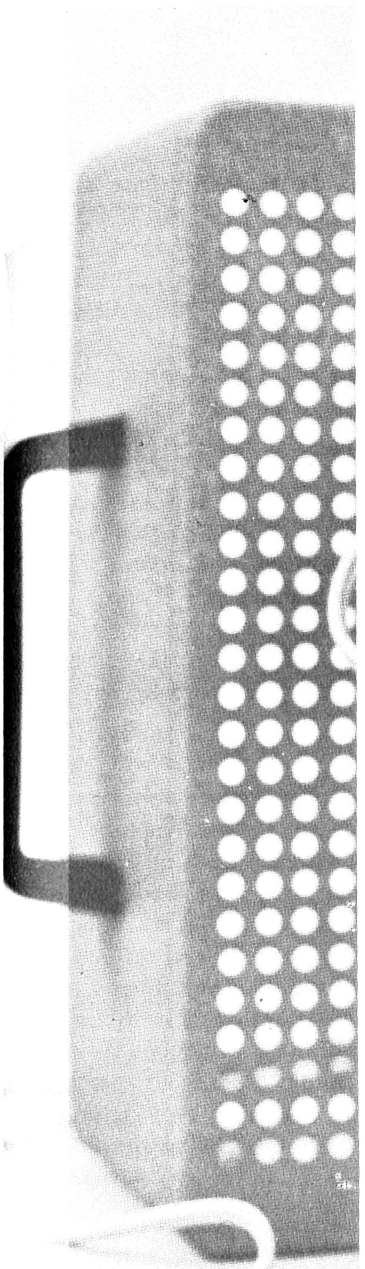
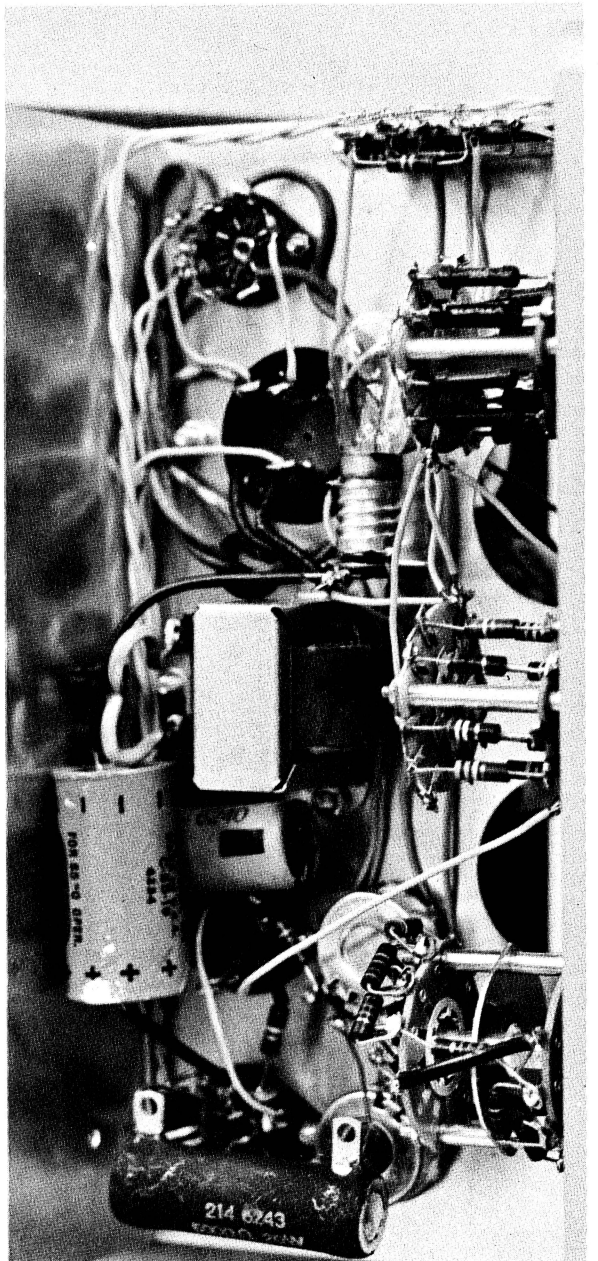
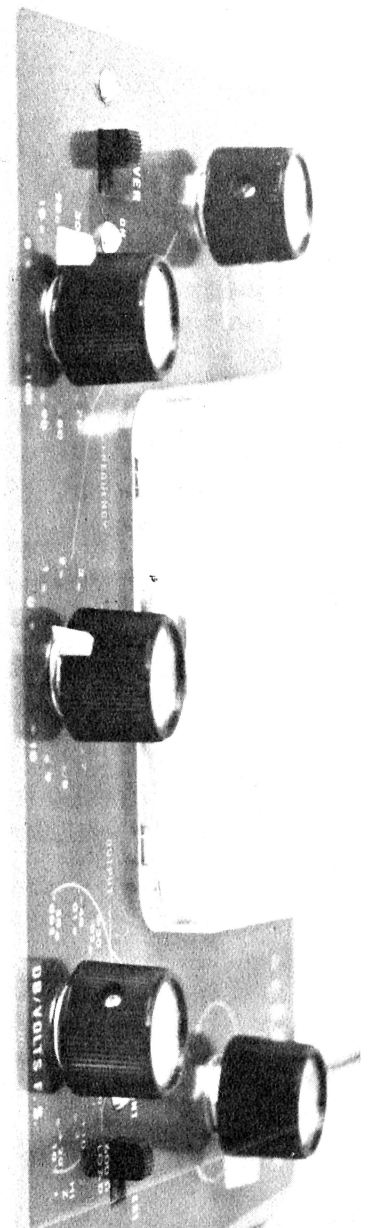
YOUR 4-H ELECTRIC PROGRAM







