oh, not so bad. Of course, I don't like this last lot of hay as well as that nice, green hay we'd been getting, but I'll get along."

So it went, down the row of stanchions.

"And you, Spot. How are you making out?"

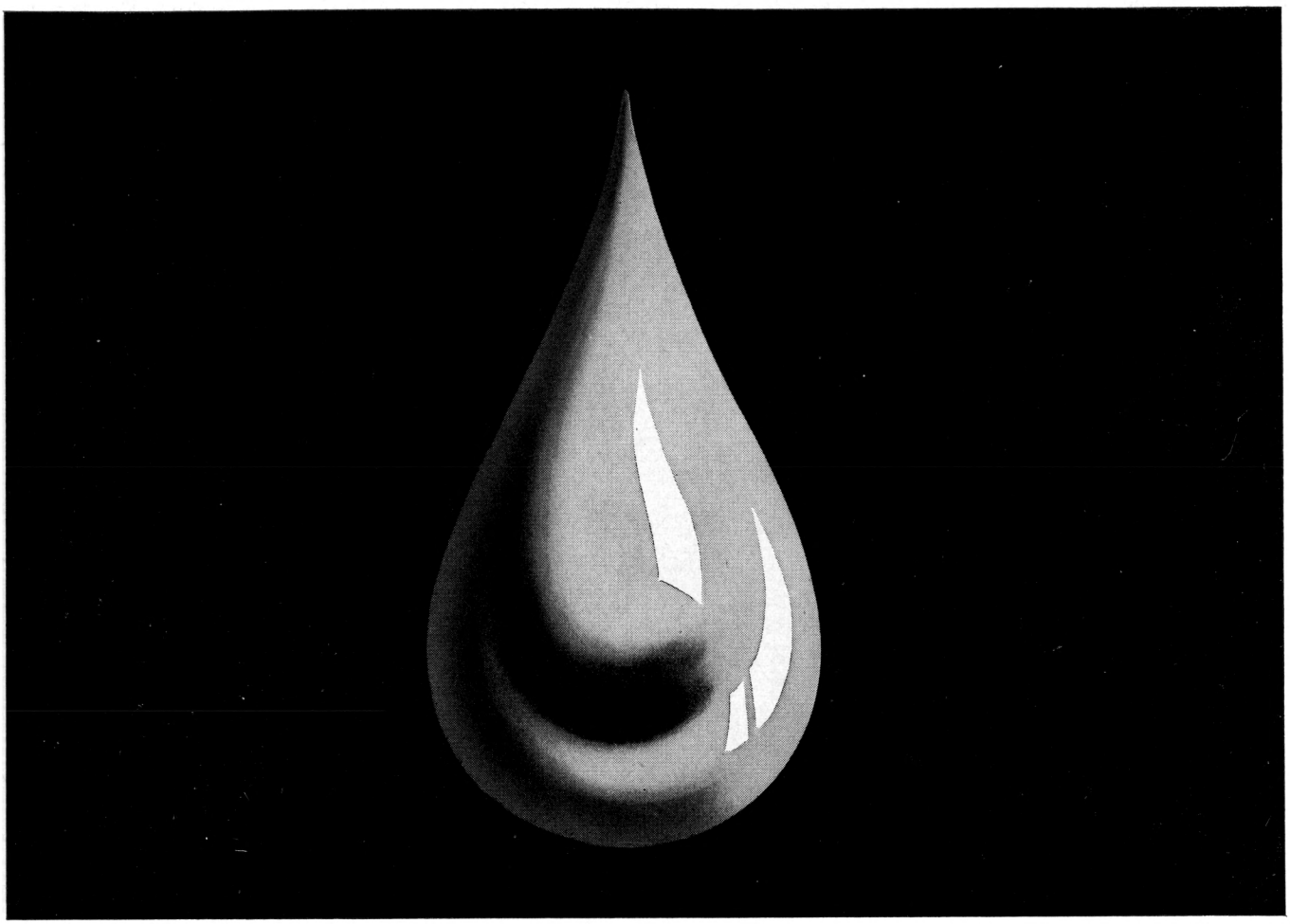
"Well, if you must know the truth, they seem to be awfully skimpy about the bedding here, considering all the straw they have on hand."

"Roan, old girl, you look hungry."

"Well, mister, I'm carrying an 80-pound calf, eating for two these days, so I'm always hungry."

The hired man, tending the milking machine, opened his eyes wider and wider as this went on. Finally he dropped the equipment and dashed toward the barn door. But he stopped just long enough to grasp the ventriloquist by the arm and plead, in an agonized voice:

"When you come to that little red heifer at the end, mister, don't believe a damn word she says!"



MOLECULE MAGIC . . .

This tiny drop of oil, say the chemists, contains hydrocarbons—the raw material for hundreds of thousands of organic chemicals . . . the makings for tires and textiles, for dyes, detergents and deodorants, for paints, plastics and polishes, for agricultural and industrial chemicals.

Oil—the ointment of the ancients and preservative for mummies—is old. It's Nature's billion-year alchemy that changed fish and lizard leftovers into black gold . . . chemical "gold" that is just now being developed.

DREAMLAND IN A DROP . . .

It wasn't until this century that the chemical and petroleum industries began the molecular magic that transformed a drop of oil into a two-and-a-half billion dollar enterprise.

How did it happen? Principally because of the way we Americans work. Every art, science and branch of engineering has the opportunity and the incentive to add its drop of genius to the pool of progress. Here cooperation and competition bring benefits of better living to people everywhere.

And lighting the way toward the brighter future is America's all-seeing, all-hearing and reporting Inter-Communications System.

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McGRAW-HILL FOR BUSINESS

BACK IN '32 . . .

Mr. David Aldag, Editor
The Shamrock
Room 233, Engineering Building
University of Missouri
Columbia, Missouri

Dear Mr. Aldag:

Attached is the only clipping I have been able to find relating the details of the Engineer-Lawyer skirmish of 1952.

In re-reading this article and evaluating its contents in the light of some twenty years of kicking around since my graduation, I can truthfully say that lawyers haven't changed in their approach one bit. The Honorable Senator Nick Cave states that he had positive proof that the Engineers were shooting also! It's the old story of making a false statement to distract attention from a basic fact in a situation. In this case, why was the lawyer, who was "attacked", carrying a gun in the first place?

So help me I still get mad reliving that time! Anyhow, had no shooting occurred, those two lawyers would have been objects of attention the next morning at the end of the nine o'clock classes. Our plan was to shave half their heads, one eyebrow, and all other hairy adornment they might have. Paint them with a nice red substance, non-toxic of course, dress them in shorts only, turn them loose on the steps of the Engine building. Their clothes were to be on the steps of Jesse Hall! After all these years I would appreciate seeing such a sight.

The other point in this article which is not brought out, is the fact that our queen, of that year, was in on this kidnapping. She spent an enjoyable evening with the kidnappers eating and playing bridge in Moberly. I believe I mentioned that nearly all our Shamrocks' of that date had her picture torn out and the pages burned on the campus in front of the Engineering Building a few days later.

Keep this article as long as you have any use for it. Please see that it is handled carefully though and when you are finished with it, please return it to me.

Sincerely yours,
Chas. Love
February 25, 1954

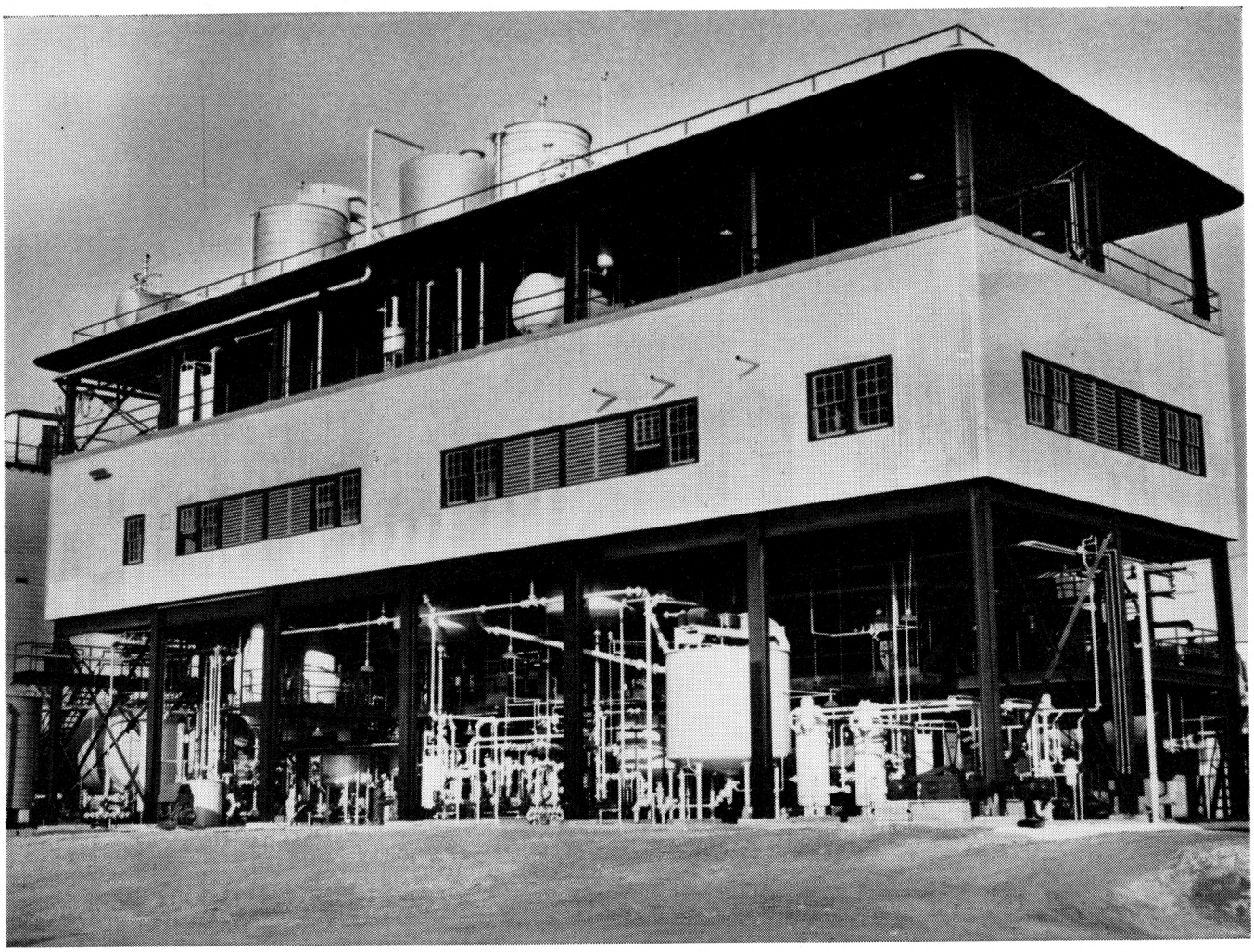
COLUMBIA, Mo., Mar. 23—(AP)—Burnis Frederick, University of Missouri law student, was under bond of $1000 tonight and faced a charge of carrying concealed weapons, pending the outcome of serious wounds suffered by Frank Luckey, an engineering student, in an outbreak of a feud between the engineering and law schools here last night.

Meanwhile two investigations of the fracas—one by civil authorities and another by University officials—were under way. The shootings grew out of the "kidnaping" of Miss Mary Butterfield of Kansas City Saturday night, just before she was to be crowned queen of St. Pat's ball, an engineer's function.

Two other students, Jerry Cebe, St. Louis and Charles (Bus) Love, Jefferson City, were shot and wounded, not seriously, and Frederick was slugged.

Today Luckey hovered between life and death and while the attending physician said his condition had been satisfactory, he still held only fair hopes for his recovery. Luckey was shot through the abdomen.

(*Continued on Page* 36)



EXCESS HYDROCHLORIC ACID is put to work in this catalyst plant of the Morton Salt Company at Weeks Island, Louisiana. The acid is used in a process developed by a Standard Oil scientist to produce a top-quality catalyst.

What the scientist saw in the sandpile!

This story starts with a child's sandpile and a scientist's curiosity. It ends eight years later with a new top-quality catalyst—the result of a scientist's ingenuity.

One day a Standard Oil chemist took home some granular blast furnace slag from a neighboring steel mill for his children's sandpile. Suspecting that it had properties of potential value, he took a pailful back to his quarters in the Whiting Laboratory the next day.

Treating the slag with hydrochloric acid and then drying it in an oven produced 30 cc's of powder that proved to be an effective and active catalyst. However, commercial production of the catalyst was uneconomic because of the market price of hydrochloric acid. To overcome this obstacle, Standard Oil contacted the Bay Chemical Company, a salt cake producer which, at times, had difficulty marketing hydrochloric acid—a co-product of salt cake.

The Bay Company, of Weeks Island, Louisiana, now merged with Morton Salt Company, became interested in the new catalyst and built a plant with the aid of Standard Oil scientists. The output of this plant is a top-quality catalyst with unlimited new sources of raw materials.

This is only one example of what Standard Oil scientists accomplish in an atmosphere of independent research. In our constantly expanding laboratories, our scientists are free to investigate and pursue ideas, for Standard Oil knows that one of a scientist's greatest assets is his curiosity.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

Awards—

(*Continued from Page* 19)

he was named Chief Engineer of the St. Francis Levee District, a position he still holds, and in 1907 he was elected a member of the board of supervisors of the Little River Drainage District. He is now chairman of this board. Mr. Reynolds has received many high honors, including citations by the Corps of Engineers of the U. S. Army.

Mr. Laffoon was presented the Missouri Honor Award for his "notable achievements in the fields of engineering design and management; his leadership in the development of large generator, synchronous condensers, and hydrogen cooling in generators; and his ability to understand his fellow men which has resulted in his assuming progressively greater responsibilities in one of the world's largest and best known manufacturing corporations."

Mr. Laffoon was born on a ranch in Kansas in 1888, but his family moved to Missouri two years later, and he was reared on a farm near Peculiar, in Cass County. He attended Central Missouri State Teachers' College, and then the University of Missouri, receiving the B.S. degree in Electrical Engineering in 1914, and a Master of Science degree in 1915.

He joined the Westinghouse Company in their graduate engineering training course in 1916, and two years later entered the field of design engineering for that firm, gaining experience and responsibility in various phases of the work. He has been successively manager of five of their design and engineering departments.

In 1938, Mr. Laffoon received the Westinghouse Order of Merit and Silver Award Medal for "outstanding achievements in the fields of engineering, management, and design." He has been an active member of professional engineering societies for many years, and from 1943 to 1947 served on the Board of Directors of the American Institute of Electrical Engineers. In 1950 he received the AIEE Lamme Gold Medal Award for "outstanding contributions to design of electrical machines, particularly large turbine generators and high frequency generators."

Rex M. Whitton is also one of those rare individuals who has remained with a single employer since his graduation, and has achieved fame by doing an exceptional job. He was cited by his Alma Mater for "his thirty-four year career with the Missouri Highway Department, beginning at the bottom of the engineering ladder and working his way by merited promotions until finally achieving and notably fulfilling the highest responsibility as chief engineer."

Mr. Whitton was born in Jackson County, Missouri, in 1898, and graduated from the University of Missouri with the B.S. degree in Civil Engineering in 1920. He joined the staff of the Highway Department as a surveyor in May of that year, and won his first promotion in October of the same year.

Successive promotions brought him to the main office of the department in Jefferson City in 1927 as engineer of special assignments, and in 1936 he was named engineer of maintenance for the entire State system. He was made Chief Engineer of the Missouri State Highway Department in 1951. Mr. Whitton's son, Rex Jr., is also a graduate of the University with a degree in civil engineering, and is now serving as an ensign in the U. S. Navy.

Leonard J. Fletcher was cited not only for achievement in agricultural engineering, but also for exceptional ability in promoting public understanding of American industrial economy.

Dean Croft conferred the honor upon Fletcher for "his brilliant career as an educator, both as a teacher and an administrator, in agricultural engineering; . . . and his unusual accomplishments in the field of human and community relations, resulting in improved understandings of our American industrial economy by various segments of society."

A native of Chadron, Nebr., but reared in Iowa, Fletcher worked at the Tinsmith's trade to pay his way through Iowa State College, obtaining a Bachelor of Science degree in Agricultural Engineering in 1915. He taught at Washington State College, and then at the University of California, where he was head of the Division of Agricultural Engineering.

Joining the Caterpillar Tractor Co., in 1927, he spent the years 1929 to 1933 in the Soviet Republic teaching Russians the application of mechanical power and machine operated equipment to their grain production and road building. Returning to the United States, he became Caterpillar's assistant general sales manager in 1937, and in 1941 was named director of training. In the latter capacity, he developed methods of solving the pressing war problem of manpower mobilization and training, and his program became a pattern for American industry in general.

In 1944, Mr. Fletcher assumed the additional responsibility for a new Community Relations Division to bring greater understanding of mutual problems between the company and the public. He was elected vice-president of the company in 1951, but continues responsibility for the public relations program.

Recipient in 1944 of the Cyrus Hall McCormick Medal "for exceptional and meritorious engineering achievement in agriculture," Mr. Fletcher is a member of numerous professional societies, a trustee of Bradley University, and a well known author and speaker.

In Dr. Webster N. Jones, the College of Engineering is again honoring one of its own sons, and a former teacher in the University here. Dean Croft and the University cited Dr. Jones today for "his role as a pioneer in the development of the modern professional education of engineers; his insatiable interest in the welfare and professional growth of young men; and his service to his country as the organizer of the Office of Production, Research, and Development during World War II.

Born in Rich Hill, Mo., Mr. Jones received his A.B. degree from the University in 1908 and a Master's de-

(*Continued to Page* 31)

gree the following year. He majored in chemistry. He obtained his Ph.D. degree from Harvard University, and holds an honorary degree of Doctor of Engineering from Stevens Technical Institute.

Mr. Jones returned to Missouri in 1913-14 to teach chemistry, and also taught at Purdue, Maine, and Montana universities and at Carnegie Institute of Technology. He became Dean of Engineering at Carnegie in 1932, and in 1953 was named Vice-president of the Institute in charge of industrial and government relations.

Dr. Jones pioneered the abolition of technical shop courses in favor of a professional curricula in engineering, the abolition of training for a job in favor of education for a lifetime of service and growth as a professional engineer. He has always maintained an insatiable interest in the welfare and professional training of young men.

For many years, Dr. Jones was also associated with the B. F. Goodrich Rubber Company in research, production, and management.

He served as an officer in the Army Chemical Corps in World War I, and in World War II he organized the Office of Production. Research and Development, and served on the Baruch Committee for Synthetic Rubber.

Dr. Jones's wife is also a Missourian, the former Miss Nettie Donald Haire of Smithton, Mo. She graduated from the University of Missouri in 1914, and they were married in 1918.



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SCIENTIFIC AND ENGINEERING STAFF
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NEWSTUFF

(*Continued from Page 24*)

melting point (about 3200 degrees Fahrenheit), superior insulating properties, and resistance to acids and thermal shock are expected to contribute greatly to the new lamps versatility.

The new lamp has many advantages: It produces higher energy concentrations in a smaller space than has previously been possible. It produces full radiation almost instantly, not requiring a warmup period. It requires little maintenance, having a rated trouble free burning life of more than 5000 hours.

First application of the new lamps is expected to be in industrial radiant drying and baking ovens. Because of the higher energy concentration it makes possible, and because it provides energy over a considerable range of wave lengths, advantageous in many processes, the new lamp promises to open up new fields in industrial drying and baking. An intriguing possibility for the lamps involves their installation at the marquees or entrances to department stores, office buildings, theaters, and other establishments to keep window shoppers and others warm and comfortable in the winter. Similar installations are seen as desirable for bus and railroad waiting stations. Lamps in such locations would reduce the effect of snow and ice.

Two GE engineers have developed a small radio receiver which can be worn like a hearing aid. They said it was designed primarily for use in civil defense where a compact lightweight receiver, operating from a minimum number of flashlight batteries, is desired.

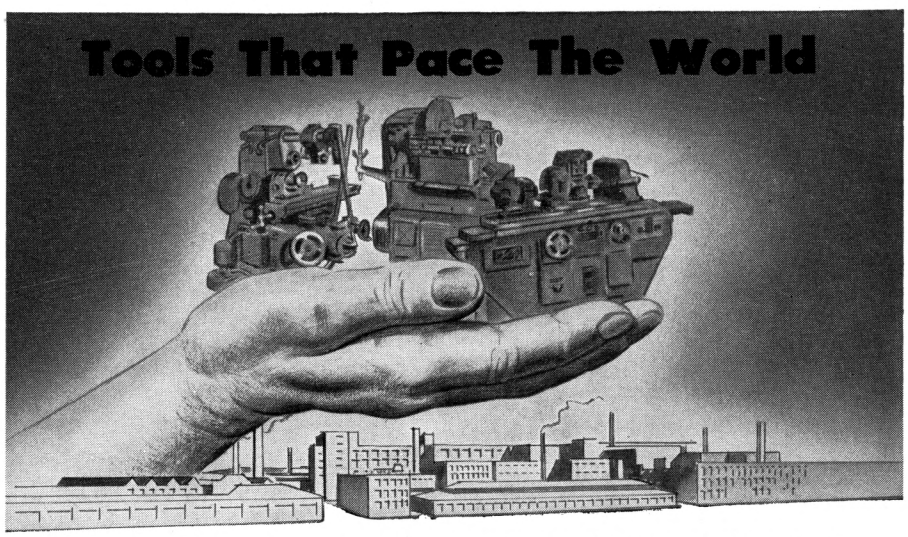
The radio, described as an experimental model, is tuned to a single broadcast frequency of 1240 kilocycles, which is one of two channels to be used by radio stations in broadcasting civil defense instructions to the general public during emergency periods.