Workbook Number 4

University of Missouri
Extension Division
4-H C186, 3, 63, 1M

Contents

NAME _____ ADDRESS _____

PARENTS NAME _____ _____

4-H CLUB _____ LEADER _____

POWER SUPPLIER _____ LOCATION _____

HELLO AGAIN!

We are pleased that you are again enrolling in the 4-H ELECTRICITY PROJECT—for this indicates your strong interest in ***electricity,*** a most useful ***tool*** for the betterment of mankind and a form of energy that provides HEAT, LIGHT, and POWER for farm, home, and industry.

Workbook 4 has been developed much like the Group B units in the latter part of Workbook 3. In fact, those Units in Workbook 3 that were not used last year can be counted for credit in Electricity 4 Project. The rules for this year will, however, apply toward all work that you plan to undertake.

The information contained in most of this year's suggested Units is very much abbreviated and you will need to consult local electricians, or skilled technicians, and appropriate references ***before*** the work is attempted. Here is the general procedure which you should follow:

1. Determine ***what*** you want to do, ***why*** you should do it, ***who*** you can consult for technical help and supervision and when it can be completed.
2. If you select Unit 12, fill out the APPROVAL FORM on the back page, talk with your extension agent about your plans and qualifications for doing this work and, if you are qualified, receive his approval. If he feels you can better handle the responsibilities of another Unit, he will encourage you to work on this. So have some alternate Units in mind ***before*** consulting your agent
3. Obtain all of the technical material needed for completing your Unit (s) and study the appropriate sections carefully and thoroughly.

Warning—Because electricity can be dangerous when not properly used, you ***MUST*** agree to follow the required procedures listed below after approval is granted to participate in a specific unit.

Required Procedure

1. Draw up a plan of any new wiring systems or changes in the wiring that are to be made. Check with electric power supplier and/or an electrician regarding its technical accuracy and whether it meets all code requirements that apply
2. Have an electrician supervise all wiring work and complete all work in such manner that it meets requirements of the National Electric Code and any local codes (NOTE: In towns having their own local electric code, it is often illegal to do any wiring without a city permit and, in such cases, units containing electric wiring applications shall be avoided by the 4-H club member)
3. Never work on a circuit that is "LIVE" (Wire the fixture, switch, or building with all circuits disconnected and have all wiring inspected before energizing new or additional wiring)
4. All materials you use should carry the inspection-approval label of the Underwriter's Laboratories
5. In writing up your complete report on what you did and how it will benefit you and your family, be sure to indicate how you proceeded with your work and who approved and supervised the work (Remember "one ***GOOD*** picture is worth a thousand words" so use photographs to tell your story whenever possible).

Reference Material

Each work unit will require some additional study. Because the list of good references changes from year to year, we have placed these on a separate sheet inserted in your Workbook. If you should not find this reference list enclosed or attached, ask your Extension Agent to get one for you.

Project Units

1. VENTILATION—Moving Air With A Purpose
2. SPACE, HEAT, and YOU
3. Install AN ANIMAL SHELTER VENTILATION SYSTEM
4. Build A HOTBED FOR BETTER PLANTS
5. Install ELECTRIC HEAT CABLE for Comfort, Pro-

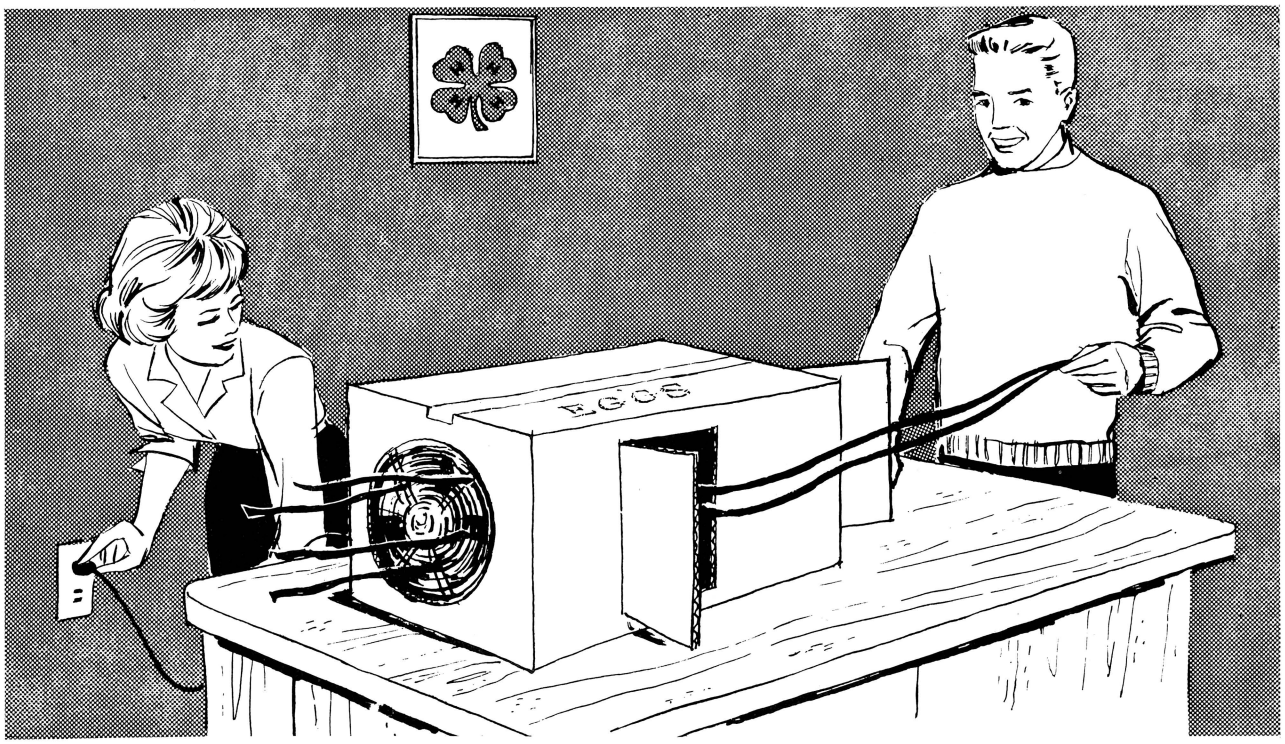
tection, and Safety

6. BUILD A HI-FI SET
7. TRANSISTORS AND TRANSISTOR PROJECTS
8. AMATEUR RADIO PROJECT
9. REWIRE THE SHOP
10. WIRE A SMALL BUILDING
11. Install A FEED HANDLING or DISTRIBUTION SYSTEM
12. OPEN-SUBJECT TO EXTENSION AGENT APPROVAL.

Project Requirements

1. Attend a majority of project meetings held and six community meetings.
2. Complete at least 2 units.
3. Perform at least one demonstration before a group of people.
4. Write a short story on page 3 telling "How Electricity Has Benefited Me This Year".
5. Turn in workbook or project record to your club leader by_____, 19____.

Unit I



Ventilation—Moving Air with a Purpose

Good ventilation is something you aren't likely to miss until you are without it.

Have you ever attended a meeting where the air was "stuffy" and where you had trouble keeping awake, or where you even got a headache?

Or maybe you have walked into the house when cabbage was being cooked, and wondered if you wanted to stay for supper!

Proper ventilation can solve both of these problems, as well as others. And here's what we'll do in this project unit:

1. Learn what proper ventilation can do
2. Learn the basic principles of good ventilation
3. Select a size and type of fan that would be right for some job in your home or on your farm

4. Determine the proper location and method of control for this fan
5. Demonstrate the principles of ventilation to others using a portable fan.

Ventilate the Sure Way

If we were to take a glass bottle, and put a cork tightly in the top, we would come pretty close to having "no ventilation" inside. But most homes and other buildings designed for humans or animals are far from being that tight. As a result, every such place has more or less ***natural*** ventilation. This is the movement of air through or around doors and windows, and through other tiny cracks in the structure.

In many cases, natural ventilation is enough, but in many other situations, it is inadequate. We often try to increase natural ventilation by adjusting doors and windows, but the wind and outdoor temperature may change or rain may blow in. As a result, this method is often not dependable.

An electric fan, properly sized and installed, and equipped with a suitable control and anti-backdrafting device, is a very dependable and positive means of providing the ventilation we need.

Ventilate to Remove Heat

Ventilation is sometimes used to remove excessive amounts of heat in situations like these:

In a kitchen where much cooking is being done, we have an excess of heat, as well as odors and moisture.
In a meeting hall, the heat given off by a crowd of people, together with that produced by the heating system, makes the room too warm. In bedrooms during warm weather, the buildup of heat during the day is often so great it interferes with comfortable sleeping at night. In dairy stables, the heat produced by cows often raises the temperature above 50-55°F, a level that's considered a desirable winter-time temperature for good milk production.

Ventilate to Remove Odors

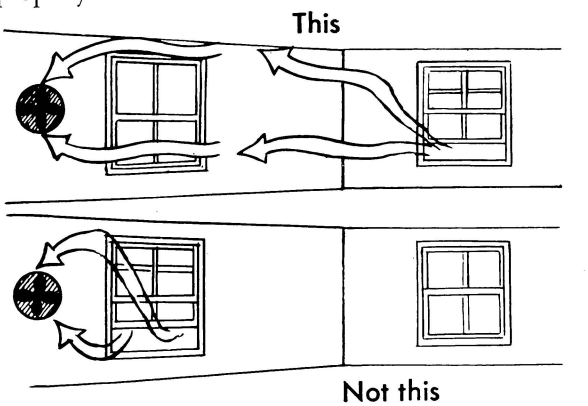
We talked about odors from the kitchen, but there are other areas from which odors should be removed. Some of these are places where dry cleaning or painting are being done, bathroom and powder rooms, poultry houses, hog houses, etc.