The radio has a hearing aid type earphone and weighs about five ounces. It can be slipped into a shirt or vest pocket, and is estimated to be capable of continuous operation for more than a month without battery replacement. Two tiny batteries like those used in pen-sized flashlights power the radio.

General Electric, which builds motors rated in thousands of horsepower, also makes motors rated in thousanths of horsepower. A miniature direct-current motor, recently developed for use in the defense systems of advanced operational bombers, is rated as .002 horsepower at a speed of 6500 rpm.



One of the smallest motors ever built by GE, the tiny unit is about the size of an ink bottle. The motor can take temperatures as low as 65 degrees below zero and is also unaffected by dry, hot or humid weather. Each of these midgets needs 40,000 turns of .002 inch wire wound into its coils—a total of more than two miles of wire.



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CAPACITORS

(*Continued from Page* 13)

ers are also capable of supplying Kvar in excess of their ratings for short periods, while capacitors cannot.

Even though capacitors do not have these desirable characteristics, they do have some very definite advantages. Capacitors lend themselves to economical distribution throughout a system, and economical distribution is not practical with small synchronous condensers. In addition, the losses of synchronous condensers are much greater than those of shunt capacitors, and synchronous condensers add to the short circuit current of a system. This latter characteristic may cause the requirements for circuit breaker sizes to be increased.

Each of these devices has its advantages. Sometimes it is possible to make use of both synchronous condensers and shunt capacitors in conjunction. This is a step toward ideal power factor control with maximum economy. When fluctuating loads of low power factor are prevalent and switching steps on capacitor banks are too coarse, control of Kvar supplied to the system may be obtained by a combination of capacitors and a synchronous condenser.

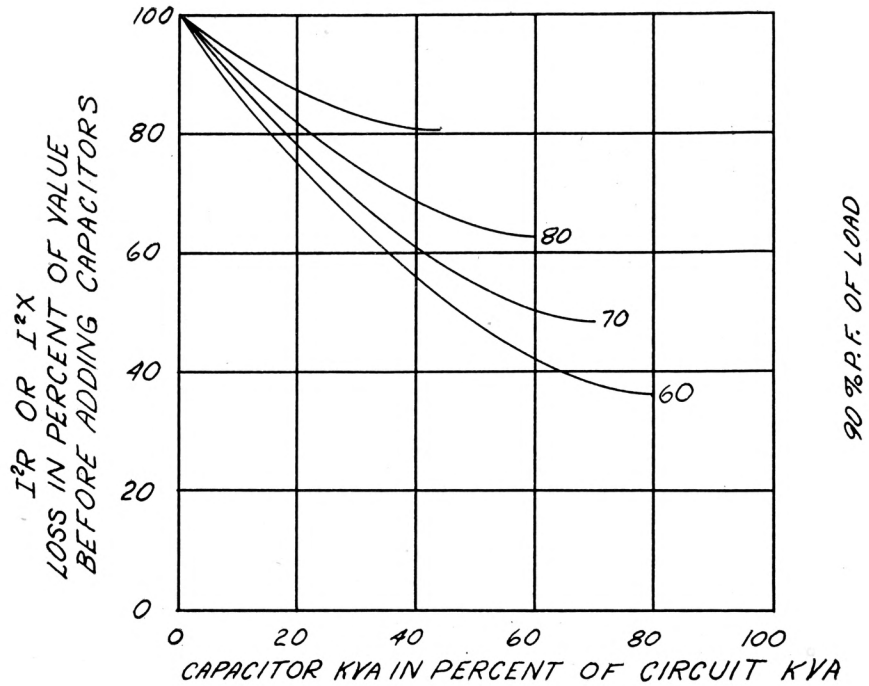

FIG 3- REDUCTION IN LOSSES IN THE SOURCE CIRCUIT TO SHUNT CAPACITORS

Power factor correction has proved to be economical for both utilities and consumers. When the distribution engineer decides to correct for low power factor, the problem may arise concerning the best method to use. The device which is more applicable for one situation may be undesirable for another. When the problem of power factor correction arises, a study should be made to determine the most economical method that will give satisfactory performance and reasonable dependability.



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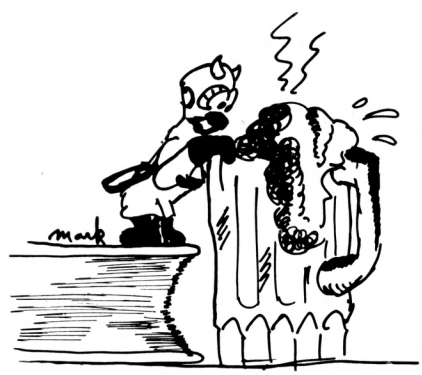



Case of the dry "oil" well

Not at all unusual, you say? But this well was *purposely* drilled that way! In fact, precautions were taken to see that the well wouldn't contact oil-bearing sands. It was to be a vital part of an elaborate waste-disposal system built into one of Du Pont's new plants near Victoria, Texas. It is an example of the unusual engineering problems which Du Pont technical men encounter.

The "well" itself is almost a mile deep—4900 feet, to be exact. Waste fluids from the plant are forced down this well, to be absorbed by non-oil-bearing sands—far below the level of any surface water. Piping near ground level is in the form of concentric shells, and fresh water is delivered to the annular opening around the waste pipe. Furthermore, the water pressure is higher than that of the fluids in the waste section. In this way, any leakage in the pipe system causes fresh water to enter the surrounding sands (or the inside waste system) and prevents objectionable materials from reaching the sands at surface levels.

Other interesting procedures are used throughout Du Pont's many plants to guard against river pollution. For example, scientists were asked to make a complete marine-life census on one river before a plant was built nearby. The company wanted to be certain that no waste would be discharged which would challenge the natural pattern of marine life.

Throughout the Du Pont Company, wherever there is a need for the services of technical men, there are varied and interesting problems that present a challenge to engineering skill and imagination.

Now available for student ASME chapters and other college groups, a 16-mm. sound color movie—"Mechanical Engineering at Du Pont." For further information, send post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Bldg., Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Watch "Cavalcade of America" on Television

BACK IN '32

(*Continued from Page* 28)

Frederick told Prosecuting Attorner Franklin E. Reagan that he fired six shots when a group of engineering students attacked him and a companion as they were leaving a private home to enter a taxi cab. Frederick, who is also in the university hospital with a head wound, arranged to make a $1,000 bond on the concealed weapon charge.

Love emphatically denied today that any of the dozen engineers who captured Frederick after the shooting was armed, or that more than the six shots in the chamber of Frederick's revolver had been fired.

"We made our plans the night before to capture Frederick," Love said, "and it was specifically understood by all of our men that they were not to be armed with firearms, blackjacks, or any other weapon that would injure the men they wanted to catch. We all lived up to that. I know no shots were fired at Frederick, for Arthur Nienhueser of Jefferson City, my room mate, and I were so close to him all of the time that we would have been in the line of fire.

"I heard only five shots, but Nienhueser said there were six, and he is probably right, for I stopped chasing Frederick to pick up Frank Luckey and put him in our car to take him to the hospital."

Former State Senator Nick Cave, Frederick's attorney, today said, "From my investigation it appears purely a clear case of self defense on the part of Frederick. These other students were chasing him and shouting, 'Get him, get him.'

"He wasn't the only one doing any shooting. We have positive proof the engineers were doing some shooting, too."

Cave said the charge of carrying a concealed weapon was filed against the student at the lawyers request, to enable him to give bond and relieve the university hospital of being responsible to the state for Frederick. Frederick gave bond without being arraigned.

Cave appeared before Justice of the Peace W. H. Tandy for Frederick and entered a plea of not guilty to the charge of carrying a concealed weapon. A preliminary hearing was set for April 2.

Dean of the University Albert K. Heckel and the university disciplinary committee, launched an investigation today, although it was at a standstill tonight pending outcome of Luckey's wounds.

Dr. Walter Williams, president of the University declared in a statement that "college pranks are defensible when they degenerate the lawlessness."

"The incidents culminating in the tragic occurrence of last night are most regrettable," Dr. Williams said. "The university will not tolerate either as manifestations of college spirit or collegiate rivalry such actions on the part of its students. Those guilty of transgressing the laws of the university will be summarily dealt with."

Miss Butterfield was held captive nine hours Saturday night by Frederick and three fellow law students and was returned to the campus too late for her coronation as St. Pat's Queen.

Normalcy appeared to prevail on the campus today, with the University's 3800 students preparing to leave tomorrow noon for the Easter holidays.

Last night's fight was not the first between the two schools. The feud has been traditional at Missouri and in a number of other universities and colleges in the country, having similar schools.



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Another page for **YOUR BEARING NOTEBOOK**

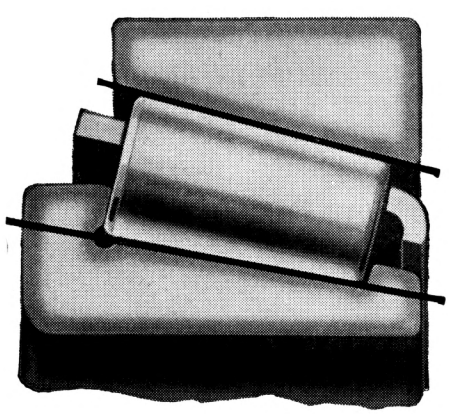


Jet's wheel bearings have to take three kinds of forces

When the F86-D Sabre Jet lands—the wheel bearings take a triple beating. There's the initial landing shock, an almost instantaneous acceleration; and, if there's a crosswind, heavy thrust loads. Bendix and North American solved this triple punch problem by using Timken® tapered roller bearings for all three landing wheels. Their tapered design enables them to take radial and thrust loads in any combination. And Timken bearings' true rolling motion and incredibly smooth surface finish practically eliminate friction permitting rapid acceleration.

Line contact helps TIMKEN® bearings take jet landing load

This cross-section drawing shows one reason Timken bearings are ideal for taking the heavy landing load of the plane itself. Note the full line of contact between rollers and races. This gives Timken bearings high load capacity. It's a basic advantage of roller bearings.



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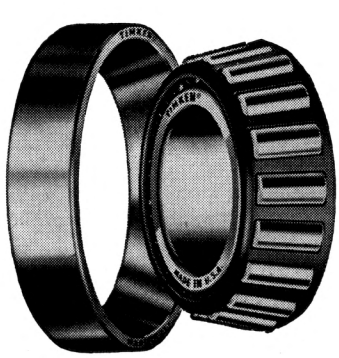
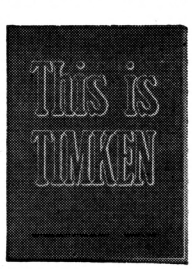
TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ◎ AND THRUST —◎— LOADS OR ANY COMBINATION ✳

To be successful, a product design must first be simple ...inexpensive to produce.

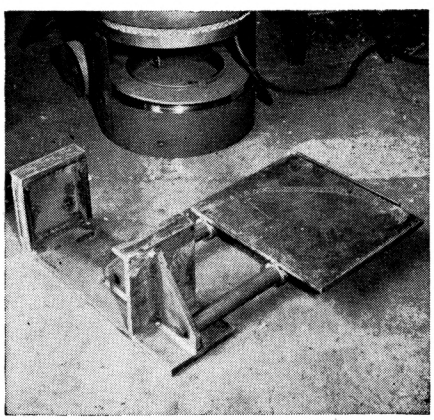
HOW TO ELIMINATE COSTLY OPERATIONS IN DESIGN

BEFORE any design is acceptable, methods and costs of production are carefully studied. Every needless expense in material and machinery is eliminated to meet price demands of competition.

By using steel instead of cast iron, substantial savings in material can be realized. Steel is three times stronger, 2½ times as rigid as iron. As a result, only one-half to one-third the amount of metal is needed with steel. Also, steel costs only one-third the price of iron, pound for pound.

In manufacture, welded steel components can be produced today at an average of 50% less cost. Production methods are simpler . . . fewer man-hours are involved with arc welding.

With welded steel construction, ultimate savings are limited only by the ingenuity of the designer. For this reason, every product engineer needs to keep in step with the rapid progress in low cost manufacturing with arc welding.



Motor Swing Base *is fabricated at low cost from tubing and steel plate. Welds are made with "hidden-arc" process in agglomerated flux, using Manual Lincolnweld.*

DESIGN AIDS FOR LOW COST

Principles of designing or converting existing products in welded steel are presented in Lincoln Weldesign Manual available at nominal cost for hours of study. Write for free design bulletins to

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

AROUND THE COLUMNS

(*Continued from Page 22*)

ing Holidays next Fall? Man if it gets so that we have to have a note pinned to our shirt saying we have been home all the time on the holiday, or we are supposed to get up at the obnoxious hour of 6:00 to get ready to go to class, why we might as well toss it in right then and there.

♣

Well, it won't be long until we bid farewell and cut home for three solid months of partying and living it up at various summer resorts, like FORT SILL, OKLA. and other feature garden spots around the U. S. It just won't seem the same not going to class from 8 to 5 and studying until 2 in the morning, every nite without fail. Until that sad moment when we blow our top with nothing to do, let's have a beer for old times. Have you joined that drinkin' club, Sure Happy Its Thursday?

♣

Until next month when we draw closer to those joyous finals, I'll say goodbye. Anyone interested in slightly used campaign handbill, please send $5.00 and autographed picture of Leon Trofsky to "You Bet Your Ass," o/o Shamrock Office Mizzou.

♣

OHM ON THE RANGE

OPUS 314—IN THREE PHASE TIME

Oh give me an ohm
Where the impedances roam
Where the fields are not fluxing all day,
Where you'll never see
A field without phi,
And the flux is not leaking away.
Ohm, ohm on the range,
Where the flux is not charging all day:
Where never is seen
A shunt field machine
With its armature running way.

♣

Papa loved Mama
Mama loved men
Mama's in the graveyard
Papa's in the pen

While searching through an old pack of someone's Stress notes, we ran across this lament, probably written by an engineering student's wife after he disappeared into the covers of "Timoshengo" and was heard of no more:

Verily I say unto you, marry not an Engineer, for the engineer is a strange being and possessed of many devils. Yea, he speaketh eternally in parables which he calleth "formulae;"

And he wieldeth a big stick, which he calleth "formulae," and he hath but one Bible, a Hudson's Manual.

He talketh always of stresses and strains, and without end on thermodynamics; and he picketh his seat by its springs alone and not by the damsel beside him.

Neither doth he know of a waterfall except for its horsepower—Nor a damsel except for her "live-load."

Always he carrieth his books with him and entertaineth his maiden with steam tables.

Yea he holdeth his damsel's hand but to measure the friction, and he kisses but to measure the viscosity.

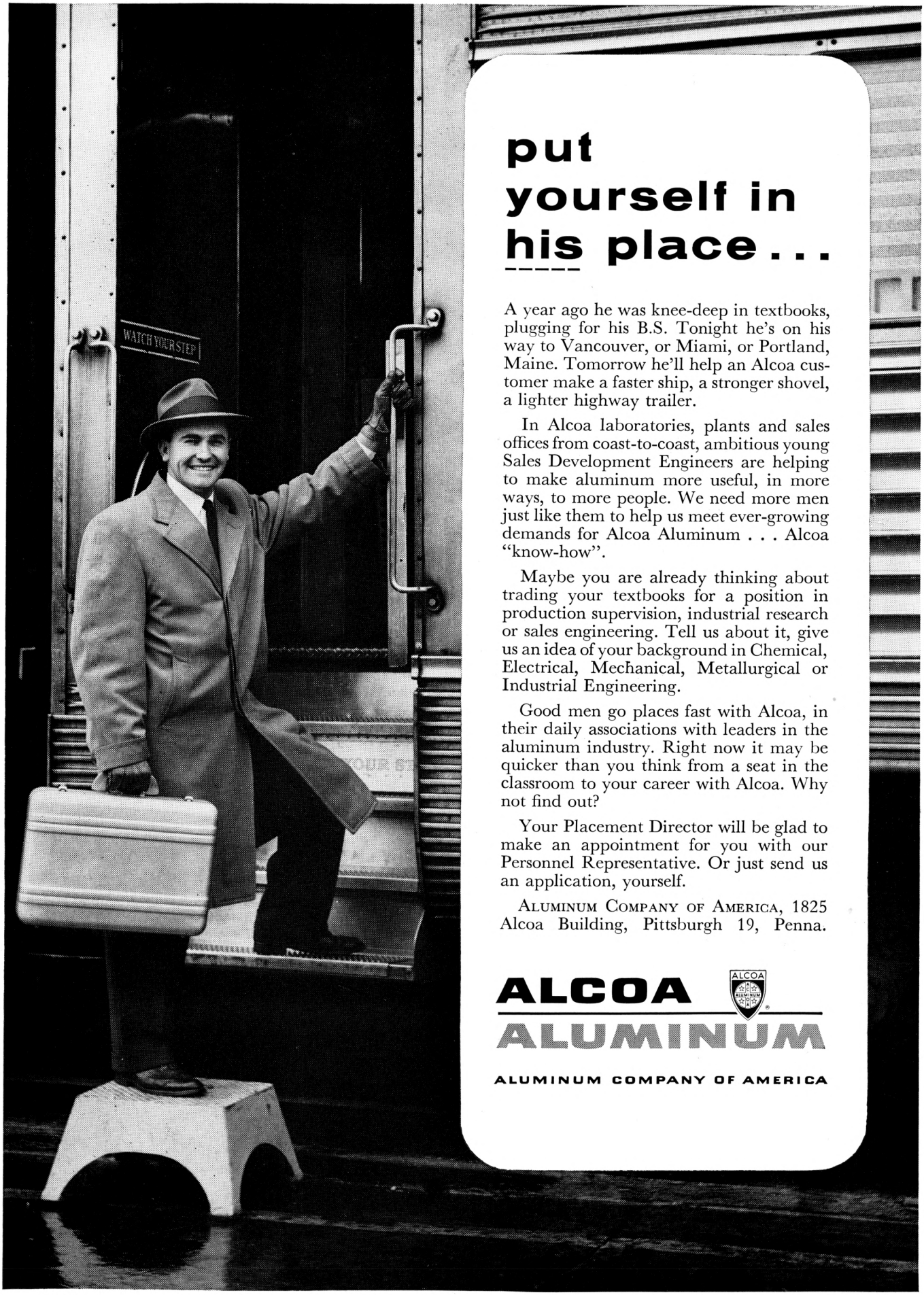
For in his eyes shineth a far away look that is neither love nor longing, but a vain attempt to remember the Module of Elasticity.

There is but one key to his heart and that is the key to his Stress Problems, and when he writeth of love to his maiden, mistake not his crosses for kisses for they are merely unknown quantities.

Even as a young boy he pulleth girls' hair to test elasticity, and later he would test the vibrations of her heart, and reckon her strength of materials.

For he seeketh ever to pursue his scientific investigation. Even his heart flutterings he describeth in a formula, and his marriage is a simultaneous equation involving two unknowns and yielding diverse results.

I once had a classmate named Jessar
Whose knowledge grew lesser and lesser.
It at last grew so small
He knew nothing at all
And now he's a Thermo Professor.



put yourself in his place...

A year ago he was knee-deep in textbooks, plugging for his B.S. Tonight he's on his way to Vancouver, or Miami, or Portland, Maine. Tomorrow he'll help an Alcoa customer make a faster ship, a stronger shovel, a lighter highway trailer.

In Alcoa laboratories, plants and sales offices from coast-to-coast, ambitious young Sales Development Engineers are helping to make aluminum more useful, in more ways, to more people. We need more men just like them to help us meet ever-growing demands for Alcoa Aluminum . . . Alcoa "know-how".