Ventilate to Remove Moisture

If there's too much moisture vapor in a room, it condenses on windows, mirrors, woodwork, and walls to cause an unsightly appearance and eventual peeling of paint and rotting of wood. Ventilation is used to help remove this excess moisture in kitchens, basements, bathrooms, milking parlors and milk houses, dairy stables, and poultry houses.

Intakes Are Important

The fresh air that enters the space to be ventilated should be brought into the structure at some distance from the exhaust opening. This means that windows right next to a fan should not be opened. If they are, air will "short circuit" and the rest of the room will not be properly ventilated.



If drafts are to be avoided, air intakes must be small in size and more or less uniformly distributed. In warm weather, we are usually not much concerned about drafts, and windows on the opposite side of the fan-ventilated room can be opened without any bad effects. In cold weather, however, there's the danger of making persons or animals sick if large quantities of cold air is allowed to strike them.

Sometimes the natural small cracks and openings in a building are enough to admit the air that the fan exhausts. However, if a fan speeds up or if there is a change in sound when a door is opened, that's a sign that the controlled inlets or some windows should be opened very slightly to let more air in.

Get the Right Size Fan

The size of fan needed depends on the size of the room and the job to be done, or on the number of people or animals that the room will accommodate.

General ventilation of rooms and buildings refers to that amount of air movement needed to remove excess heat, moisture, and odors.

Comfort cooling, on the other hand, is ventilating to create a cooling breeze, and calls for more air movement than general ventilation.

Table I shows both the number of air changes needed per hour and how frequently the air must be changed in a room for both general ventilation and for comfort cooling. For example, the air in a home ***kitchen*** must be changed from 15 to 30 times per hour for general ventilation but 60 times per hour for comfort cooling. In other words, a change every 2 to 4 minutes is needed for general ventilation but a complete air change every minute for summer comfort cooling.

Fans are rated according to their ***ability*** to move air at a certain pressure. Their air capacity is given in cubic feet per minute or ***CFM.*** When a capacity is listed for "Free Air Delivery" this means that the fan will deliver

TABLE I - RECOMMENDED AIR CHANGES

Kind of Room	FOR GENERAL VENTILATION: Air Changes Per Hour	FOR GENERAL VENTILATION: Change Room Air Every	FOR COMFORT COOLING: Air Changes Per Hour	FOR COMFORT COOLING: Change Room Air Every
Assembly Hall	6-20	3 to 10 minutes	30-60	1 to 2 minutes
Attics	10-20	3 to 6 "	20-60	1 to 3 "
Churches	15-30	2 to 4 "	60	1 "
Dining Room (Home)	15-30	2 to 4 "	60	1 "
Kitchens (Home)	15-30	2 to 4 "	60	1 "
Kitchens (Other)	20-30	2 to 3 "	60	1 "
Offices	10-30	2 to 6 "	30-60	1 to 2 "
Bathrooms (Home)	12	5 "	30-60	1 to 2 "
Public Lavatories	20-30	2 to 3 "	30-60	1 to 2 "
Schools & Stores	6-12	5 to 10 "	30-60	1 to 2 "

the specified amount of air at zero (0) pressure. Most ventilating fans should, however, be selected on the basis of their air delivery at a static pressure of from 1/8 to 1/10 inches. (A static pressure of 1/8 inch is about equal to 0.0045 lb/sq. inch of pressure, a seemingly small amount but very important from the standpoint of fan design, selection and performance.)

The capacity of fans selected for those uses listed in Table I should be based on the number of complete air changes per hour for the space ventilated or cooled. Thus, the required fan capacity can be calculated as follows:

$$\text{Required C F M} = \frac{V \times N}{60}$$

where: V equals the space of the room in cubic feet or, (length x width x height) all measured in feet.
N equals the number of air changes per hour taken from the proper column in Table I.

Animal Shelter Ventilation

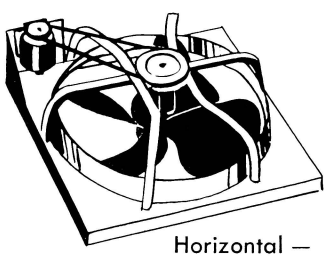
Animal shelter ventilation is usually based on the number of animals housed rather than on the number of air changes per hour. This is because of the different relationships between heat and moisture production of the animals, type of building construction, climatic conditions, and other factors, some of which are listed in Unit 3 of this Workbook

Get the Right Kind of Fan

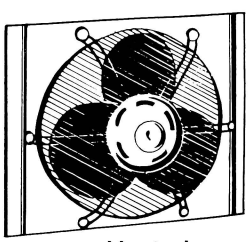
Fans can be equipped with motors that are either totally enclosed or are of the open type. Open type motors are suitable only for relatively clean installations such as in the home. Enclosed motors should always be used in dairy barns or poultry houses where dusty and dirty conditions prevail. As most fans will run for long periods, motors should be of the "continuous duty" type. The motor should, of course, be of the right type, speed, and size, factors which need special attention when any motor is to be matched to a belt driven fan.

Any belt-driven or direct-driven fan can be operated in a vertical wall. If the fan is to be installed in a ceiling, however, it should be equipped with ball bearings in both the motor ***and*** fan.

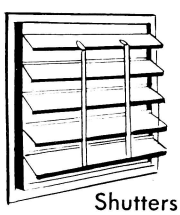
Every exhaust fan should have some kind of anti-backdraft device. These are called ***shutters*** or louvers, and they should work freely so that they will always close promptly when the fan is shut off, and open when it turns on again. A ***hood*** will protect the fan and shutters from the weather.



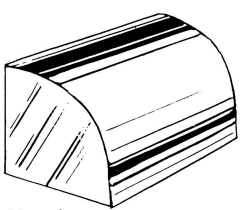
Horizontal — Ball bearings required



Vertical



Shutters



Hood

A wire guard or removable grill should always be provided to keep fingers and hands away from moving parts. It should permit cleaning and oiling.

Pick the Right Location

Consider noise, appearance, the source of whatever it is you're removing and construction of the building when you plan to install a fan. A kitchen fan is placed directly over the range, because that is the source of most odors, moisture, and excess heat. But such a fan may be connected to a hood on another wall of the house for the sake of appearance.

Avoid installing a fan near loose-fitting doors or windows to eliminate air "short-circuits". In an exposed building, you may want to locate the fan away from prevailing winds.

Use the Right Control

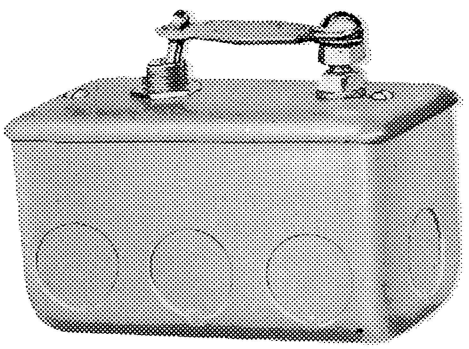
Fans can be controlled with manual switches, thermostats, humidistats, time switches and by other means. Most kitchen and other exhaust fans are controlled with a manual switch. There are occasions, however, when it may be desirable to use a humidistat on some fans, such as those in kitchens of electrically heated homes.

Attic fans are often controlled by a thermostat. Powder rooms and bath rooms can be wired with the light switch so that it would always run when the light is on. This control system is often a building code requirement for bathrooms that have no windows or natural ventilation.

Animal shelter ventilating fans are usually controlled with a thermostat but some are controlled with the combination of a time clock ***and*** a thermostat. The location of such a thermostat is important. It should sense the ***average*** temperature in the shelter. For this kind of application, select a thermostat of the "cooling" type or one that turns the power on when the temperature rises.

Wire It Safely

Always provide proper motor protection.—Select a motor with "built-in" overload protection, install a thermal breaker switch or time delay fuse of the proper size. For attic fan installation, it is especially important that a fusible link cut-off switch be mounted in the air stream and wired so that electric current to the fan motor is interrupted when the air temperature reaches 165°F. Thus, if a fire should ever occur, the attic fan would not whip flames throughout the home.



What Did You Learn?

(Underline the right answers)

1. All buildings have (no, some) natural ventilation
2. Always locate fan (near, away from) places where air can enter freely
3. (Comfort cooling, general ventilation) means ventilating to create a cooling breeze
4. Select a fan based on its delivery at (zero, one-eight inch) pressure
5. Exhaust fans should (always, never) be equipped with shutters
6. CFM is an abbreviation for (cubic feet per minute, central fan measurement)
7. Moisture must be in the form of a (liquid, vapor) to be exhausted by the ventilating fan
8. If a thermostat control is used for ventilation, a (cooling, heating) type is needed.

Demonstrations You Can Give

Secure a corrugated paper box, longer than it is wide. An egg case or citrus box would be fine. Using a knife, cut a round hole in one end and position a small portable fan in it so that air can be exhausted from the box. Attach paper streamers to the output side of the fan. Next, make one hinged door in the side of the box adjacent to the fan, and another in the end opposite the fan. Seal the top with tape.

1. With both doors closed, operate the fan, pointing out that not enough air is entering the box (you may have to insert nails in the edges of the doors so that they aren't drawn inward)
2. Open the door opposite the fan just ***slightly,*** and operate the fan (Show that the fan is now getting enough air for general ventilation)
3. Open this same door all the way, showing that the fan is now moving air at full capacity, and is comparable to comfort cooling
4. Close this door to the position it had in 2, and open the side door all the way (With some paper streamers, show where most of the air is entering and tell about air "short circuits")
5. If possible, get a second fan and some automatic shutters (Let the second fan represent the wind and aim it at the first fan and explain how the wind can cause serious draft by blowing in through a fan that is not running).

What to Do

Install an attic fan.