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SHAMROCK

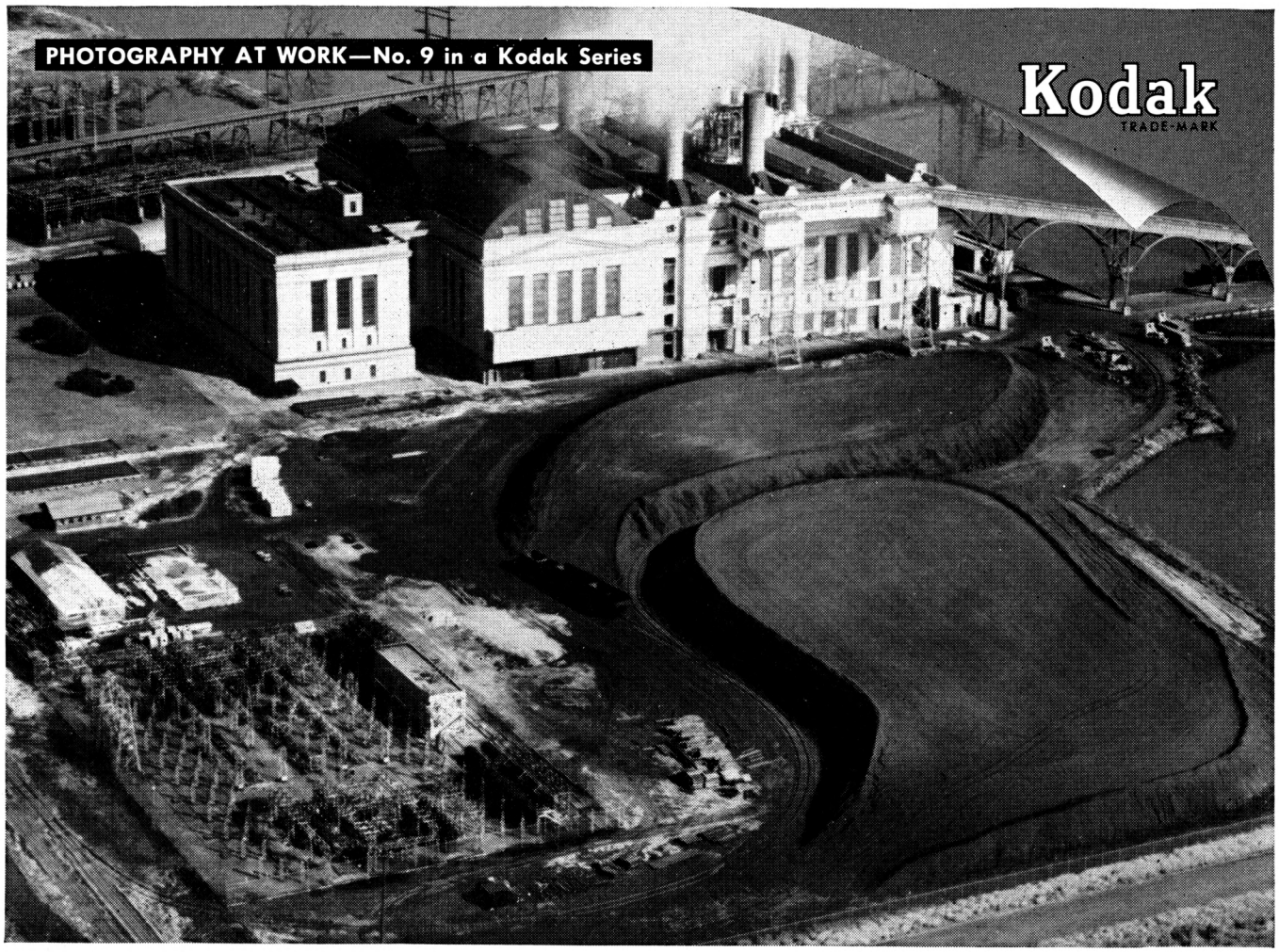


SEZ

ECHOES OF ENGINE WEEK are still sounding. With a student awaiting prosecution at the hands of law; with University bringing charges against Engine Club, with threats to individual students hanging in the air, and with blundering editorials in the Missouri Student not yet forgotten, should we review these days? So let's ask what really happened, and why . . . are the present-day students really gangsters and hoods, like the Student said? No, definitely no. Ol' SHAMROCK has a theory, and whether right or wrong, it deserves consideration. Going back to the days of 1903, when St. Pat's Week was founded—what was the main driving force that sent all the students out as an organized group, to parade, to build floats, to make campus stunts that really stunned people? Ol' SHAMROCK thinks it happened because nobody told these students what to do, but that their pioneering spirit made the idea work. With time, however, most of these functions lost the student initiative, came under the supervision and finally control of the dean, until finally everything done had to be approved by the dean and the faculty. The students still had the initiative, but in some things even that was lost—lost to tradition. In order to save some work, the same programs and schedule of events were used by the succeeding St. Pat's Boards. Once in a while a bright idea cropped up, and made its impression on people, but more students came to look upon St. Pat's Week as a time to cut classes and have parties. This year it went pretty far. Not anything new happened: headshavings and ag-pond baths, as well as kidnap-attempts are as old as the University, not to mention the paint-war. But the fierceness of it all showed clearly that some students tried to break away from the drab tradition and find outlet in something new, something that involved initiative and no outside control. Is there then need for such activity, and is St. Pat's Week really getting drab? The tendency for that is present. Some M.E. was denouncing the order not to have a steam-whistle on top of Engine School during St. Pat's Week. Investigations about the Hamburg Show may render it completely unattractive for future years. Steam- and air-jets used in the labs to startle girls are now prohibited. The beard-growing contest time was shortened. The article in the Missouri Student was denouncing the administration for not acting properly upon these misdemeanors, as they called. Maybe they had a point there, except that the fault of the administration would lie in curbing initiative, by limiting even the tradition that may be getting too old. At any rate, the next year's St. Pat's Board is faced with a problem bigger than ever: should there be any drastic changes in St. Pat's Week? Should the administration be told that this is primarily a student affair? Or what would happen if the present trend continued?



YE ED



Richmond Station of the Philadelphia Electric Co.

Weeks of work shrink to days as

photography weighs mountains of coal

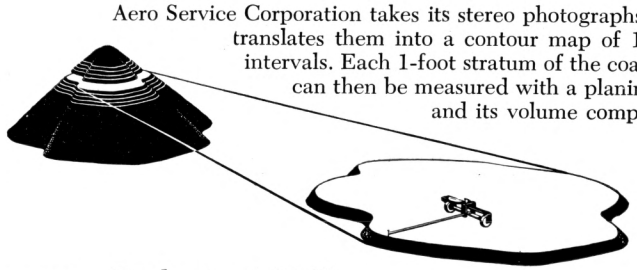
Aero Service Corporation takes stereo pictures of the coal piles at a utility's 10 storage sites—reports the fuel reserves on a single inventory date at 25% lower cost than with other methods

It used to take a surveying crew weeks to measure and figure the contents of the Philadelphia Electric Co.'s big coal piles. Now a camera and an airplane work together to cut the time to days. Overlapping pictures are taken from the air. Then with stereo plotting equipment the volume of the heap is calculated.

Streamlining the inventory job is a natural for photography. It's being used to count metal rods, automotive parts, telephone calls as well as tons of coal. But photography works for business in many other ways as well —saving time, reducing error, cutting costs, improving production.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Aero Service Corporation takes its stereo photographs and translates them into a contour map of 1-foot intervals. Each 1-foot stratum of the coal pile can then be measured with a planimeter and its volume computed.



Eastman Kodak Company, Rochester 4, N. Y.

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Opening the doors to challenging careers—as SALES ENGINEERS—APPLICATION ENGINEERS—PRODUCT SPECIALISTS—G.E.'s Sales Engineering Program is an invitation to success to all young engineers who want to combine engineering know-how with contact work . . . who want a career that is varied, challenging . . . who want long-range advancement opportunities limited only by individual performance.

ON-THE-JOB EXPERIENCE . . . provides you with outstanding training in industry sales techniques, market characteristics, sales plans and policies, product engineering work, industry engineering.

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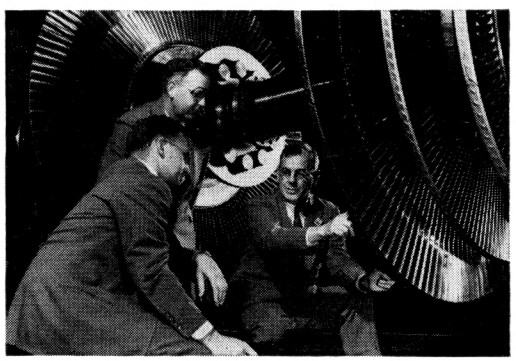
INTEGRATED CLASSWORK COURSES . . . are designed to give you information for good daily job performance and a sound background for positions of greater responsibility. Courses in sales methods, apparatus marketing, business fundamentals, etc., supplement your on-the-job experience and provide excellent advancement opportunities.

COMPLETING THE PROGRAM . . . means you may go to one of G.E.'s many Districts—with sales offices in 152 key cities in 45 states. Or you may prefer assignment to a headquarters operation. Regardless of your choice, you will be working with some of the most competent men in industry in an interesting, fast-moving career—and you will be building your career with the leader of the fastest growing industry in America!



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As a specialty salesman you'll have a chance to work with young companies, to help them grow to be leaders in their field.



On-the-job training in design or commercial sections gives excellent opportunity to learn engineering, application, marketing of G.E. apparatus products.

For more information see your college placement officer or write:
College Editor
Dept. 2-123
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GENERAL ELECTRIC

MISSOURI SHAMROCK

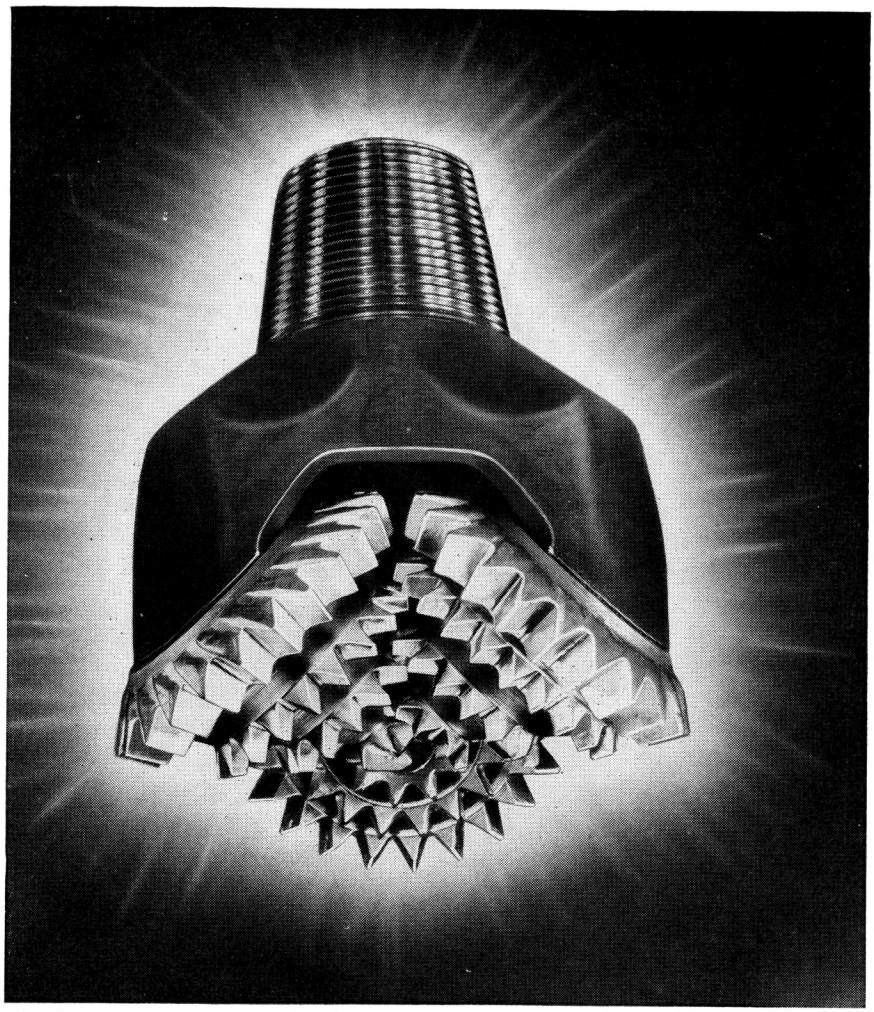


May, 1954

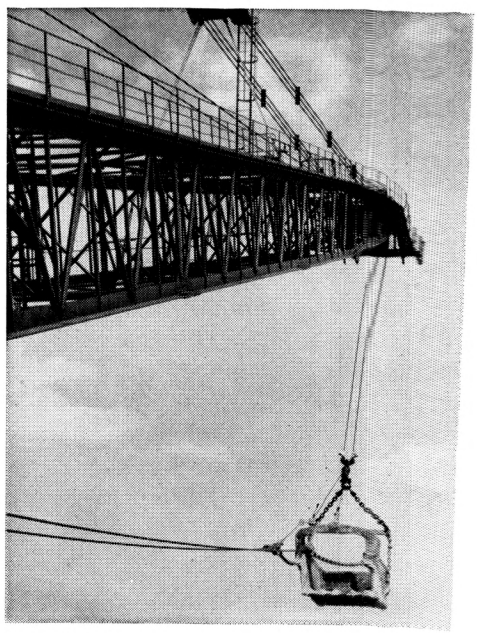
25c

Features: The Telephone Dial
The Automatic Antenna Control

Only STEEL can do so many jobs so well



They Chew Their Way to Wealth. These teeth are capable of chewing through earth, sand and rock for thousands of feet until they reach Nature's buried treasures of gas and oil. Rock bits like this need super-strength, amazing toughness, high resistance to impact, abrasion, and shock. So, many of them are made from USS Alloy Steels. And United States Steel also provides many other essentials for oil drilling, such as wire lines, drill pipe, cement, drilling rigs.



Scoop! And a big one, too . . . it can scoop out 21.5 cubic yards of earth per minute, has a boom 215 feet long! The drag lines, boom support cables and hoisting ropes on a behemoth like this must have great strength, durability, flexibility, fatigue resistance. Tiger Brand Wire Ropes, made by U.S. Steel, meet all requirements.

OPPORTUNITIES WITH U. S. STEEL

If you're thinking about what you're going to do after graduation . . . if you're interested in a challenging, rewarding position with a progressive company . . . then it will pay you to look into the opportunities with United States Steel. Your placement director can give you more details, or we'll be glad to send you the informative booklet, "Paths of Opportunity." United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.



A Man Needs a Cookie once in a while! And when cookies are kept in a tight cookie tin like this, they'll be fresh and appetizing for him. The can is steel, of course . . . made out of the same USS Tin Plate that is produced by U.S. Steel to make millions of "tin" cans every year for the protection of food, oil, paint and countless other things.

For further information on any product mentioned in this advertisement, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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UNITED STATES STEEL

This trade-mark is your guide to quality steel

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
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UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 4-890

NEEDED--- A NEW APPROACH !



HE HAD ONE

LAMAR A. RAMOS, JR.,
Sr. Design Engineer—Airplane Engineering Division
B.S.P.E. Lousiana State U. 1941
B.S.A.E. Georgia Inst. of Technology 1947

Seen here examining the architect's sketch of our recently completed Wind Tunnel, Lamar's approach in solving complex and often unique aerodynamic problems has marked him as an engineering asset to M.A.C.

In 1947, he was first assigned to the XF-85 "Parasite" fighter, model of which he is holding above, and has since contributed his aerodynamic talents to most of our airplane engineering projects. He is presently a Group Leader concerned with the aerodynamic design of aircraft proposals. We need more young engineers like Lamar Ramos, *engineers with a new approach.*

VARIETY OF WORK is one important advantage of joining M.A.C.'s engineering team. The career opportunities in our three engineering divisions—AIRPLANE, HELICOPTER AND GUIDED MISSILE—are so varied that practically all types of engineers may be placed in a satisfying assignment, one charged with technological impact and challenge to ability. Every effort is made to place each engineering graduate in the division and assignment of his choice.

VARIETY OF LIVING in beautiful suburban St. Louis can also be yours. M.A.C. engineers are encouraged to seek advanced degrees at one of St. Louis' fine universities. The educational, cultural, medical and recreational facilities available in this city are unparalleled elsewhere.

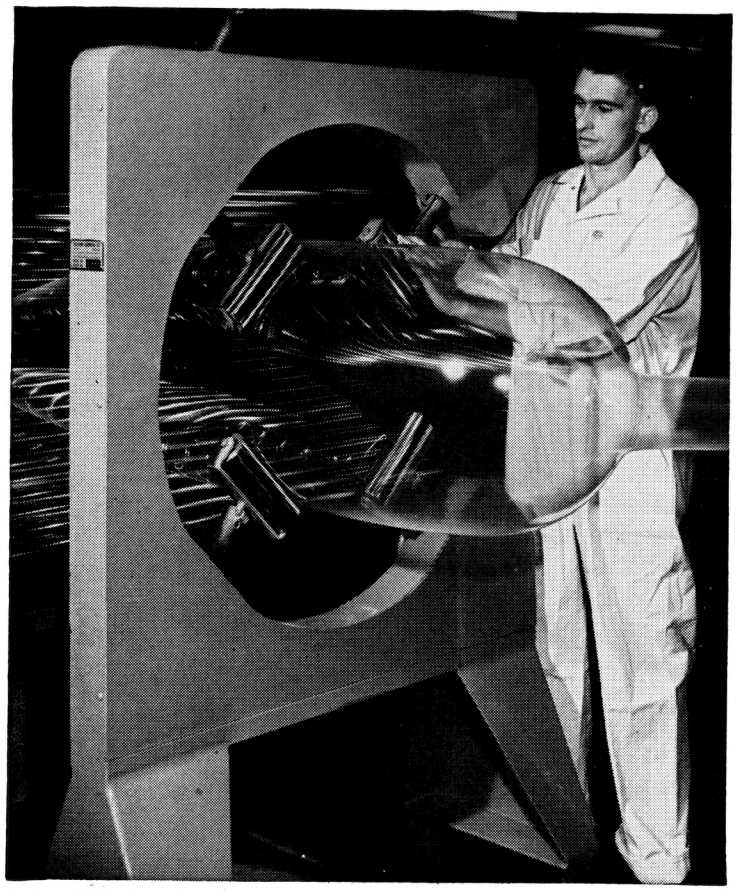
If you're looking for our type of engineering—we're looking for you. Check your Placement Office for dates when our representative will visit your school. Ask him about the McDONNELL GRADUATE STUDY PLAN. You may also write to:

TECHNICAL PLACEMENT SUPERVISOR
BOX 516, ST. LOUIS 3, MISSOURI

BUILD YOUR FUTURE WITH A COMPANY . . . . YOUNG IN YEARS, YOUNG IN SPIRIT AND IDEAS

McDONNELL Aircraft Corporation

Manufacturers of AIRPLANES AND HELICOPTERS ★ ST. LOUIS 3, MO.



One of the early steps in the production of Saran-Wrap—the "bubble" that becomes a film after being deflated in a series of rollers.



Colorful display bins are an important part of consumer sales strategy and explain the advantages of Saran-Wrap.

TAKING CHEMICALS TO MANY MARKETS...

Dow succeeds through the careful coordination of group effort in research, marketing and sales

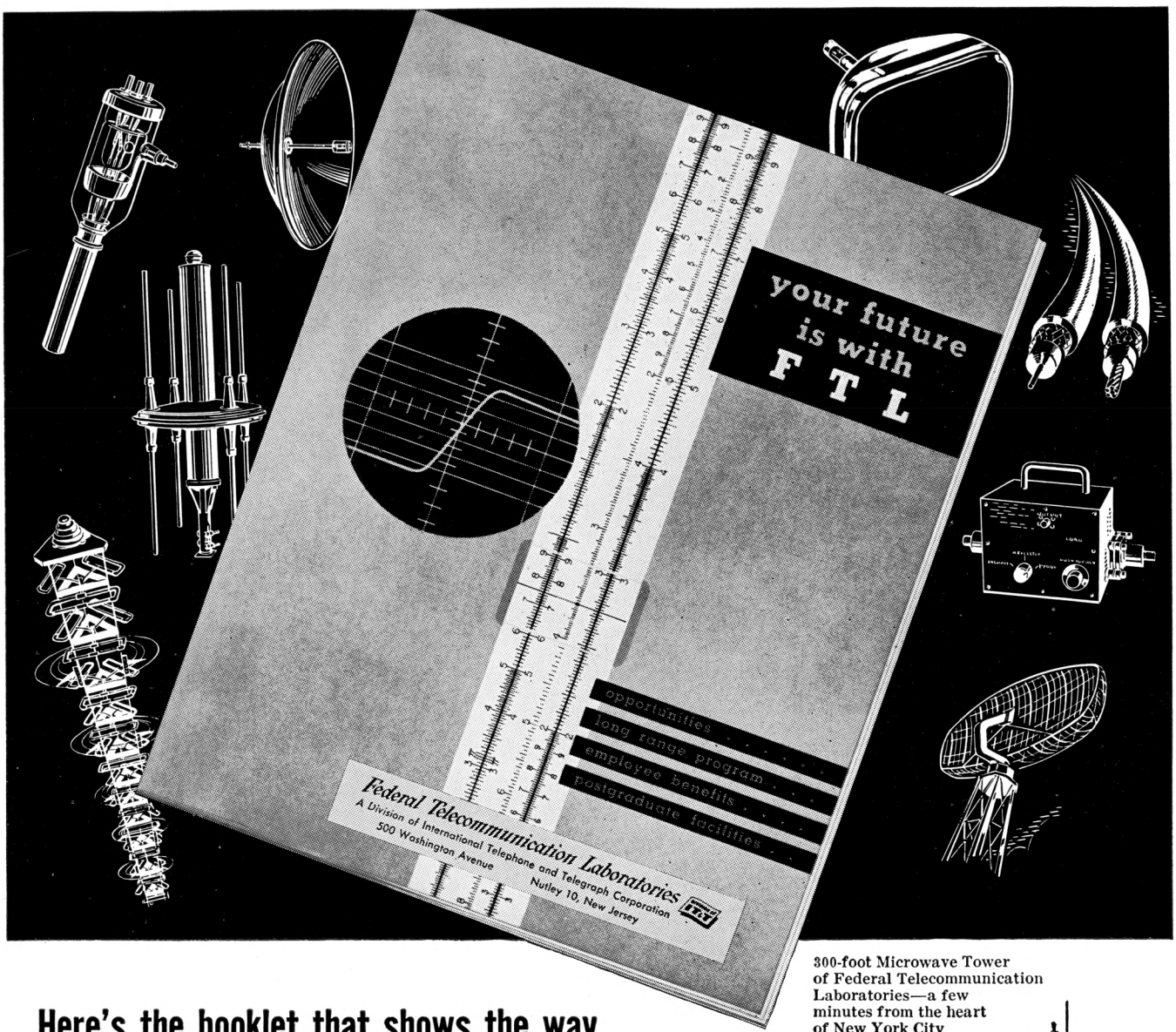
The high consumer acceptance gained by Saran-Wrap is a current example of what happens when extensive research and production planning is followed by coordinated marketing and sales strategy in launching a new product.