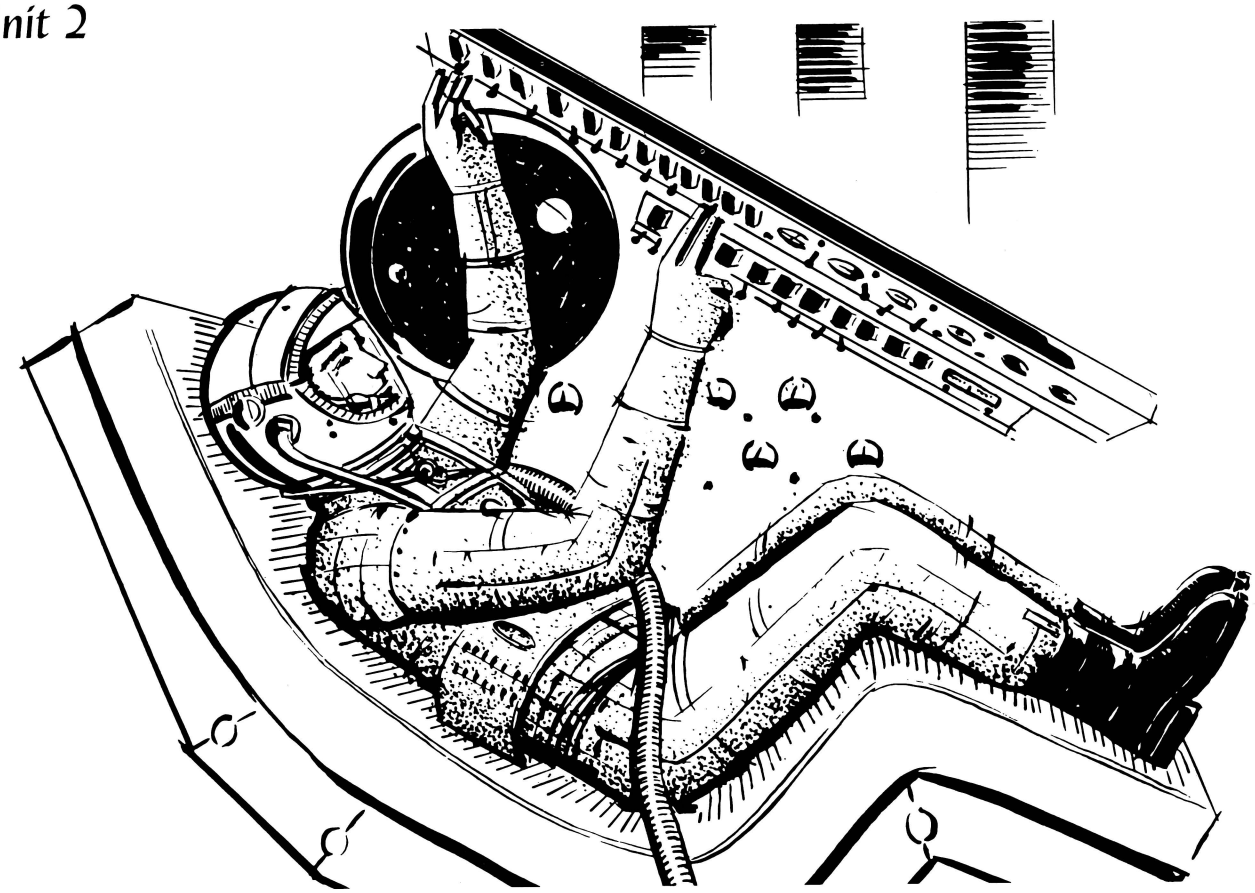
Attic fans not only pull cool air into the "living" area of the home, but they also force hot still air out of the attic. If you install an attic fan, here are some factors to consider:

1. Locate opening in central part of home and in hall, if possible
2. Install fan near or over a solid partition like a wall.
3. Reduce noise by mounting fan vertically on rubber cushions, use resilient rubber hub-mounted motors and direct air between fan and opening with a canvas plenum
4. Provide proper motor protection and install a fusible link cut-off switch
5. Install a kitchen exhaust fan.

For More Information

Ask your county Extension Agent, power supplier, or a ventilating fan dealer for literature on ventilation.

Unit 2



Space Heat and You

If you were to take a trip into outer space, one of the most important things would be how to keep you warm.

When and if you did make such a trip, chances are that a combination of two things would be used to keep you warm in the subfreezing temperatures. These two things would be electricity and insulation.

The electricity would be used to operate resistance heaters, and the insulation would keep down the loss of heat from your body to the outside.

What to Do and Learn

1. Learn why you need heat, and how the human body loses heat.
2. Get to know the ways that electricity can be used to keep you comfortable.
3. Obtain a piece of heating cable and a portable electric heater, and see how they work.
4. Get a piece of blanket-type insulation and learn how it helps prevent heat transfer and why it should be kept dry.

You Need Heat

Why do we need heat? All of us are "heaters," with a capacity that ranges from 400 Btu (heat units) to 1100 Btu per hour, depending upon whether we are resting or physically active.

In warm weather, we seem to have too much heating capacity. When outdoor temperatures are low it is often not enough.