This amazing new plastic food wrap is certainly a useful product—but it is much more than that. For Dow it marks another milestone in a continuing effort to move into new fields of endeavor and to increase the variety as well as the size of its operation. Well-planned and executed projects, introducing varied industrial and consumer products, have been responsible for Dow's rapid growth to a position of prominence in the chemical industry.

Whether you choose research, production or sales, you can find a challenging career with Dow. Write to Dow's Technical Employment Department today for the booklet, "Opportunities with The Dow Chemical Company"—you'll find it interesting. ***THE DOW CHEMICAL COMPANY****, Midland, Michigan.*



you can depend on DOW CHEMICALS



300-foot Microwave Tower of Federal Telecommunication Laboratories—a few minutes from the heart of New York City

Here's the booklet that shows the way to successful careers in radio and electronics

"Your future is with FTL" could be the most important booklet you ever read! Briefly but comprehensively, it tells the story of Federal Telecommunication Laboratories . . . one of the nation's leaders in the development of radio and electronic equipments . . . one of the major units of the world-wide group of laboratories, factories and communication systems operated by the American-owned International Telephone and Telegraph Corporation.

To young engineers of ability and initiative "FTL" offers a fertile field for achievement, recognition and advancement . . . for a stable, productive future in long-range activities.

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PROGRESS AND SCIENCE GO HAND IN HAND

OUR recently published annual report to stockholders tells more than the financial story of the progress of Standard Oil and its subsidiary companies in 1953. Its facts and figures also reflect the achievements of engineers and chemists.

For example, the report points out that:

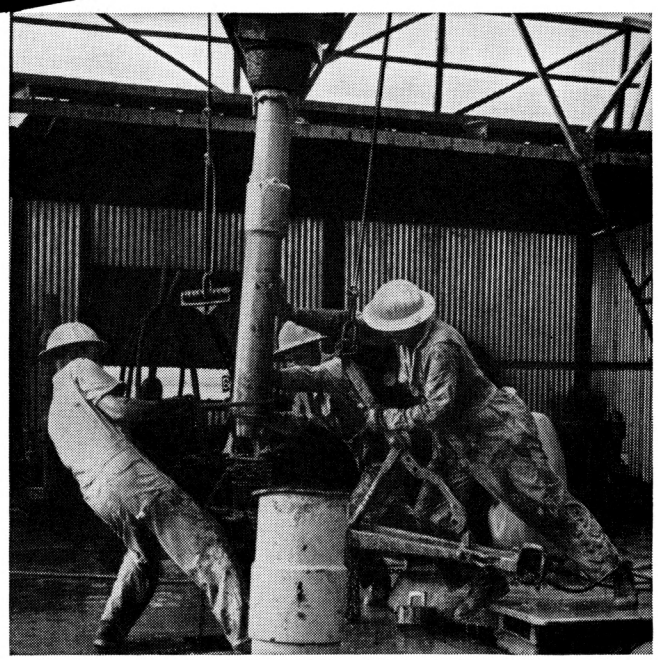
More new and improved products were introduced by our company last year than in any other year since World War II.

Our scientists developed the Ultraforming process, a new and better catalytic reforming method for improving the quality of the straight-run portions of gasoline.

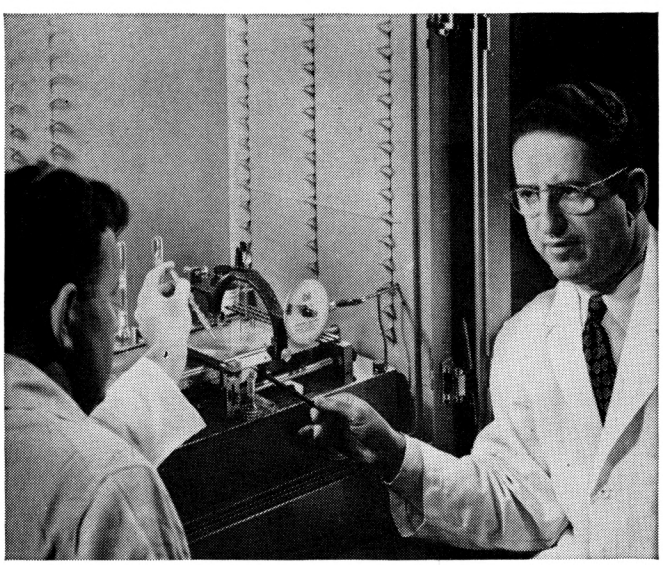
Three new research laboratories were completed.

More than $200 million was invested last year in new and improved facilities. (This year and next we expect to invest a total of about half a billion dollars.)

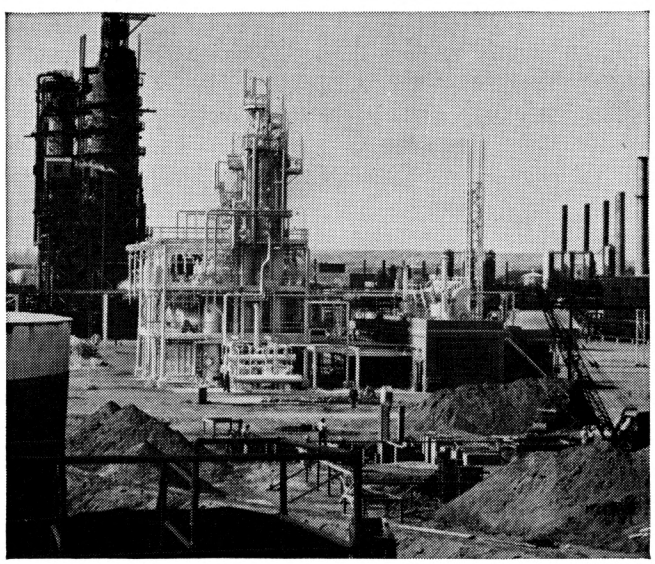
This continuing program of physical expansion and product development at Standard Oil provides many opportunities for engineers and chemists. Men with technical and scientific training have found great personal and professional satisfaction in our steady industrial advance.



Nearly a quarter of a billion dollars will be invested during 1954 and 1955 in development of new crude oil production and reserves.



Basic research on lubrication is one of the many activities at Standard Oil's extensive Whiting laboratories.



Almost a billion and a half dollars has been invested in expansion and improvement of facilities since 1945.

Standard Oil Company

910 South Michigan Avenue,
Chicago 80, Illinois

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ON THE COVER

Construction is always going on around the campus. The newest, and most remote from the Quadrangle is the new Medical Building going up on Stadium Road. Shown on the cover is some of the first steel work that has been set up. Frank took a nice photo, don't you think?

Photo by Frank Frier

MISSOURI SHAMROCK

VOL. XV NO. 8

MAY, 1954

♣

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MEMBER
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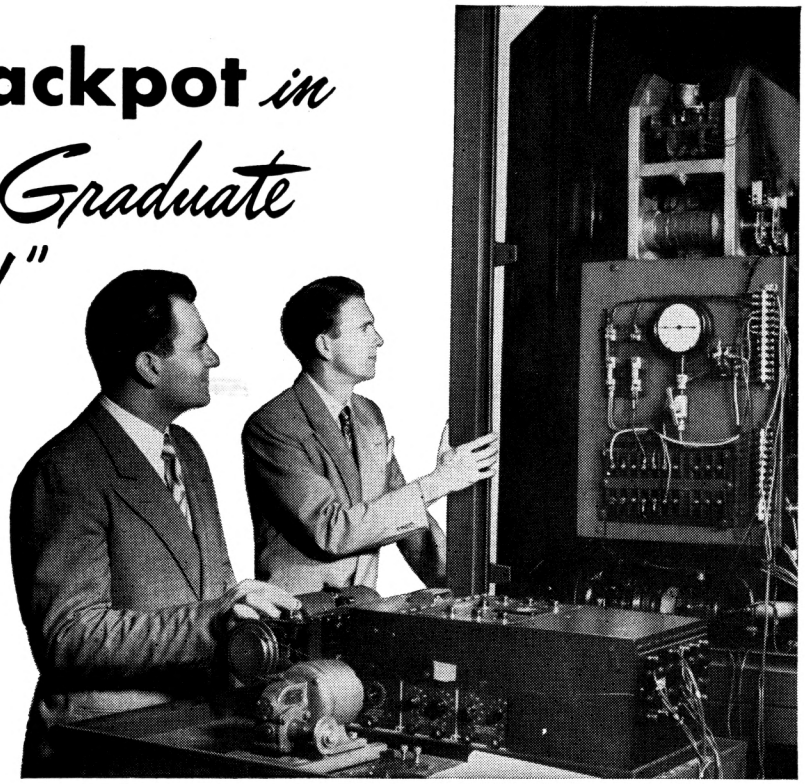
"We Hit the Jackpot *in* Allis-Chalmers Graduate Training Course!"



say N. W. MORELLI

Oregon State College, B.S.,M.E.—1950

and

E. R. PERRY

Texas A. & M., B.S.,E.E.—1950

WHILE taking the course, two engineers developed a revolutionary new circuit breaker mechanism.

"Our experience shows what *can* happen if you work with people open to suggestion. We found men of this kind at Allis-Chalmers, and it has given us a special pleasure in our job.

"We started out like most other graduates with a hazy idea of what we wanted to do. After working in several departments, we requested that part of our training be at the Boston Works of Allis-Chalmers, where circuit breakers are made."

New Design Principle

"Circuit breakers soon became an obsession with us, and we got the idea of designing a hydraulic operator and triggering mechanism for these breakers. Most operators for big breakers are pneumatic.

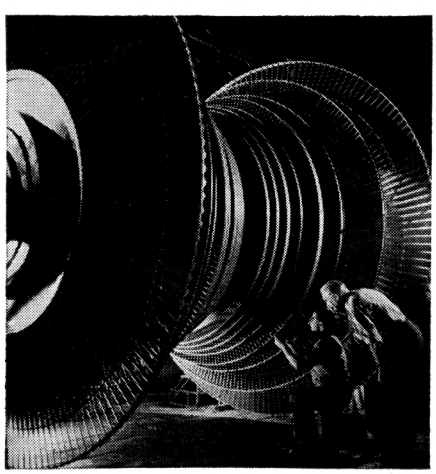
"Unsuccessful attempts had been made in the past by all circuit breaker manufacturers to build hydraulic operators. The important thing is that no one at Allis-Chalmers said, 'Don't try it—it won't work.' "

Start New Era

"To make a long story short, our study of the problem led us to the hydraulic accumulator and high speed valves being used by the aircraft industry. These had not been available when earlier attempts were made to build a hydraulic operator. With these highly developed devices to work with, we were able to build an operator that combined the best features of pneumatic and hydraulic operation. We call it the *Pneu-draulic* operator. Engineers are saying it starts a new era in circuit breaker actuation.

"This fact is important to us, but it is even more important to know that Allis-Chalmers Graduate Training Course is full of opportunity . . . and as we found out, there's opportunity right from the start."

Pneu-draulic is an Allis-Chalmers Trademark.



Low-pressure spindle for a 120,000 kw steam turbine generator. Said to be one of the largest ever built in the United States, this spindle is nearing completion in the Allis-Chalmers West Allis shops.

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

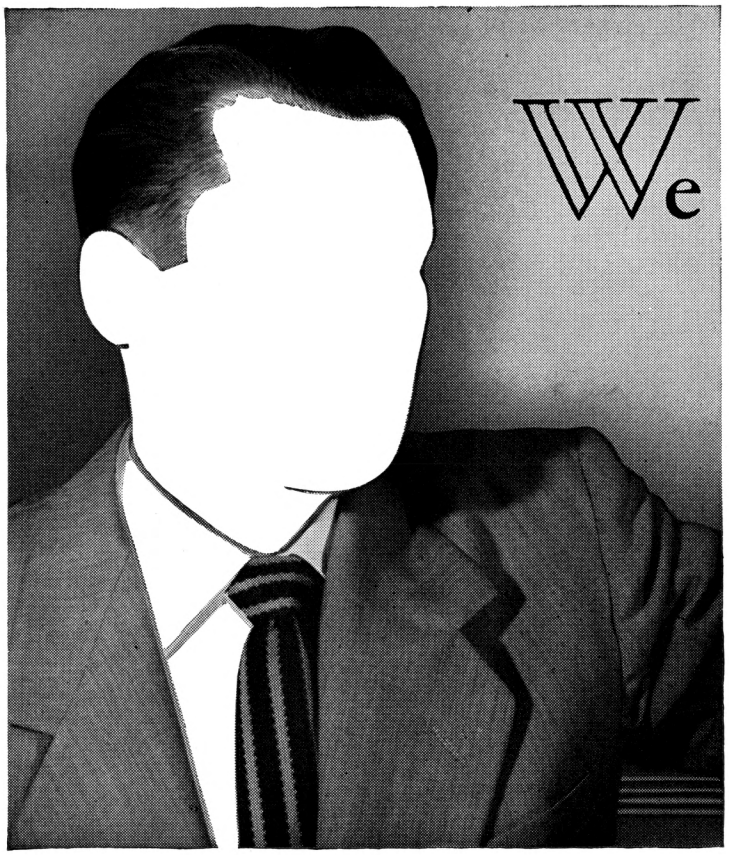
5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

C-5675



We are looking for men who can GROW

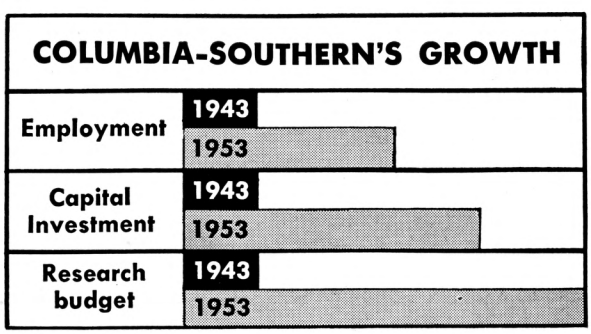
To a young man looking for opportunities, perhaps the most important fact about a company is its rate of growth, present and prospective. In a company which has become static, advancement is largely dependent on vacancies occurring through death or retirement. In a *growing* company, new openings for able men are being created constantly, and advancement is restricted only by ability.

Since 1925 the chemical industry has grown at an average rate of about 10% a year, compared to 3% for all industry. Future growth, at a more rapid rate than the rest of industry, is predicted by authoritative studies.

Columbia-Southern is growing not only in response to increasing demand for its present products, but also as a result of the steady development of new products. The company's management firmly believes in the importance of research and development and has given evidence of that belief by expanding research facilities and increasing research and development budgets.

Columbia-Southern's growth is an open-end process; as goals are reached, new goals are set. Even now new products and processes are in every stage of evolution, from nebulous ideas in the minds of research chemists to pilot plant operations and production plant designs. That's why Columbia-Southern needs men who can grow with it.

For further information, write now, Dept. P at our Pittsburgh address or any of the plants.



COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
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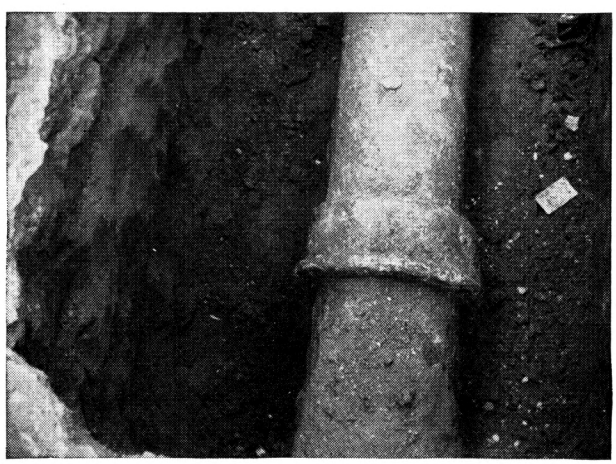
Ball-and-socket joint cast iron pipe for water main crossing river at Newark, Ohio.

Where installations are planned for long-term service to assure low cost per service year, engineers rely on cast iron pipe as a dependable and adaptable material. Consequently, it is specified for a wide variety of applications, both utility and industrial, including water supply, sewerage, fire protection, process industries and many forms of special construction. Long life and low maintenance cost are *proved* results of the high beam-strength, compressive-strength, shock-strength and effective resistance to corrosion of cast iron pipe. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.



Cast iron water main still functioning in Philadelphia after 135 years of service.

CAST IRON PIPE SERVES FOR CENTURIES



Ever Study

TERRESTRIAL ENGINEERING?

Probably not. As far as we know, there isn't such a term. Even so, the terrain of a manufacturing plant may have a vital effect on the design and location of its engineering equipment.

It certainly did in the case of our Belle, West Virginia, plant, which is just across the road from a flat-topped hill, 750 feet high.

Perhaps you'd like to match wits with Du Pont engineers, for we feel that this problem was interesting—and its solution ingenious.

Briefly, the situation was this: Carbon dioxide was to be removed from a mixture of gases by bringing them into contact with water in "scrubbers" operating at 450 psi (gauge). The inlet gases contained about 25% CO_2 by volume. Because of its greater solubility, most of the CO_2 would leave the scrubbers dissolved in the water.

It was necessary to reduce the pressure of this water to atmospheric and recover the dissolved carbon dioxide, since CO_2 was needed for use in a chemical synthesis. The degasified water then had to be pumped back into the pressure scrubbers, to repeat the scrubbing cycle.

Still like to match wits? How would you design an economical closed system for this scrubbing water? After you've thought out your solution, you might like to compare it with the one given below.

Du Pont engineers made use of the precipitous terrain in this way: pressure on the water leaving the scrubbers was sufficient to force it up to the top of the hill for CO_2 recovery. The returning water thereby provided a pressure of approximately 325 psi (750 feet of head) at the base of the hill. This gift of pressure on the suction side of the water pumps resulted in considerable energy saving.

Do unusual problems such as this one challenge you and stir your enthusiasm? If they do, we think you'll be interested in technical work with the Du Pont Company.