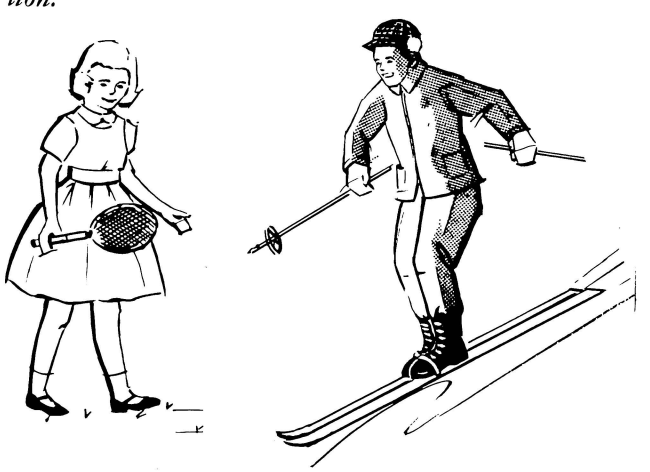
Our skin temperature is about 81°F, usually higher than its surroundings. It is necessary that the human body lose heat, and we are most comfortable when this necessary loss from the body is effortless. When you are in a room that has a temperature of from 70° to 75°F, with the proper relative humidity, you feel comfortable.

When we have trouble losing heat, we ***feel*** hot and when we lose heat too rapidly, we ***feel*** cold.

You can prove these two statements by putting on a heavy coat and remaining inside, and by standing in the air stream of an operating air conditioner for several minutes with very light clothing on.

How You Lose Heat

You lose heat in many different ways. You lose heat by ***conduction*** while in contact with cold bed sheets. You can also lose heat by ***convection.*** When you open a freezer door, the chill air will cool your skin. At all times you are losing heat by the ***evaporation*** of moisture from your skin. If you sit next to a window and the surface of the glass is as low as 40°F, your body will radiate heat to the cold window rapidly. In this way you lose heat by ***radiation.***



Try, within the limits of your surroundings, to experience as many of these types of heat loss as you can.

We help control heat losses by insulating ourselves with clothing. In summer, we wear light clothes that provide a minimum of insulation. In winter, we insulate ourselves more heavily.

Space Heating

Electricity has been widely used for many years to help keep people warm. It can easily be placed in unusual locations, it can be directed where wanted, and it is installed by simply plugging into a convenient outlet. Most of us are familiar with the so-called portable "bathroom" heater.

Electric heating is practical for a whole house or building. Room-by-room resistance heating, the most common method, has many advantages:

1. It is quiet with no air noise
2. A blanket of warm, comfortable air is provided
3. Space is saved since no large furnace is needed
4. Installation costs are low with no ductwork, plumbing, flues, or vents needed
5. The heat is more uniform and
6. Cleaner with no large quantities of air movement to deposit dust and dirt on walls and furniture
7. Individual rooms can be kept at desired temperatures by a thermostat in every room
8. With no moving parts, there is very little maintenance on the system.

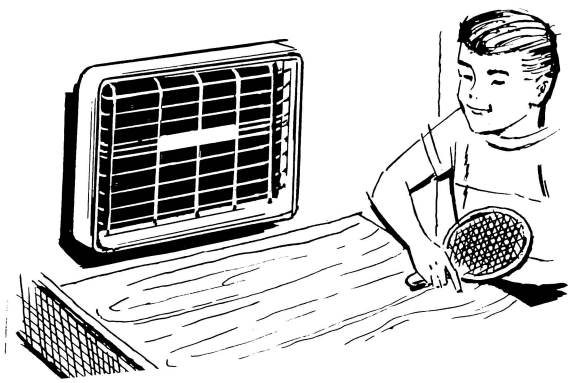
Lower installation and upkeep costs may more than offset the slightly higher cost of electricity as a heating fuel.

Many Ways to Do It

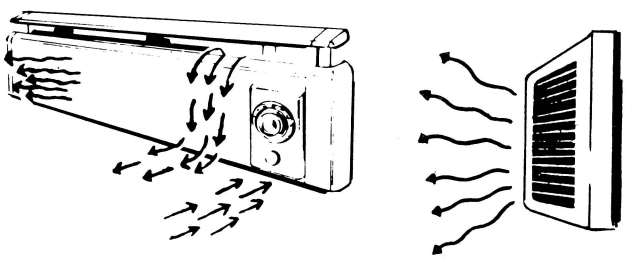
Plastic covered ***heat cable*** is installed in the ceiling

so that radiant heat rays filter evenly all over the desired living area. The cable is sometimes installed in a concrete slab floor. No floor space is required and favorite chairs can be placed anywhere in the room.

Radiant panels operate on the same principle except they are assembled as a unit. They can be mounted in the wall or ceiling or they can be made portable.



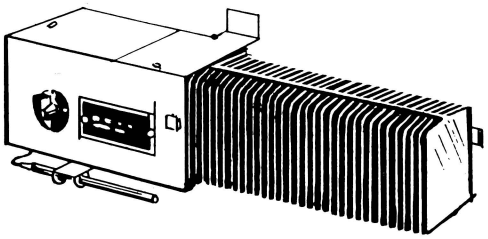
Baseboard heating units have become popular for homes already built or where it is desired to concentrate the heat under a large window. They take no usable wall space, and can be painted to match room decoration.