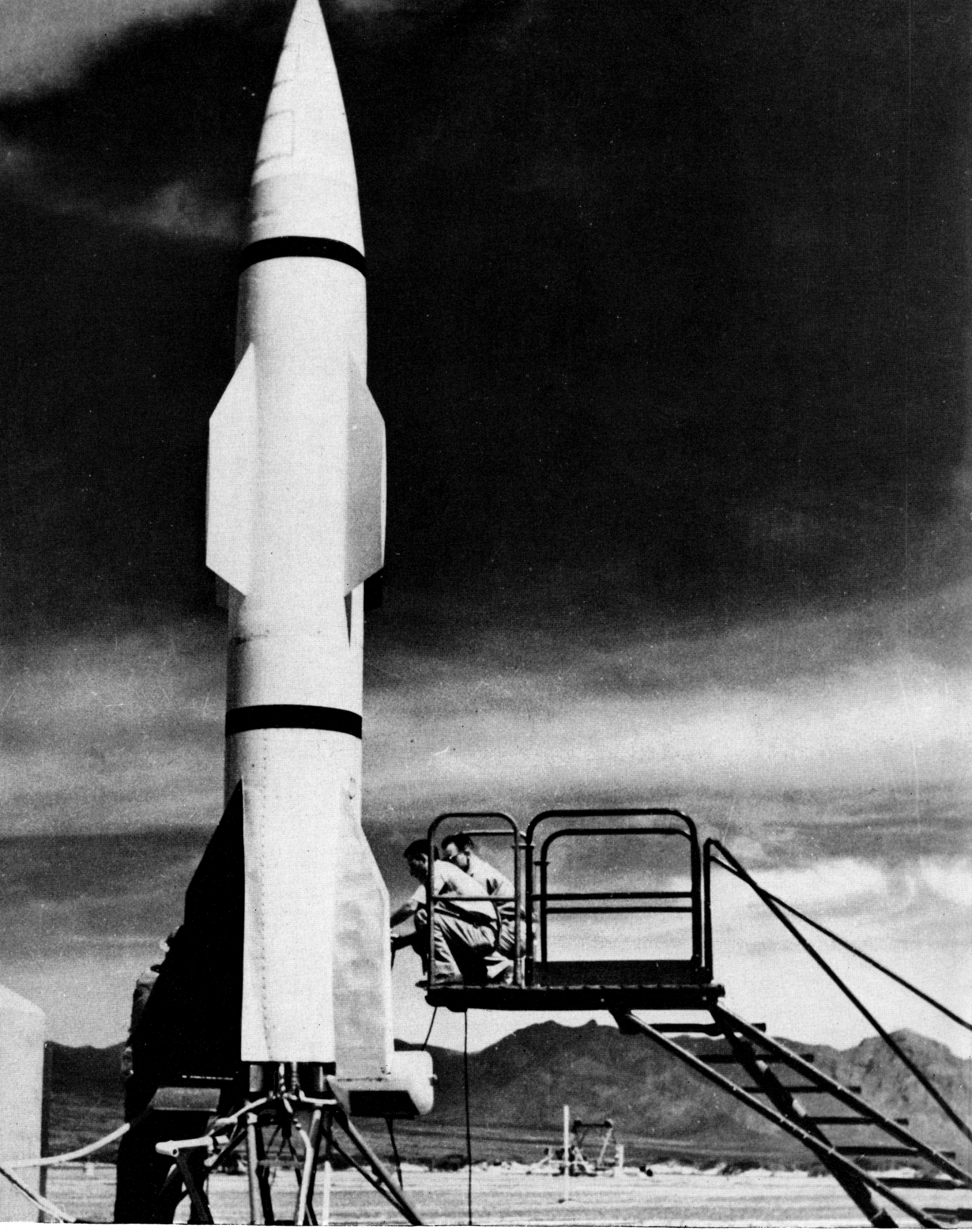
Watch "Cavalcade of America" on television

DU PONT

REG. U. S. PAT. OFF.

E. I. du Pont de Nemours & Company (Inc.)

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



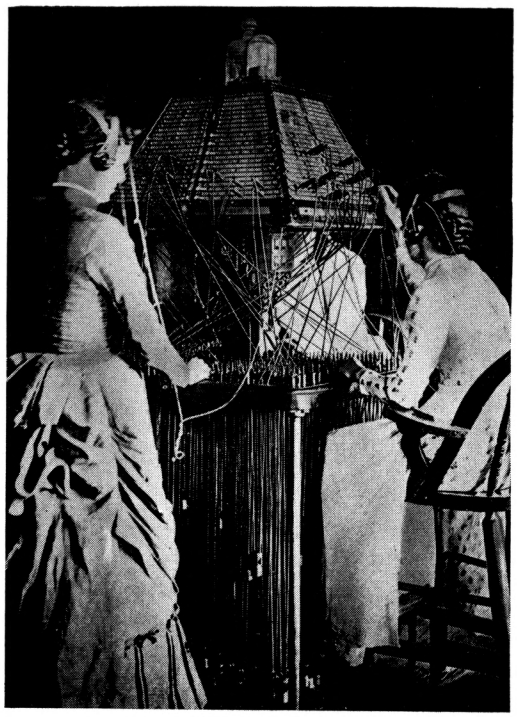
Frontis: An Army Ordnance test rocket being prepared for flight. Photo courtesy of General Electric.

Re-Hash . . .

The last issue is ready to be put to bed, and part of the staff is ready to be put to bed, studies, and bars. We have had tough going once in a while. We have had to round up some articles at the last minute, draw some line drawings while the paste-up waited, and steal a few pictures of trains, trucks, trolleys, and toys. In the long run, though, we have tried to pull together, and pull at the same time; we have sweated and chewed each other out; but we had fun. The experience we gained, both in managerial and journalistic work was invaluable. We know now how the printer feels when we bring in late copy, or when a page already made up has to be changed. We know how a lot of people feel about us. The advertiser who feels sometime that he is not getting his money's worth, the printer who feels that we are a pain in the neck, and some students who don't know where the SHAMROCK comes from. The editorials haven't been the most inspiring in the world; it's raining in Missouri at least (March); we had no trouble with the aggies during Farmer's Fair (April); we elected a darn good Editor (January); this year's Editor is taking a job outside the State (February); he has gone off half-cocked, half-baked, and hard-boiled. The whole year was worth something that cannot be defined completely, it can only be talked about.

DBA

THE TELEPHONE DIAL



Across The Nation With A Flick Of The Finger

By R. C. SANFORD, E.E. '53
Publications Department
Bell Telephone Laboratories

In ancient days, the magician was respected by everyone. Reviled by some, feared by many, he was respected by all. Today, magic has become passe; when we have the atomic bomb, who needs magic?

Yet, the tremendous strides in telephone switching make of the switching art a veritable magician. Little known and seldom appreciated, modern telephone switching systems are the Jinn of today's communications. A telephone customer in Englewood, New Jersey, for example, can dial directly to another customer in San Francisco, and be connected in seconds—without the intervention of any operator! They are, in effect, giant electro-mechanical brains; from telephone switching theory have come the electrical computers that ease the work of today's scientists.

Like most modern wonders, these automatic switching systems had humble beginnings. Shortly after Alexander Graham Bell summoned his assistant Watson from another room, using only wires and simple electrical equipment, telephone offices came into being. It was immediately realized that automatic switching would be a great advantage, and several men worked on the problem. Almon B. Strowger came up with the first practical answer—the Strowger switch—and the dial telephone system was born.

This first system, based on the functions of the Strowger switch, was called *step-by-step*. The switch could move in two directions, providing access to many contacts and permitting the introduction of "hunting" features. As a customer sent a series of pulses representing a digit—from a key until the dial was invented—the switch would "step" upward from one level of contacts to another. When the next series of pulses reached the switch, it would "step" around horizontally until the proper contact was found. This "two-way" motion is used in modern step-by-step offices in *connectors*. These switches handle the last two digits of a telephone number, completing the final connection to the called customer.

Another version of the step-by-step switch is called a *selector*. This is used for each of the other digits of a telephone number. It operates vertically from incoming pulses, just as does the connector, but it doesn't wait for another series of pulses—it starts "hunting" for another idle selector or an idle connector! Each level of contacts gives access to many selectors or connectors, and the selector switch automatically "steps" around until it finds one not in use. Just suppose for a moment that you dial 5831. In a modern system, a *line switch* hunts for an idle selector as soon as you pick up the receiver, before you dial. The digit 5 steps the first selector up to its fifth level, and it hunts horizontally for an idle second selector. The next digit—8—steps this second selector to the eighth level and around to an idle connector. The connector goes to its third level when you dial 3, and around to the final connection with the customer when you dial 1. You tell the switch what to do, and it follows your instructions.

Many improvements have been made in step-by-step switches and equipment, and the system is in widespread use throughout the United States. However, it offers some

disadvantages, and Bell System engineers quickly realized that some other system might better serve the purpose. They came up with the "panel" system.

Panel equipment gets its name from the arrangement of flat strips in wide "panels", rather than in narrow bays. Instead of the vertical and horizontal motion of the Strowger switches, panel switches move only vertically. They have, however, lost none of the functions or flexibility of the earlier switches—indeed, they offer greater flexibility! Two very important concepts in telephone switching also made their appearance in the panel system—storage and translation.

In the design of the panel system, it was found desirable to use non-decimal switches. That is, connections on the switches, and the switches themselves, were arranged in convenient groups on a non-decimal basis. Obviously, to get from the decimal series of dial pulses to the non-decimal connections on the switches, some form of translation was necessary. This function was included in a *decoder-translator,* using relays for the translation.

At the same time, the office on the other end of the line might be step-by-step, and *need* the dial pulses in the original decimal form. Another device, called a *sender,* also used relays to "store" the incoming dial-pulses and "send" them out again after the connection was made. Senders controlled the panel switches in their own office, and sent out decimal or non-decimal pulses as required by the next office. This combination of translation and storage is the basis of most modern automatic telephone switching systems and modern computers.

The next advance in the switching art was the invention of the *crossbar switch.* This is a mechanical combination of switches and relays into a single unit, whereby an incoming line may be connected to any one of several outgoing lines as in the Strowger switch. The big difference is that the outgoing line is *chosen* by other circuit units, rather than being chosen by the switch itself. A step-by-step switch can only hunt until it finds an idle line and then stop after making the connection. A crossbar switch can have its outgoing line chosen, tested, *held out of the circuit,* and then connected, by other equipment. Furthermore, the mechanical design is such that only a portion of the switch is used for each call, and it may handle several individual calls at one time!

To provide the necessary "choice" for the crossbar switch, the "brain" functions of translation and storage were called into use and improved in new decoders and senders. Another circuit unit, called a *marker,* was designed to test the outgoing lines to see if they were busy, and to actuate the crossbar switches. In modern dial telephone offices, such as #5 crossbar, the storage function has been given to relay *registers.* All these circuit

(*Continued on Page* 24)



The modern telephone plant where relays replaced the "Number Please . . ."

An Automatic Antenna Control

Ken Walton EE '55

TABLE OF SYMBOLS

$Cg_1 = Cg_2$ = condensers in grid circuit of V_1 and V_2

Cg = Representation of grid condenser in simplified circuit

Ep = Plage voltage

Ecg = bias voltage produced across Cg

Ein = Voltage produced across the secondary of T as a result of the error voltage

Eg = Voltage at which the thyratrons conduct. Wide variation of values as shown in Figure II.

i = Current through either V_1 or V_2

f = Frequency of AC input

Pm Motor = High impedance motor designed for plate circuit use.

R = Resistor used to supply necessary bias voltage

$Rg_1 = Rg_2$ = Resistor in grid circuit to provide necessary phase shift and leakage

Rg = Representation of Rg_1 and Rg_2 in simplified circuits

RgL = To limit grid current in V_1 and V_2

RT = DC resistance of transformer secondary

Rt = Rg + Rt + R = Rg

RT + R << Rg

O = Angle of lead produced by Rg and Cg

$V_1 + V_2$ = 2D21's Ec = 6.3

iF = .6 amps max.

average current .1 amp.

min. load resistance 1200

In the installation of the UHF type of television receiver a special directional antenna is required. These antennas, because of their directional characteristics have need of a rotative mechanism of some kind.

The conventional rotors are of a manual type. These require manipulation of a left-right directional switch to rotate the antenna to the required direction. These rotors also have some type of a bearing indicator that usually is in the form of a meter which indicates antenna orientation.

Having to use a manual switch for setting antenna position when changing a station and waiting for the antenna to swing around in the proper direction presents an inconvenience which can be eliminated by the use of an automatic control. A control of this nature does not need to be an automatic direction finder since the receiver and transmitter remain in a fixed position. This suggests a positioning servo with a multi-position switch which would have a position for each channel.

The usual form of servo system requires large amplifiers and attendant power supplies, as well as special types of transducers (selyns) and directional motors. With the above requirements in mind, a system was designed, as shown in Figure Ia, which

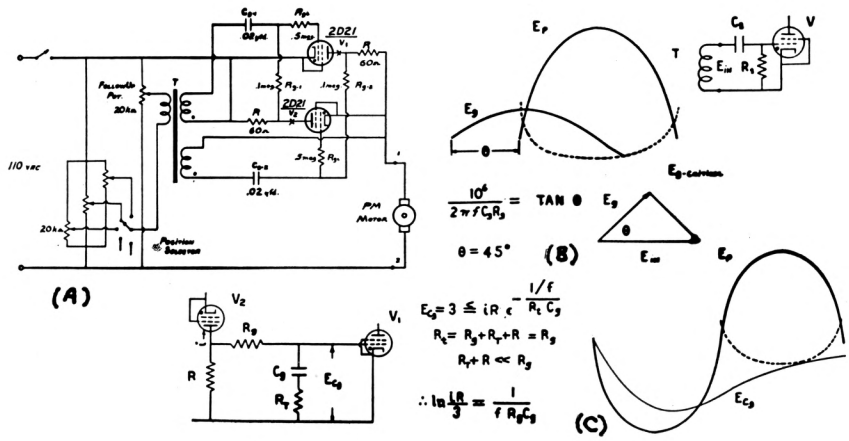


Fig. 1

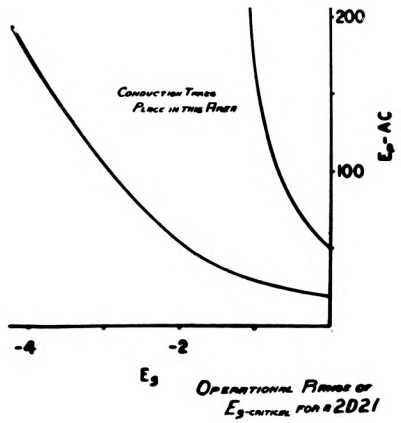


Fig. II

eliminated the complicated amplifier and its power supply.

The positioning servo system to be described in this paper is simple in operation and construction and required but few of the special parts needed with the more complicated systems.

The basic principle behind the operation of the circuit as shown in the diagram, Figure I, is the selection of either the positive or negative half of the input sine wave. By keying the thyratrons, which are used as grid controlled rectifiers, with a properly phased sine wave a half wave positive or negative signal can be produced for the control of a permanent magnet motor. When either of the thyratron's grid potential is in phase with its plate that thyratron will conduct and produce its half of the sine wave at the output terminals. This phasing is accomplished by use of a bridge consisting of two potentiometers with the transformer primary between the sliders.

There were two faults in the basic circuit when tested.

1. Lack of accurate control and low sensitivity.

2. The output to the load was an AC signal due to both tubes conducting, when there was a zero error voltage across the primary of T_1.

By proper selection of the values of Cg and Rg the phase of the grid voltage was made to lead the plate voltage. This phase shift increased both the sensitivity and accuracy. In Figure Ib the phase and vector diagrams, and simplified grid circuit are shown. Because of the nature of the thyratron's characteristic, the closer the intersection of the grid potential with the critical firing potential is to a right angle, the better and more positive is the control.

A grid potential of O volts, Figure II, is sufficient to cause the thyratrons (2D21's) to conduct, thus providing an alternating current to the load. There are three ways to eliminate this. All three are a variation of biasing the tube to keep it nonconducting. These methods are:

1. Use of batteries of bias supplies; requires some type of bias supply plus decreased sensitivity.

2. Placing of a sine wave on the grids of the proper phase which would produce the same effect as a DC bias. This also decreases sensitivity.

3. Method of obtaining negative bias from the opposite tube (V_2) and storing the voltage in a capacitor holding the grid of (V_1) negative for a short length of time.

The latter of the three methods was used.

How this biasing is accomplished is shown in Figure Ic. A negative voltage from the voltage drop across R_1 when V_2 is conducting is stored in the capacitor Cg and allowed to leak off through a resistance, composed of the transformer resistance, Rg, and R. In addition to providing the proper phase shift of the grid signal obtained from the control potentiometers the Rg and Cg should be adjusted to have a potential not less than three volts after a leakage time of one cycle. This enables the tube to again be ready to conduct on the next cycle if an error voltage is present. Another way of adjusting the value of Ecg is to change the value of R, which changes the potential on Cg. Cg and Rg serve a dual purpose, that of shifting the grid control voltage and also providing a bias voltage. This bias does not affect the sensitivity of the unit like the other types of bias would since the bias voltage is

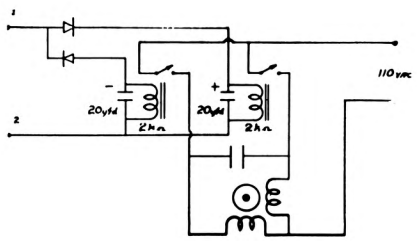


Fig. III

effectively removed after one cycle.

This circuit can be used with larger thyratrons to control a larger motor or by adding relays as shown in Figure III. The second method would not require modification of the existing circuit constants except to adjust the iR drop as discussed previously to allow for the change of load resistance. By the use of these relays a standard rotor could be used.

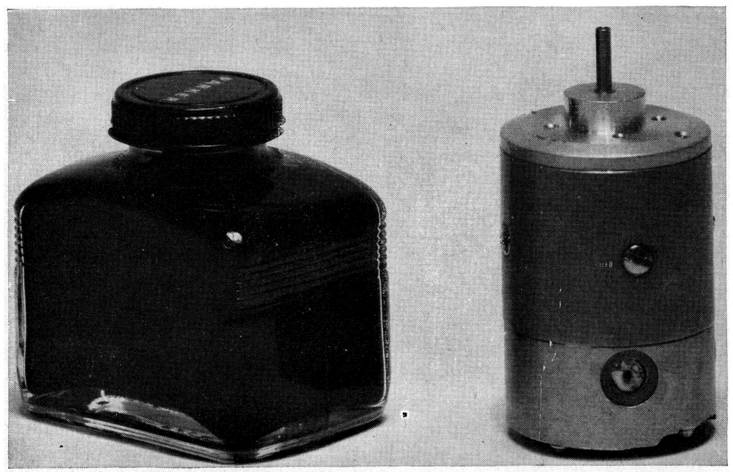
The potentiometers that were used in the original unit were Allen Bradley type "J's". These were modified by removing the covers to enable the control to be rotated through 360°. In the final unit all control rheostats would be of the standard type. This would not present any unusual requirement on the control potentiometer, but this is not true for the potentiometer in the rotor. This must be geared to the antenna shaft by a three to four gear ratio if a standard control is used.

This type of circuit could be used for many different types of applications. The use would be limited only by the ingenuity of the user. A discussion of the complete system's characteristics will not be presented in this paper. These characteristics depend considerably on the type of motor and gear train that would be used in a similar unit.

KWIK PIK

Single Shots of Engineering Interest

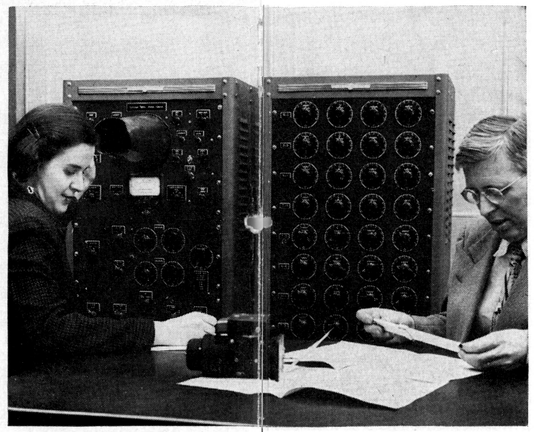
—Cuts Courtesy General Electric



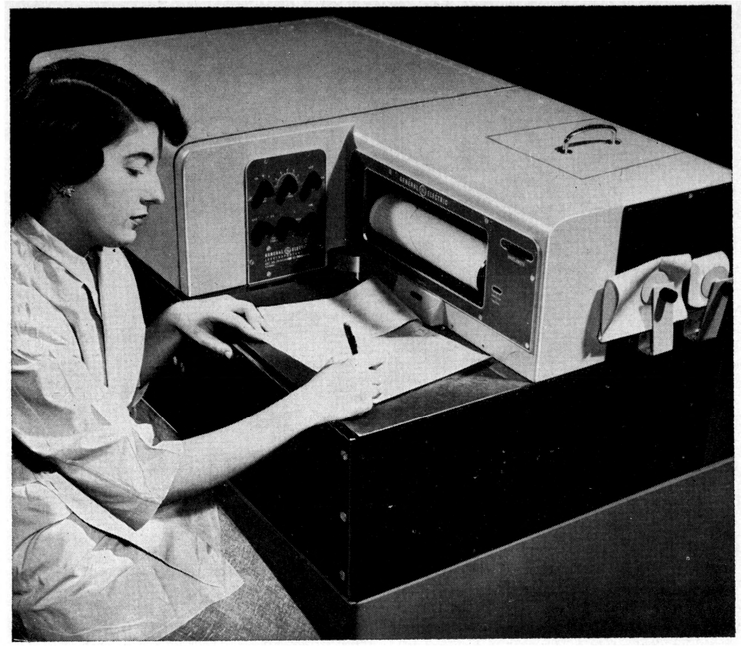
A miniature direct-current motor, the smallest ever built by General Electric, is currently being produced by the Company's Specialty Motor Sub-Department for use in defense systems of the most advanced operational bombers.

About the size of an ordinary ink bottle—1⅝ in. diameter, 2⅜ in. long—the tiny motor weighs approximately eight ounces. Rated at two-thousandths (0.002) horsepower at a speed of 6500 rpm, it is so sensitive that it is controlled by the output of two small vacuum tubes.

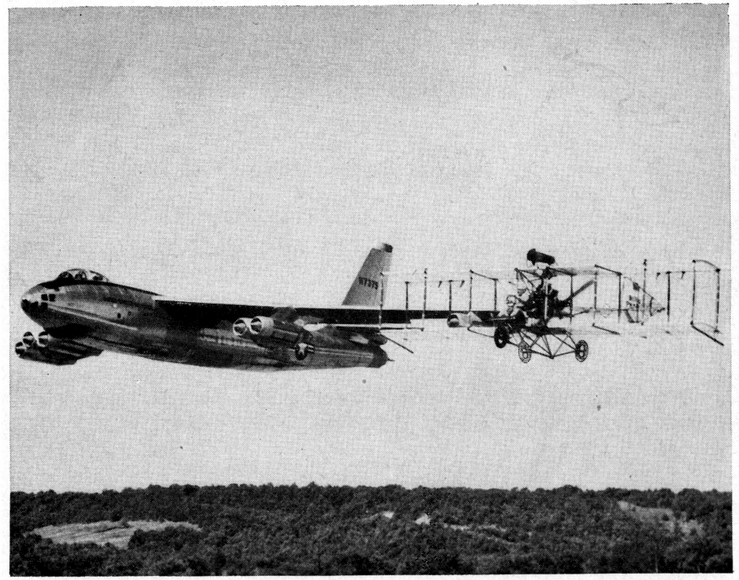
Of the split-shunt, reversible-rotation type, drawing maximum armature currents of 0.8 amperes from a 28-volt line, the "Tom Thumb drive" is required to withstand a high potential of 1500 volts above the ground. It is capable of responding to field currents of 0.00075 amperes.



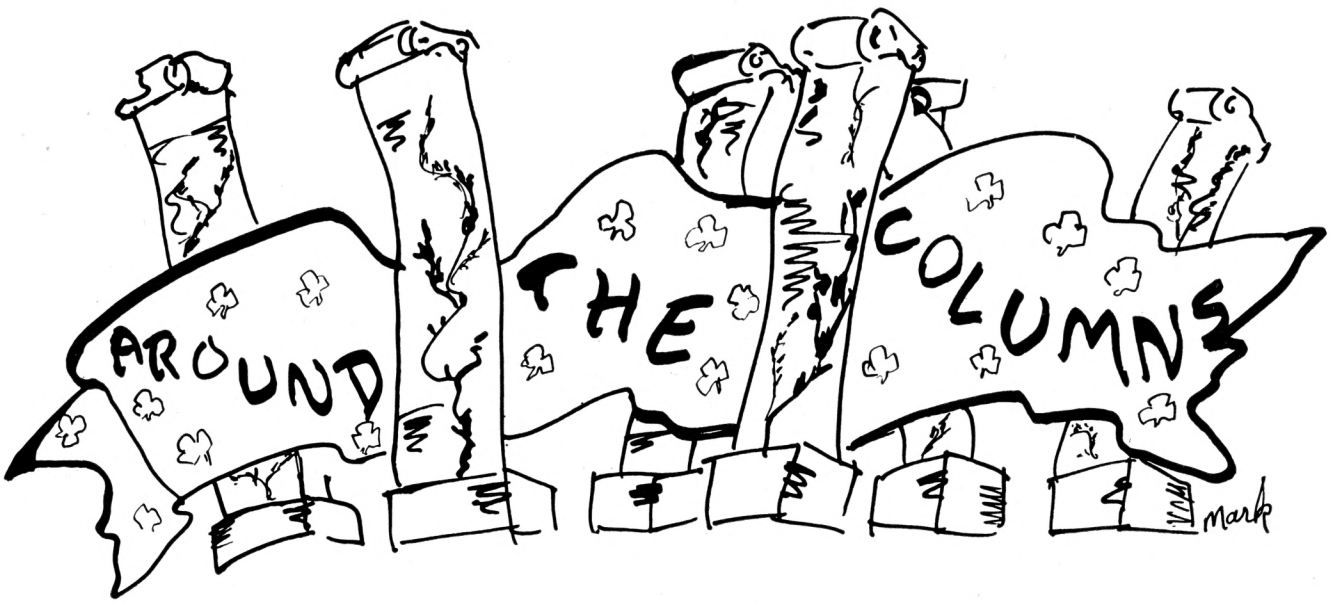
Doing two weeks' work in a half hour is simple for this new "brain" designed by General Electric to solve heat problems in small motors for aircraft at the Company's Specialty Motor Sub-Department here. The instrument, called an electronic thermal analog computer (ETAC), eliminates the need for engineers to spend long hours working complex and detailed mathematical problems. It is believed to be the first computer of its kind ever built.



A technician operates G.E.'s redesigned recording spectrophotometer, which is drawing a color curve for satin cloth. The device was recently redesigned with emphasis on accurate color measurement, greater sensitivity and faster operation to increase applicability.



Dramatic progress in the past 41 years of aviation is depicted here as a jet-powered Boeing B-47 zips past a 1912 pusher-type plane piloted by Billy Parker, owner. Although the 92½-ton swept-wing Stratojet is rated in the "600 miles per hour" class, it has knifed through the stratosphere at a ground speed of 794 miles an hour during an accelerated service test program early this year. The B-47 is powered by six J-47 jet engines. Mr. Parker can keep his small plane in the air an hour and a half. His estimated ceiling is between 8,000 and 9,000 feet, the top speed 65 mph. The Boeing plane, in contrast, has a range of more than 3,000 miles and can operate at altitudes above 40,000 feet.



By BRUCE McGILLAWAY *With SLIPSTICK SAM, B.S. '99*

Well, as the ship draws away, and the sun sinks slowly in the west, we leave our lovely little town of Columbia, Mo. and head out for parts unknown. Just think, we will be able to tell our grandchildren of our years at the resort town of the Ozarks, Columbia, Missouri, of the times when if you got 16 out of 100 on a Chem. II test that you really "cooled it"; of the times when you had 18 different Physics quizzes to study and the real McCoy looked like something written in Greek; the time way back in the fall of '53 when you slept through a quiz in Prof. Wood's course in concrete and had ulcers ever since. Well it's been a long hard pull and sometimes I didn't think I would have the energy to stagger over to the Black and Gold for some refreshment after 4 hours in Machine Tool Lab. but its over now for the next three months and you have nothing to worry about now except your girl back home and the 6 weeks at summer camp.

♣

You know, I wonder and I bet that you have too, and that is about the $50 tacked onto your semester's fees and that one word "incidentals". Well the story is out, here is the straight poop. Don't tell a soul, but our dear Dr. Trimble, who is the head bone crusher at our shining clinic is going strictly George on us. Besides getting fat and rowdy, he has taken to putting on an old pair of jeans, and a Tee-shirt and grabbing a Stephens girl and cutting out to a local movie. Nice work if you can get it! How about that Doc?

♣

The Mekanikal Senior Inspection Trip this year was really a dandy. They went to Louisville, Ky. and from what Sam heard, they had a great time. One of the highlights of the trip and one which got the closest inspection was their tour of the Nite Spots. One of the more liver quivering places was the Merry-Go-Round. There, the music was fine but the dollies were better so they stayed for the second show, strip show that is, and guess who had a front seat with a pair of 12X binoculars, you guessed it, your buddy and mine (after this I hope) Mr. Pringle.

The fellow who wins this month's "Cool Head of the Month Club" is Jim McCann, while everyone else was goggling and oggling, Jim-boy was going mad with his camera. As that sort of thing is frowned upon in those places, Jim couldn't use a flashbulb but believe it or not, he got 2 pictures to come out, *without* the use of flashbulbs. For that piece of amazing work he is to be awarded: One free ticket to the annual convention of the Women's Christian Temperance Union, and one autographed picture of King Farouk.

♣

George H. Tomlin, a student in the University of Missouri College of Engineering, was elected vice-president of the student chapter of the Mid-Continent Conference of the American Society of Civil Engineers at the annual meeting of the organization at Lawrence, Kansas, last week.

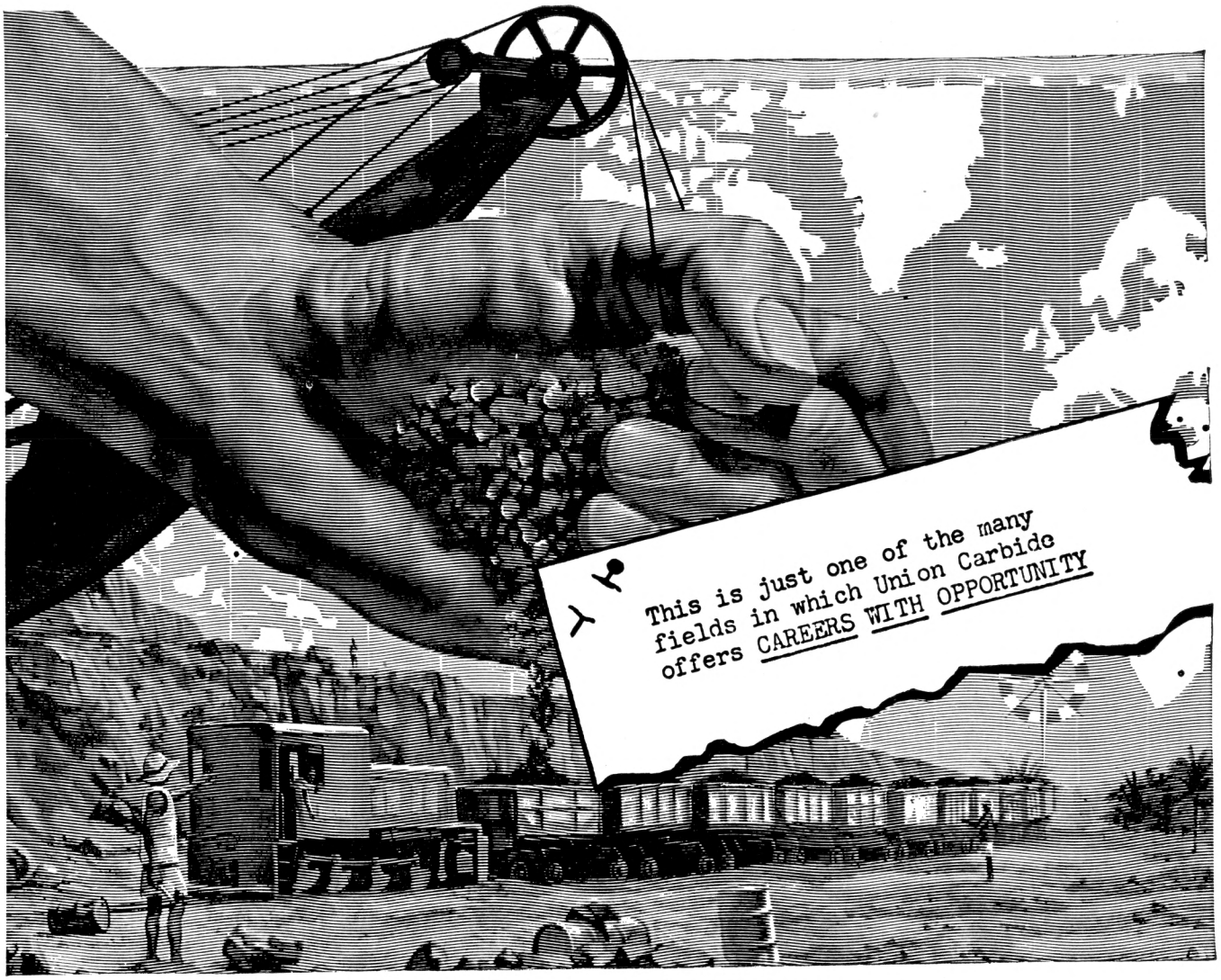
Tomlin, the son of Mr. and Mrs. Frank E. Tomlin of Mt. Vernon, Mo., and James Butner, another student in the College of Engineering, represented students of the University of Missouri at the meeting which was held at the University of Kansas Thursday through Saturday. They were accompanied to the conference by Horace W. Wood, professor of civil engineering at the University.

The Mid-Continent Conference includes chapters from the Universities of Missouri, Arkansas, Kansas, Oklahoma, and Nebraska, Washington University, Kansas State College, Oklahoma A. & M. College, and the University of Missouri's School of Mines and Metallurgy.

♣

Another fella around school is ready to bite the dust as far as marriage

(*Continued on Page* 28)



The metal that thrives on punishment

Steel serves you better when manganese is added —because the harder it works, the tougher it gets

EVER WATCH a power shovel bite into earth and rock? And wonder how the teeth of the steel bucket can endure such punishment? The amazing answer is that the teeth not only endure such treatment—they actually get harder because of it!

MANGANESE HOLDS THE SECRET—The story behind this remarkable steel is the unusual metal called *manganese*. The hundreds of thousands of tons of manganese required each year by steel and other metal-making industries are obtained by refining huge quantities of ore that come from mines in widely scattered points across the face of the globe.

ADDED TO STEEL—All steel contains manganese. A small amount "cleanses" molten steel and removes impurities. A larger amount of manganese makes the steel tougher and stronger.

FROM ORE TO ALLOY—Transforming raw ores into a variety of manganese alloys for the metal-producing industries is one of the many important jobs of the people of Union Carbide.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for booklet C-2.*

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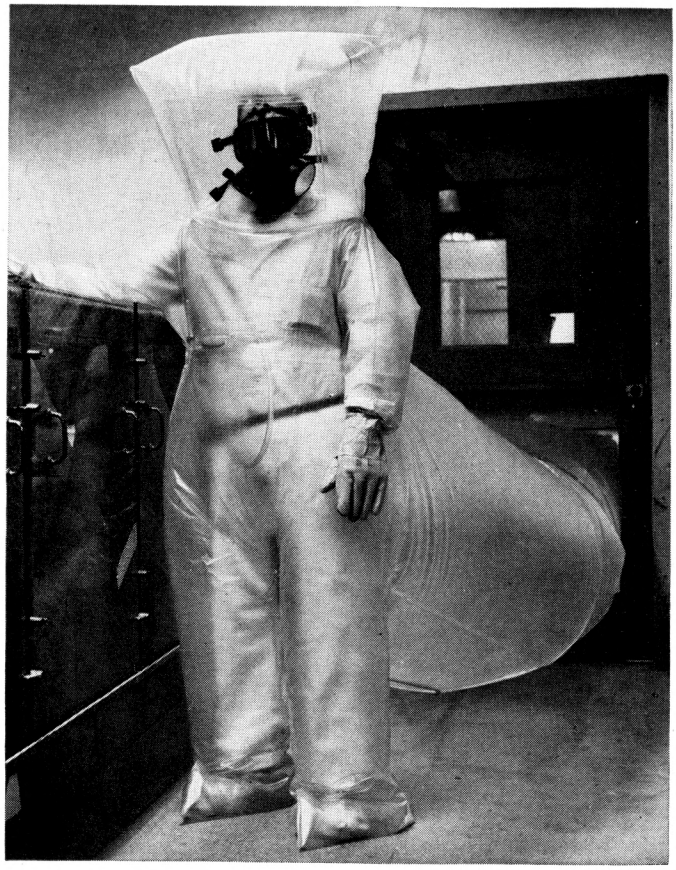
EVEREADY Flashlights and Batteries
BAKELITE, VINYLITE, and KRENE Plastics
SYNTHETIC ORGANIC CHEMICALS
DYNEL Textile Fibers
LINDE Oxygen

NEW STUFF

By MIKE McDANIELD



Cut Courtesy General Electric

General Electric engineers have found a new way of testing glass vacuum tubes—by slicing them just like salami. Slicing up the tubes is part of a checking program which continues from the raw product stage to the finished product. The slicing technique has solved the engineer's problem of getting inside the tube's glass exterior to inspect its inner parts without disturbing them. They had to check spacing and alignment tolerances of thousands of an inch in the completed tube. The earlier checking methods never satisfied the engineers, as breaking open the glass and cutting out the parts for study could move or distort them and spoil the test. In the new slicing technique the tube is first immersed in clear, liquid plastic. Then its submerged glass tip is cracked off with pliers and normal atmospheric pressure forces the liquid plastic in the vacuum to fill the tube completely. Chemical action and baking harden the plastic in about two hours, with the tube parts undisturbed. Engineers then crack away the glass tube exterior and slice the plastic encased parts into quarter-inch sections for study under a microscope.

Passengers who have sat in airplanes waiting to take off and either sweltered or shivered, according to the weather, will find relief at the Greater Pittsburgh Airport at Pittsburgh, Pa.

It is the only airport in the world to provide a central air-conditioning and heating system that connects by hose to standing aircraft.

Trap doors on the apron where airplanes park contain the hoses for fresh air as well as gasoline and oil. The hose for the air-conditioning and heating system is connected to the bottom of a plane and fresh air is pumped through the airliner's ventilation ducts as long as the craft remains in the parking area.

Housed in the basement of the airport Administration Building are 71 heating and cooling coils, 30 fans ranging from three to eight feet in height, and nine air cleaning units. The equipment will supply 31 planes at once in addition to conditioning the administration building itself.

The suit shown in the photo is not something from another planet but merely a suit which the employees at the Hanford River, Washington Atomic plant wear to prevent contamination while working in "hot" areas. The suit is made of plastic and the worker enters the suit by means of a tube attached to the suit from outside the contaminated area.

The XP-21 Firebird, a sleek white, single-seater automobile with aerodynamic styling, made its first public appearance at the GM Motorama of 1954.

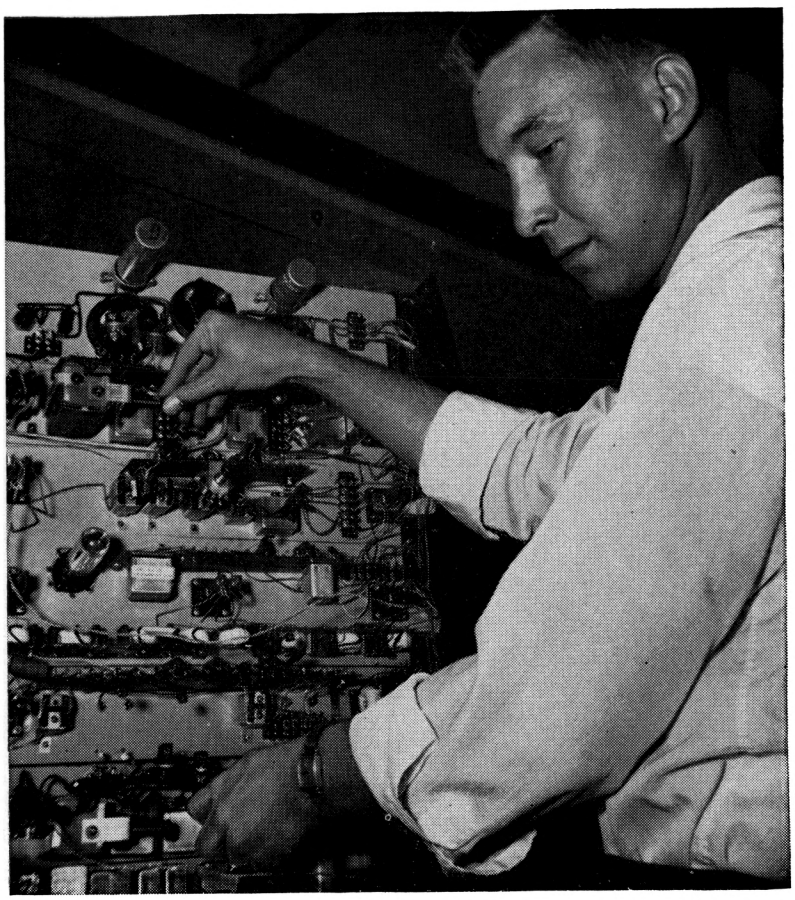
Constructed as an experiment to study future possibilities of the gas turbine for commercial uses, the XP-21 has undergone preliminary tests since last October.

The gas turbine car's mechanical anatomy, the reverse of a conventional automobile, includes a 35 gallon glass fiber-plastic fuel tank in the nose ahead of the driver.

Behind the driver is an engine consisting of two mechanically independ-

(*Continued on Page* 28)

A CAMPUS-TO-CAREER CASE HISTORY



Bob Wilson uses a "breadboard" circuit, studying the electrical properties of a carrier system

"My first assignment at Bell Labs"

Fresh out of school, Bob Wilson, '53, was put to work on a Transistor project at Bell Laboratories. He explains why he never had time to be awed.

(*Reading time:* 39 seconds)

"In some ways it was hard to believe. I had received my B.E.E. at the University of Delaware in June, 1953, and a week later I was working in the world-famous Bell Laboratories.

"But I didn't have time to be awed because they put me right to work. They gave me responsibility fast.

"My group was working on the experimental application of transistors to carrier systems. My assignment was the electrical design of a variolosser for the compressor and for the expandor to be located in the terminals.

"The supervision I received and the equipment I had were tops. I quickly discovered that I had to rely on my ingenuity as much as on the college courses I had taken. Perhaps that's one reason for the great new discoveries continually turned out by the Labs.

"Now I'm in the Communication Development Training Program, continuing my technical education and learning what all the Laboratories sections do and how their work is integrated.

"In a year I'll be back working with the group with which I started."

• • •

Assuming responsibility fast is a common experience among the engineering, physical science, arts and social science, and business administration graduates who join the Bell System. Bob Wilson went with Bell Laboratories. There also are job opportunities with the operating telephone companies, Western Electric and Sandia Corporation.

BELL TELEPHONE SYSTEM

BULLARNEY



By GRAY

She was only the optician's daughter—two glasses and she made a spectacle of herself.

♣

Have you heard about the fellow who took his girl out in the night and mist?

♣

The cannibal king looked at the beautiful young woman about to be tossed into the cooking pot.

"Humm. Believe I'll have breakfast in bed this morning."

♣

♣

"Yes, this is nice little apartment, but where is the bath?"

"Oh pardon me! I thought you were one of those engineers who wants the place just for the winter."

♣

A woman was driving her car along the highway at 60 miles an hour when she noticed a motorcycle cop following her. She pushed the car up to 70 and then noticed two cops trailing her. Not to get caught she upped the speed to 80, and this time there were three bike cops trying to catch her. Suddenly she spied a gas station so she pulled up in front of it and dashed into the ladies room.

Ten minutes later she ventured out and there were the three cops waiting for her. "I'll bet you thought I wouldn't make it," she said.

♣

Sugar Daddy:: A form of crystallized sap.

♣

"Knock, knock!"

"Who's there?"

"Amsterdam."

"Amsterdam who?"

"Amsterdam tired of these Engineer jokes."

Coed to Ch.E.: "I know you're a volunteer fireman. But please keep your hands off my hose."

♣

Honeymoon Sandwich: Just lettuce alone.

♣

"I hear you lost your husband. How did it happen?"

"He was kelt by a veasel."

"Killed by a weasel? That's unusual."

"Yep, vas drivink h o t o m o b i l e. Deedn't hear no veasel."

♣

Then there was the butcher who accidentally backed into a meat grinder and got a little behind in his orders.

♣

In ancient days the ladies in waiting to the king would curl up with a book. Some of them curled up with a page.

♣

We understand that manufacturers of certain feminine garments are currently making only three kinds. The Russian type, the Salvation Army type, and the American type. The function of the Russian type is to uplift the masses; the function of the Salvation Army type is to raise the fallen; the function of the American type is to make mountains out of molehills.

♣

I never kiss, I never neck.
I never say hell, I never say heck;
I'm always good, I'm always nice.
I play no poker, I roll no dice.
I never drink, I never flirt,
I never gossip or spread the dirt;
I have no lines or funny tricks,
But what the hell,
I'm only six.

If you think you are going to be happy and prosperous by sitting back and letting the government take care of you—look at the American Indian.

♣

A very rich deposit of oil was discovered on the farmer's land. Immediately he rushed into town to purchase a new car. An obliging salesman showed him a sleek roadster selling for $5,000.

"I am prepared to pay cash," said the farmer, "Will I get a discount?"

"Why certainly," replied the salesman. "We will give you a 10% discount on a cash purchase."

Not being confident of his ability as a mathematician, the farmer said he would think it over and return later.

He walked into a restaurant and over his coffee tried to figure what his discount would be, but to no avail. Finally in desperation he turned to the waitress and asked, "If I gave you 10% of $5,000 how much would you take off?"

Blushing prettily, the waitress whispered, "Would my earrings bother you?"

♣

An engineering prof was lecturing his 8:30 class on the virtues of being wide awake.

"I've found that the best way to start a day is to exercise for five minutes after arising, breathe deeply, and finish with a cold shower. Then I feel rosy all over."

Interested voice from back of room: "Tell us more about Rosy."

♣

Since we call professors "profs," it's easy to figure out what we ought to call assistants."



Compatible color television will eventually reach every TV home

The rainbow you can see in black and white!

RCA brings you compatible color TV. Lets you see color programs in black and white on the set you now own!

"When a modern and practical color television system for the home is here, RCA will have it . . ."

Echoing down through the years, these words—spoken in 1946 by David Sarnoff, Chairman of the Board of RCA—have a ring of triumph today.

Behind this great development are long years of scientific research, hard work and financial risk. RCA scientists were engaged in research basically related to *color* television as far back as the 1920's . . . even before *black-and-white* television service was introduced.

Since then RCA has spent over $25,000,000 to add the reality of color to black-and-white TV, including development of the tri-color tube.

The fruit of this great investment is the RCA all-electronic compatible color television system, *a system that provides for the telecasting of high-quality color pictures that can be received in full color on color receivers; and in black and white on the set you now own.*

RCA and NBC will invest an additional $15,000,000 during color TV's "Introductory Year"—1954—to establish this new service on a solid foundation.

RCA color sets are beginning to come off the production lines in small quantities. Although it will probably be another year before mass production is reached, the promise of compatible color television is being fulfilled.

RCA pioneered and developed compatible color television

INTRIGUING OPPORTUNITIES FOR GRADUATING ENGINEERS

You're sure to find the exact type of challenge *you* want in Engineering Development, Design, or Manufacturing at RCA. Men with Bachelor's, Master's or Doctor's degrees in EE, ME, IE or Physics are needed. *You'll find your optimum career work* among the hundreds of products RCA produces for the home, science, industry and Government.

If you have the necessary education and experience, you will be considered for a direct engineering assignment. Otherwise, you'll participate in our Specialized Training Program, in which you can explore RCA's many interesting engineering operations for a full year.

Your rapid professional advancement is enhanced at RCA by the free flow of engineering information.

Write today to: College Relations, RCA Victor, Camden, New Jersey. Or, see your Placement Director.

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Welded Steel Designs Cost Less because:

1. **Steel is 3 times stronger than gray iron.**
2. **Steel is 2½ times as rigid.**
3. **Steel costs a third of iron.**

Ultimate savings are limited only by the ingenuity of the designer.

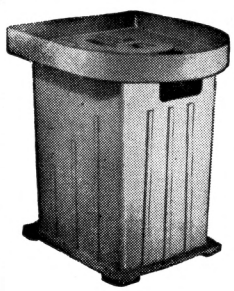
SIMPLIFIES DESIGN CUTS FABRICATING COSTS WITH WELDED STEEL

The successful industrial designer is one who can suggest ways of cutting the costs. That's why the engineer who knows how to utilize savings through welded steel finds his designs readily accepted.

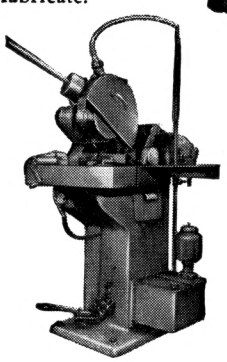
Here, for example, is how steel design has eliminated 356 pounds of metal in the manufacture of the base for this machine. All former machining has been eliminated. There are no bolted joints to cause leakage of coolant. Cost of manufacture has been cut 20%.



First redesign to steel . . . weighed 764 pounds. Required only 31 hours to fabricate.



Final design more compact in construction, weighs 692 pounds . . . takes less floor space, requires only 24 hours to fabricate.



Original design required 1048 lbs. of castings bolted together. Each casting required costly machining and fitting.

HOW TO PUT STEEL'S SAVINGS TO WORK—
DESIGN DATA for welded construction is available to engineering students in the form of bulletins and handbooks. Write:

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

THE TELEPHONE DIAL

(*Continued from Page* 13)

units other than the crossbar switches themselves are grouped under the term *common-control equipment.* They may be used for only a few seconds to set up a talking path through the crossbar switches, disconnected, and used for another call. They are "common" to all calls passing through the office. It is these common-control, or "brain" functions, that have made modern switching systems and computers possible.

While telephone engineers were making the dream of an automatic telephone office a reality, they also visualized the eventual adaptation of such methods to long-distance, or toll, calls. Why, they reasoned, must these advantages be limited to short distances? The answer, though not obvious, lay in the telephone numbering plan in use! In a small town, with only one telephone exchange, a telephone number need only have four or less digits. As each new exchange was added to the town (10,000 more lines) a code digit was prefixed to the number. Thus 3-5831, 7-5831, and 8-5831 would indicate telephones connected to three different exchanges. In still larger cities, still more "code" digits had to be prefixed to the number. Since a long string of numerals is difficult to remember, the exchanges were given names and the first two letters of the name become the code digits. If you dial CHelsea, for example, the dial doesn't know or care whether you are thinking of CH or 24; it pulses out 24.

In New York, for example, a telephone number might be CH 3-1000, the code letters and digit directing the call to the proper exchange. For dialing to be extended to toll calls, more digits had to be prefixed, to direct the call first to the proper city, and then to the exchange. This system had been in use for some time in operator toll dialing. Toll offices were equipped—some of them, at least—with automatic switching systems ca-

(*Continued on Page* 26)



COURTEOUS SERVICE
Mizzou Barber Shop
South Ninth at Elm
Finlay Bros Proprietors **Ph. 23809**



Foreground: Boeing RB-47E, world's fastest day-or-night long-range reconnaissance plane. *Background:* Standard B-47E six-jet bomber.

What do you want most in an engineering career?

Is it room to grow? Then join a company that's *growing*. Boeing, for example, has grown continuously throughout its 37-year history of design, production and research leadership. There's always room up ahead—and Boeing promotes from within. Regular merit reviews are held to give you steady recognition.

Do you want long-range career stability? Boeing today employs *more* engineers than even at the peak of World War II. Here you'd work on such projects as pilotless aircraft, research on supersonic flight and nuclear power for airplanes, on America's first jet transport, and the world's outstanding jet bombers.

Do you want variety of opportunity? Aviation is unique in this respect. It offers you unmatched variety and breadth of application, from applied research to production design, all going on at once. Boeing is constantly alert to new materials and new techniques, and approaches them without limitations. In addition, Boeing's huge subcontracting program—requiring engineering co-ordination—offers you contacts with a cross section of American industry.

Boeing engineering activity is concentrated at Seattle, Washington, and Wichita, Kansas—communities with a wide range of recreational opportunities as well as schools of higher learning. The company will arrange a reduced work week to permit time for graduate study and will also reimburse tuition upon successful completion of each quarter's work.

There are openings in *all* branches of engineering (mechanical, civil, electrical, aeronautical and related fields) for DESIGN, PRODUCTION and RESEARCH. Also for physicists and mathematicians with advanced degrees.

For further information,
consult your PLACEMENT OFFICE, or write

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

THE TELEPHONE DIAL

(*Continued from Page* 24)

pable of handling a maximum of fourteen digits. A toll operator keyed or pulsed these digits to direct the call through various cities to its destination.

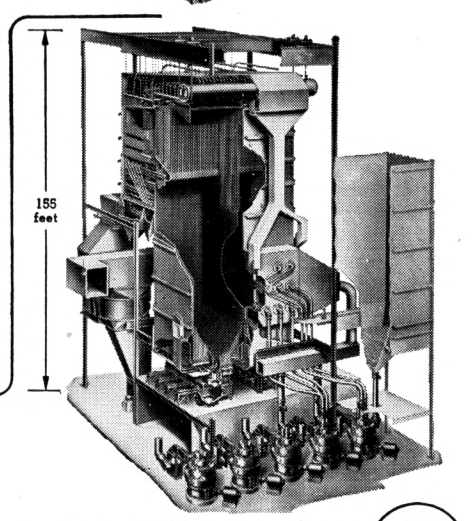
Unfortunately, calls from different cities to a given telephone would usually have different code digits; the telephone number was not universal. Some form of universal numbering was required so that the entire number, including the code digits, could be listed in directories, no matter where the caller was located. Such a plan was evolved, and the first step was to divide this country and Canada into ninety-odd numbering areas. Each area was given a distinctive three-digit code number, and this code would always direct a call to that area. Instead of the code representing a route, as before, it now represents a destination. A typical call to New York from some other part of the country, then, would be 212 CH3 1000. The 212 directs it through the various toll offices to the New York area, and the rest of the number is the same as you would dial if you were in New York.

Once this universal numbering plan was set up, a new toll switching system was developed to take care of all the possible types of calls that might be handled. This system—4A toll crossbar—is more of a giant brain than ever. Here, the job of translating area codes into the correct digits to direct calls throughout the country was so great that a new translating method was needed. Bell Laboratories engineers came up with the *card translator,* the first major use for transistors. Beams of light shining through holes in metal cards operate phototransistors to provide the required coded information. The translation function was still further broken down, so that in the 4A system we find *card translators, decoders, markers,* and *senders,* each with a specific job to do. The translators and decoders are equivalent to a tremendous card file, or directory. Markers do the same job as an operator when she plugs in her cords. Senders are the memory.

With this new toll switching system, and modifications of existing crossbar local telephone offices, it is now possible for customers to dial directly to telephones clear across the nation. Such customer toll dialing is being rapidly expanded by the Bell System, to fulfill the dream of the engineers who first thought of applying automatic switching to long-distance calls.

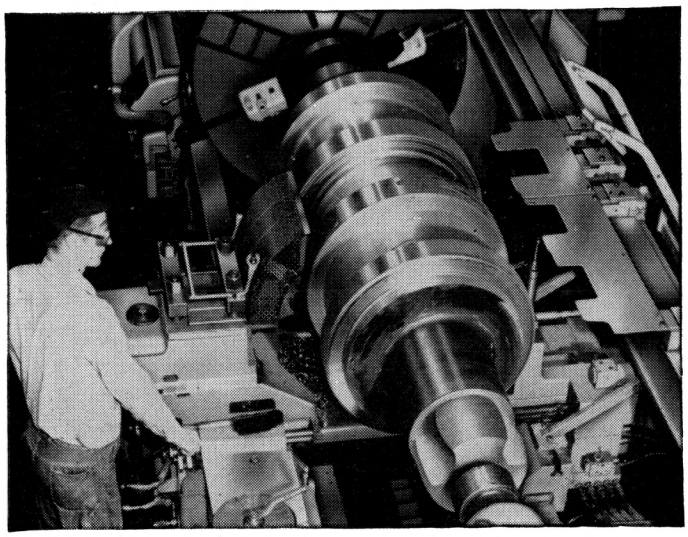
POWER COSTS ARE WAY DOWN HERE

instead of way up here because ever since 1881, when Thomas A. Edison installed this B&W boiler in America's first central station on PEARL ST. in New York, B&W has committed men, machines and money to a fruitful, continuing search for better ways to make steam and get more energy from common fuels. Today's power boiler stands this high. It stands for power progress and the B&W pledge to keep research and engineering first--to produce even more steam power at lower cost.



BABCOCK & WILCOX
BOILER DIVISION
G-647

Another page for **YOUR BEARING NOTEBOOK**

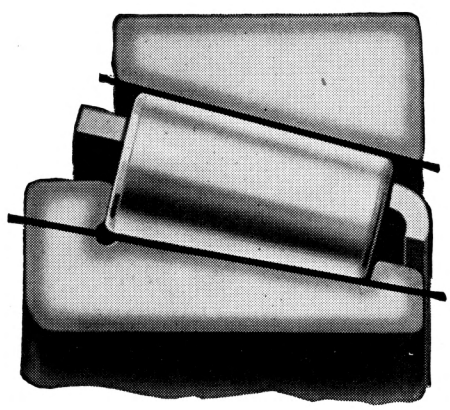


How to hold a heavily-loaded lathe spindle in accurate alignment

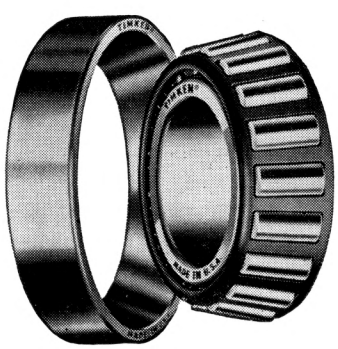
This big lathe machines rolls for steel mills. The roll is rotated by the lathe spindle and it must be machined to very accurate dimensions. So the lathe manufacturer, LeBlond Machine Tool Company, mounts the spindle on Timken® tapered roller bearings. Despite the great weight on the spindle, the Timken bearings hold it precisely in place—because they are made so accurately and have such high load capacity.

Why TIMKEN® bearings have high load capacity

This picture shows why Timken bearings have such high capacity—the load is carried on a *full line contact* between the rollers and races in the bearing. Note also the tapered construction. This permits the bearing to be tightened up (preloaded, we call it) to prevent chatter in rotating parts like the machine tool spindle above.



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ◎ AND THRUST ⟷ LOADS OR ANY COMBINATION



Regardless of wastes carried,
Dickey Pipe will still be in service

LONG AFTER BONDS ARE PAID



Dickey Sewer Pipe offers protection
for the investor and the community.

Bond issues are easier to swing when investors know that long-lasting Dickey Pipe is to be used in a sanitary sewerage system. And long after the bonds are paid off, Dickey vitrified clay pipe will continue to serve the community. Because it is made of clay, Nature's most endurable material, Dickey Pipe cannot rust, rot, corrode, or disintegrate. Sewer gases and chemically active industrial and domestic wastes cannot harm it. That's why Dickey can offer a fifty-year guarantee to protect towns that specify Dickey Pipe.

If it's made of clay, it's good . . . if it's made by Dickey it's better

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San Antonio, Tex., Texarkana, Tex.-Ark.

Dickey Sanitary
Salt-Glazed Clay Pipe
EXCEEDS STANDARD SPECIFICATIONS

NEWSTUFF

(*Continued from Page* 20)

ent parts called the gasifier and power sections.

The gasifier section replaces the engine and torque converter pump in a conventional automobile, while the power section replaces the torque converter turbine, transmission and rear axle gears.

The Whirlfire gasifier section is a compressor rotor and a gasifier turbine wheel, both attached to the same shaft. Air enters the compressor where it is raised to more than 3½ times atmospheric pressure before entering the engine's two combustion chambers. Kerosene is burned in these chambers, raising the gas temperature to approximately 1500 degrees Fahrenheit.

The Whirlfire engine develops 370 horsepower when the gasifier turbine is spinning at 26,000 rpm and the power turbine is revolving at 13,000 rpm. Total weight of the engine unit, including gasifier and power sections, is only 775 pounds. Overall weight of the entire car is 2500 pounds.

AROUND THE COLUMNS

(*Continued from Page* 18)

is concerned. The passed Ed of this rag, Dave Aldag, is going to marry Ann Barnhart sometime in August. If Aldag isn't at home, he can be found at Annie's house. She let you talk yourself into it, Dave?

I hope to see most of you back in the fall, when we can really settle down to some serious studying and beer-drinking. See you around the columns, Tripod and me that is.

Missouri Farmer

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2

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Purchase Your
Engagement Rings
At
CAMPUS JEWELRY
Free Gift Wrapping and
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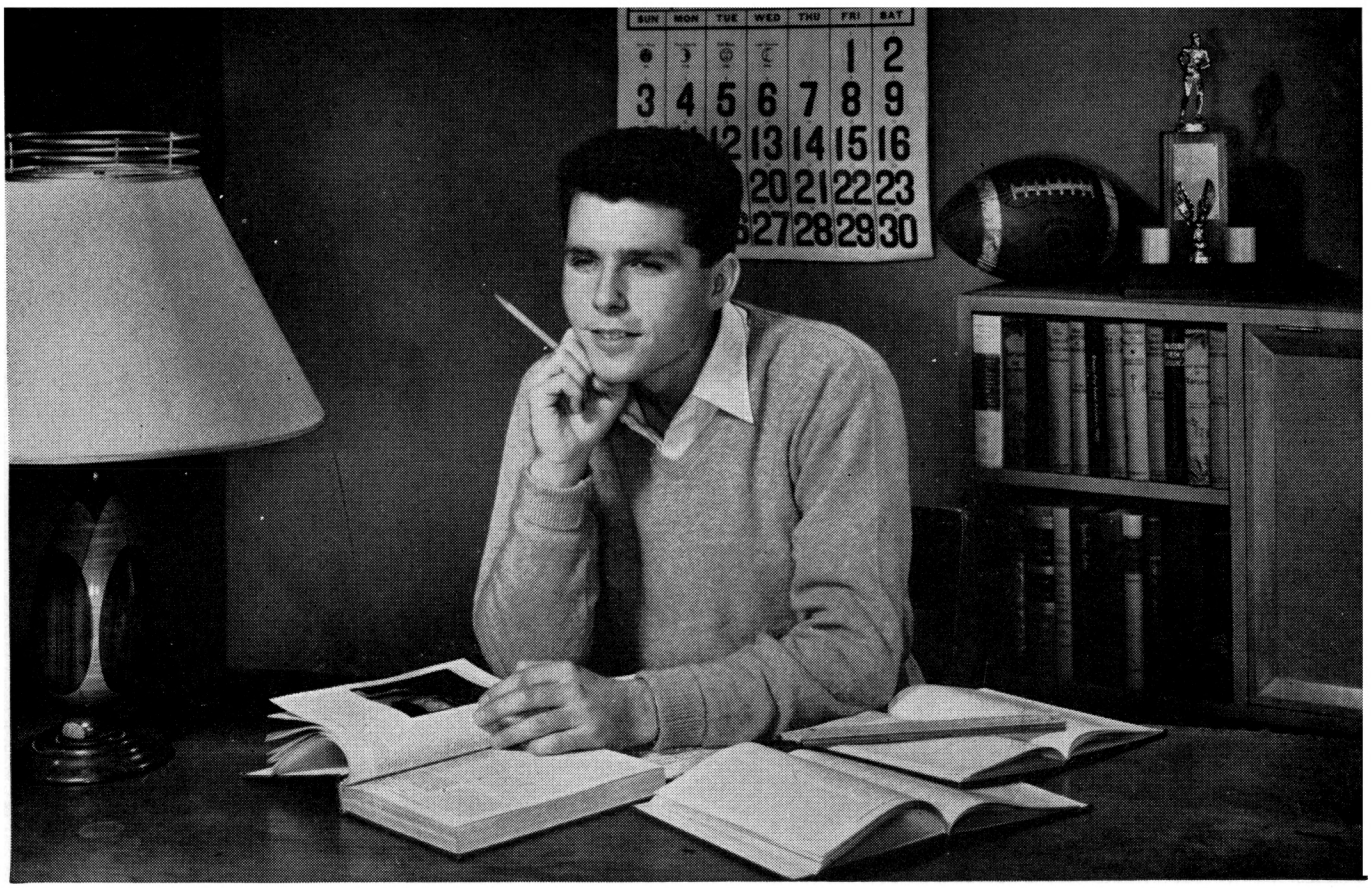
706 Conley in front of Jesse Hall



The Only Problem...
"Which Way Is Up—and How Fast?"

Today, plenty of jobs are waiting for the man with a degree in Engineering or Chemistry. You can take your choice, but that choice will probably be one of the most vital decisions of your life. So don't fail to consider the exciting, fast-moving chemical industry. Don't fail to consider Spencer Chemical Company, which has been called "America's growing name in chemicals."

If Opportunity is what you're after — a chance to learn, accept responsibilities and move ahead, it will pay you to investigate the Chemical industry. Our Spencer organization is young, aggressive and willing to listen to junior employees with ideas and drive. And we have openings from time to time in basic engineering, Research and Development, technical service and technical sales.

Of course, Spencer offers insurance, a retirement plan, vacations and all of the other so-called "fringe benefits," but if you're the man we're looking for, you consider those matters strictly secondary. It's more interesting to you to know that Spencer Chemical Company is a dominant producer of agricultural nitrogen . . . that numerous long-term research projects are under way . . . and that a $14,000,000 plant to manufacture polyethylene, the "wonder plastic," is now being built at Orange, Texas.

Yes, if you are asking, "Which way is up?"—you are the kind of man the Chemical industry and Spencer admire. We are, of course, especially interested in technical people, but we often have places for graduates in Business Administration, as well. If you would like further information, please write, giving details of your educational background.

SPENCER CHEMICAL COMPANY, Dwight Bldg., Kansas City 5, Mo. • Manufacturers of "Mr. N" Ammonium Nitrate Fertilizer • SPENSOL (Spencer Nitrogen Solutions) • HO-NO-MO (Spencer Herbicide) • Ammonia (Commercial and Refrigeration Grade) • Aqua Ammonia • 83% Ammonium Nitrate Solution • Synthetic Methanol • Formaldehyde • Hexamine • Polyethylene (1955) • FREZALL (Spencer Dry Ice) • Cylinder Ammonia.

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America's growing name in chemicals

NATIONAL PRESIDENT VISITS

The student chapter of A.S.C.E. at the University of Missouri, was recently honored by a visit from Dean Daniel Terrell, National President of The American Society of Civil Engineers. President Terrell, who is also Dean of the Engineering College at the University of Kentucky, spent most of the day visiting with the faculty members and students in the Civil Engineering School.

Dean Terrell was entertained at a luncheon given by the Missouri Alpha Chapter of Chi Epsilon. After the luncheon Dean Terrell conducted a discussion period with those present concerning various subjects relating to the A.S.C.E. One of the subjects discussed that was of special interest, was the A.S.C.E. Code of Professional Ethics.



Faculty, honorary members and student members of Chi Epsilon with National President Terrell third from left in the front row.

At a special afternoon meeting of the student branch of A.S.C.E. Dean Terrell was the guest speaker. After being introduced to the membership by Professor Karl Evans, Dean Terrell spoke on the duties of the A.S.C.E., what it does for the civil engineer and what the civil engineer should do for the society. At the conclusion of his talk he entertained questions from the membership.

The student branch of A.S.C.E. thoroughly enjoyed and was most appreciative of this visit from the national president.



● There's a K&E slide rule for every purpose. Whether designed to meet the modest needs of the beginner or the exacting requirements of professionals, all K&E rules feature "built in" accuracy and reflect the skill and craftsmanship of America's most experienced slide rule manufacturer.

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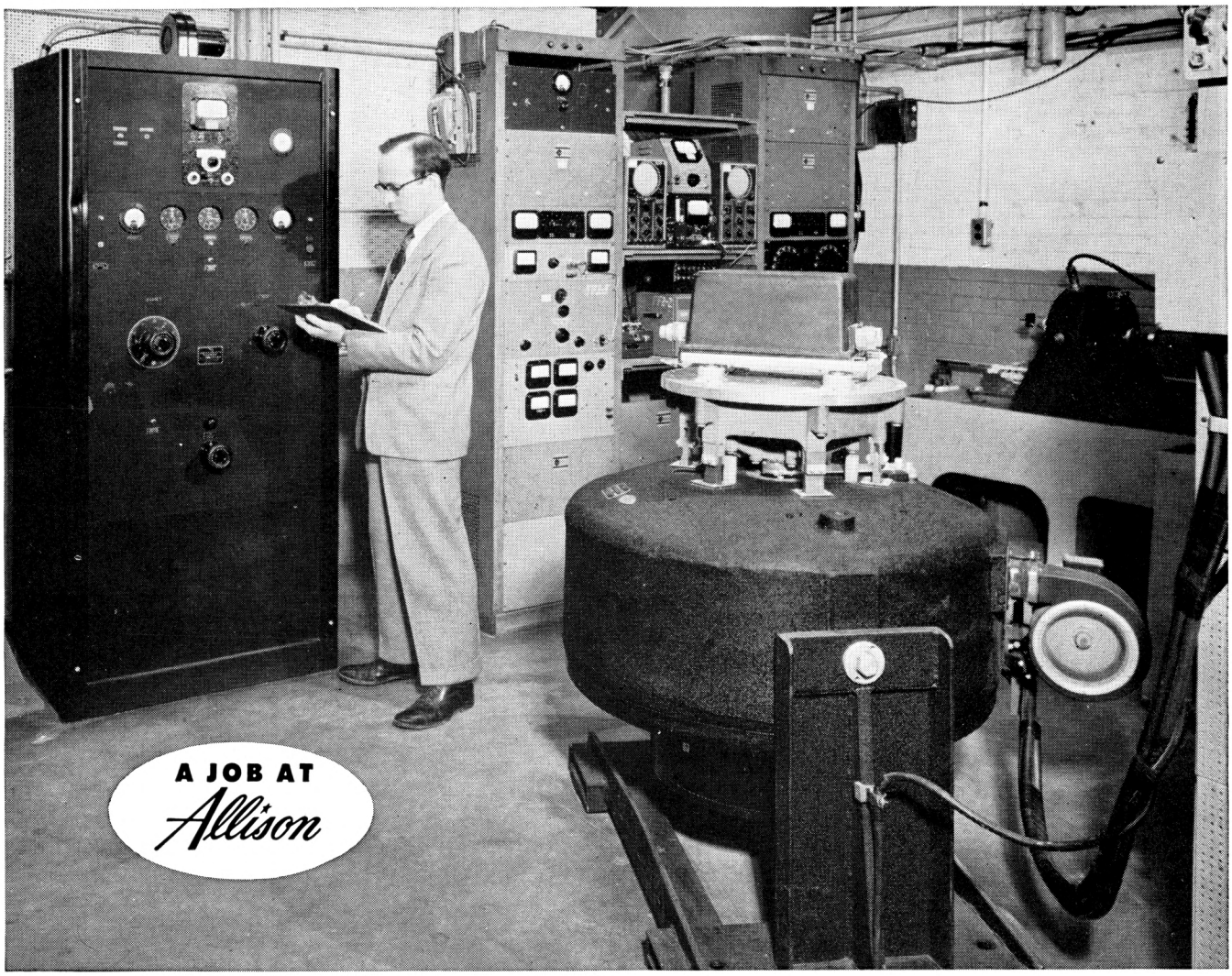

● Cort Kegley received his Masters Degree in Physics from Connecticut Wesleyan in 1951.

When the above picture was taken he had been on the job less than a month, and was one of a group of young graduates then in training at Allison.

Much of the experimental and test equipment at Allison is entirely different from any other. And, Cort—like other new engineers on the job—must first learn about these various facilities which he will be using in instrumentation and testing.

He is pictured here getting acquainted, so to speak, with some of the equipment used in vibration and shock qualification testing. One of the many electronic accessory units used with the Allison jet engines is here undergoing a "shake test" on the large MB vibration exciter shown in the foreground.

A turbo-propeller governor is bolted to the shake table of the exciter, which is controlled from the panel at the left, to determine if simulated engine vibration will cause the unit to malfunction. The large MB exciter has the capacity to exert a vibratory force of 2500 pounds, with a frequency range up to 500 CPS. A smaller MB exciter, shown on the bench in the background, is rated at 50 pounds peak force available to 2000 CPS.

• • •

Our long range program calls for additional engineering personnel. Why not plan early for your engineering career at Allison where unlimited opportunities are offered to young graduates, especially to those with degrees in Mechanical Engineering, Electrical Engineering, Aeronautical Engineering and Industrial Engineering.

For further information about YOUR engineering career at ALLISON, discuss it with your Placement Counselor and arrange for an early interview with the ALLISON representative the next time he visits your campus. Or, write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

Allison **DIVISION GENERAL MOTORS CORPORATION • Indianapolis, Ind.**

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SHAMROCK



SEZ

WHITE ELEPHANTS have been found around the old building. They are in the form of books printed by members of the faculty telling of the history of Engine School and the history of St. Pat's Week. The first, written by Professor Weinbach, late Chairman of the Electrical Department, *Engineering at the University of Missouri,* is a complete history of the College from the beginning with Civil Engineering in 1850 to the time not long ago, 1940. He describes some of the old faculty, such as Professor Rodhouse, Arthur M. Greene, and others. His discussion takes the form of periods—the Formative, Constructive, and Contemporary. There is no marked price in the book, but we have talked to the Dean, and he feels that one dollar would be a fair price for such a journal. If you are interested in purchasing *Engineering at the University of Missouri,* you can send your money with some extra to handle mailing cost to the Dean's office and receive your copy. Any money received will be turned over to the Engineering Foundation, as they own the books.

The second elephant which is on sale are a few copies of the magazine, *St. Patrick Was An Engineer,* written by Dean Curtis who was here in 1949. He deals with the evolution of St. Pat's Week, giving some of the original documents as proof. This is the history of St. Pat's up to the date of issue, March 1949. This can lead to some enjoyable reading in the evening, and remembrance of your own activities. Each year is covered by a brief sketch. This is also in the Dean's office for the price of two bits plus something for mailing.

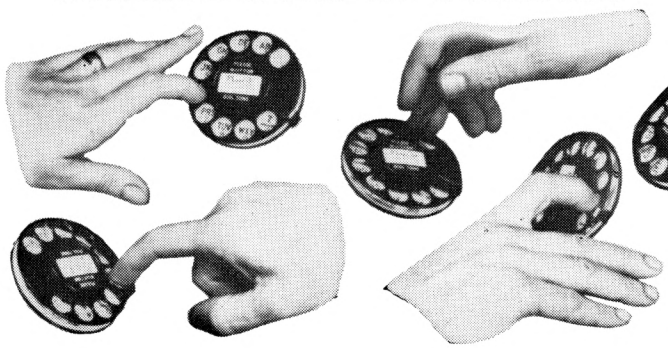
WE HAVE more complaints about the lack of Alumni news. It seems that we have had no alumni column in the last issue, and we don't have one in this issue. Again we say that this magazine is printed for the alumni along with the present students, but we seem to get no direct support from the Alums—in the form of news from themselves. During St. Pat's week this year, YE ED had some forms dittoed and placed on the Alumni registration table. He got no replies from this form for one of four reasons. First, the forms may not have been placed on the Registration table as they were left in the Dean's office where all registration material is kept. Secondly, the student sitting at the table knew not what to do with the forms, although the instructions on the form were clear enough to make it evident what the forms were for. Thirdly, there were too many forms to fill out and this one was neglected. And fourth, no alumni registered at the table. What happened, we don't know, but it sure left us up a stump for news. See what you can do about the first issue next year.

TECHNICAL ARTICLE CONTEST results are as follows: First prize, *German Automatic Weapons of World War II, by* Maxwell Atchison, M.E. '56. Atchison left school last semester, so we could not have a picture of his receiving the prize in this issue, but we are mailing him twenty-five smackaroos, enough to finance a hell of a lot. The second prize went to Pete Gale for his article, *Einstein: Special Theory of Relativity,* in the March issue. Pete, E.E. '54 gathers in fifteen folding greens for his supreme effort in the writing field. The third prize, goes to Jim Fithian, E.E. '54, for the paper entitled *The Nuclear Reactor as a Source of Electrical Energy.* And special mention goes to John Renken for his article on KOMU-TV. The EE's ran away with the loving cup this time fellas, what's going to happen next year? Don't feel discouraged that all these men took English 60, and these were results of that course. In fact the bulk of the articles submitted were from English 60, and from the Staff. The cash is here, it's yours to take.

OL' SHAMROCK is going to do its best next year to serve the Engine School. Every department has had the opportunity to be represented on the staff, and to actively participate in each publication. The SHAMROCK is your magazine—it is, in all actuality, a tool of the students in Engine School. If you fail to put Ol' Shamrock to work, you have failed yourself.

THIS SUMMER, MANY OF YOU will be working in industry. You will be observing first hand, engineering in practice, and industry will be observing you. Here is one way Ol' Shamrock can help you. Write an article on what you are doing, or what the company is producing. Contact their publications department or their sales department and tell them what you are doing. They should go all out to give you data and any cuts (pictures) you can use. Next year, Ye Ed will see to it that your article is printed and copies sent to the company you wrote about. Ye Ed doesn't think it is necessary to point out the advantages of this plan.

PHOTOGRAPHY AT WORK—No. 7 in a Kodak Series



Photography reads the meters *2500 an hour!*

Dial a call—an accurate register counts it—then each month photography records the total, precisely right, ready for correct billing.

TWENTY-FOUR hours a day, hundreds of thousands of dial phones click their demands in many central exchanges of the New York Telephone Company.

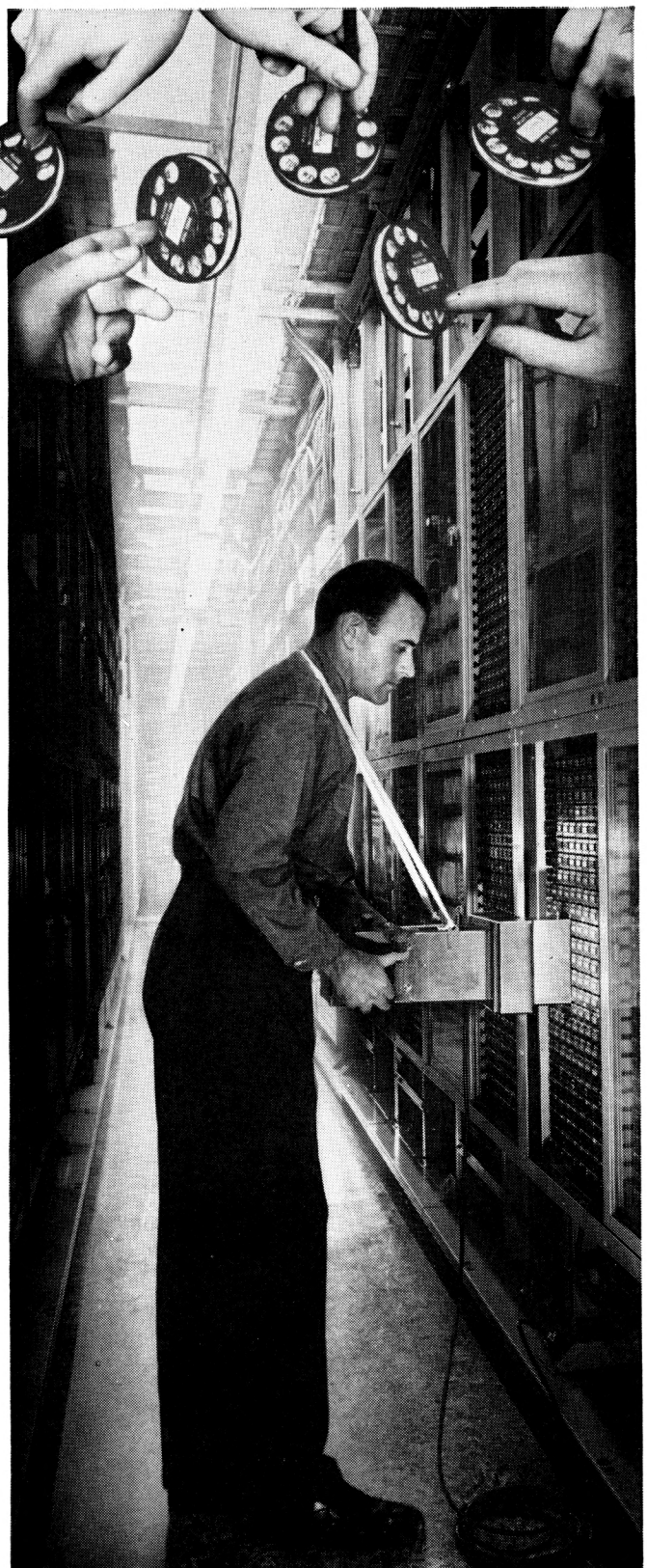
Little meters keep careful tally of the calls. Then the night before each bill is dated, photography reads the up-to-the-minute totals in a fraction of the time it could be done in any other way. Here is an idea that offers businesses everywhere simplification in copying readings on meters, dials or other recording instrumentation.

Photography fits this task especially well for two reasons. It is lightning fast. It can't make a mistake.

This is another example of the ways photography saves time, cuts costs, reduces error, improves output. In large businesses—small businesses—photography can do big jobs. In fact, today so many new applications of photography exist that graduates in the physical sciences and in engineering find them valuable tools in their new occupations. Other graduates—together with returning servicemen—have been led to find positions with the Eastman Kodak Company.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

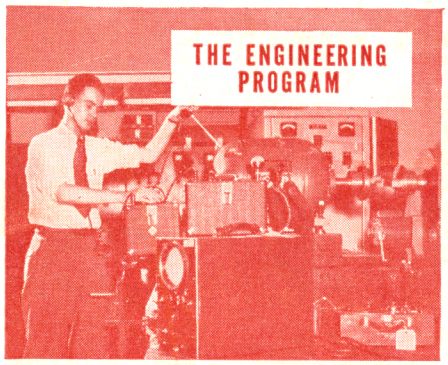
Eastman Kodak Company
Rochester 4, N. Y.



At New York Telephone Company exchanges a unique camera records the dial message register readings—up to 25 at a clip—saving countless man-hours of labor, assuring utmost accuracy and at the same time providing a permanent record.

Kodak
TRADE-MARK

10 ways to build a successful career



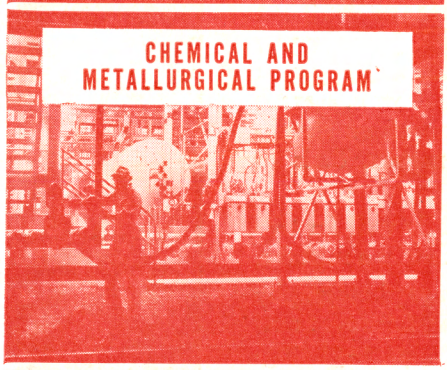




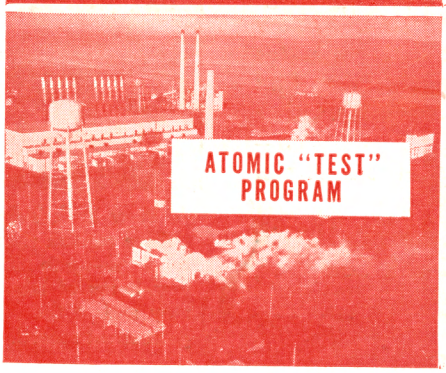














Few companies can offer as broad a range of career opportunities as General Electric. Whether a young man is interested in science or engineering, physics or chemistry, electronics or atomic energy, plastics or air conditioning, finance or sales, employee relations or advertising, marketing or metallurgy—he can find a satisfying, rewarding career.

The development programs shown here are "open doorways" that lead to highly successful careers in a Company where big and important jobs are being done, and where young people of vision and courage are needed to help do them.

If you are interested in building a G-E career after graduation see your college placement officer, or write:

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