Forced ***convection*** heaters have quiet fans that blow air across an electric element, discharging the warmed air gently into the room. Although suitable in most locations, this type is especially good where a large amount of heat is needed from a relatively small unit.

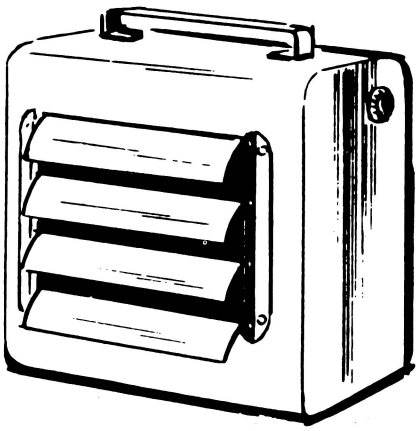
Electric ***furnaces*** and ***boilers*** are also in use, and they work exactly like the flame-fuel ones, except that they substitute large resistance heaters for the burners or fire-pot.

Special heaters and heat lamps are available for rooms such as milk houses and pump houses where high temperatures are not required. They can be automatically controlled, if desired.



Try Them Out

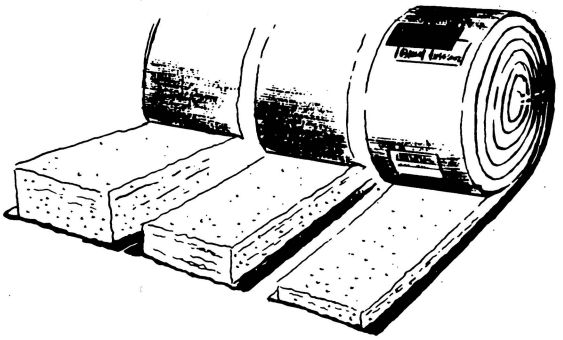
Get a piece of heating cable of a length that can be plugged into a 120 volt circuit. Be sure to uncoil it before operating. Borrow a portable electric room heater.



What is the heat output (in terms of watts) of each? Operate both of them. How do the two compare in temperature of the heating element? Get some dust from a vacuum cleaner and sprinkle it on each one. What happens? What advantage does this show for cable and other low-temperature heating equipment?

Insulation Is a Must

We wouldn't think of trying to keep warm on a cold day outdoors while dressed in shorts and a T-shirt. We would insulate ourselves with much heavier clothing. And if we are to keep our house comfortably warm without using excessive amounts of electricity we must do the same thing with it—insulate.



For Missouri homes that are to be electrically heated, ***six*** inches or more of insulation should be installed in the ceiling of the home, 3⅝ inches in the sidewalls and two inches under the floor.

Insulation loses its value if it picks up moisture from the air, so it must be protected on the warm side with a "vapor barrier" of aluminum foil, specially treated paper, or a plastic sheet. This impermeable material, properly applied, will prevent the invisible moisture in the warm room air from passing through the wall and into the insulation. Exterior paint peeling problems are reduced or eliminated by the use of the vapor barrier.

For more information on electric heat, insulation and ventilation for Missouri homes obtain University of Missouri Extension circulars on this subject from your University Extension Center.

As has already been implied, there are many other "spaces" around the farm where electric heat can provide a most economical and satisfactory solution to either personal comfort or to freezing problems. A small space heater or heat lamps in an insulated pump house can assure that your automatic water system will furnish a fresh supply of water all winter long.

Small electric resistance heaters and/or heat lamps can keep the space in the milkhouse from freezing and the washup area warmed for personal comfort. Electric resistance heaters warm the space under brooders to maintain the proper environment of baby chicks.

Regardless of the application, these principles apply when using electric heat for heating space: Conserve heat with insulation, calculate the heat losses, select the most desirable type of heating unit for the job and obtain desired temperature with accurate, properly located thermostatic controls.

Proposed Projects:

1. Review the National Electric Manufacturers Association Manual for Electric House Heating and other listed references. Select a room or building that needs heat and calculate its heat losses.
2. Install an electric space heater or other heating device in a milkhouse or milk parlor.
3. Install a thermostatically controlled heater in an insulated pumphouse. Insulate the pumphouse, if necessary.

What Did You Learn?

1. If the human skin temperature is about 81°F, why aren't you most comfortable at 81°F?
2. List all the advantages you can think of for using electric resistance heat for comfort heating.
3. Tell why winter clothing is usually dark in color and summer clothing light.
4. Can you think of reasons why man could not exist if it were not for radiant heat?
5. When you sit next to a cold window, why do you feel uncomfortable even if the temperature around you is 75°F?

Demonstrations You Can Give

Show and tell others the difference in operating temperature between heating cable and a portable heater.

Show and tell the proper method of insulating a home for electric heating in your climate.

Show how the presence of moisture affects the value of insulation.

Get one or more samples of some insulating material, preferably some with vapor barrier attached.

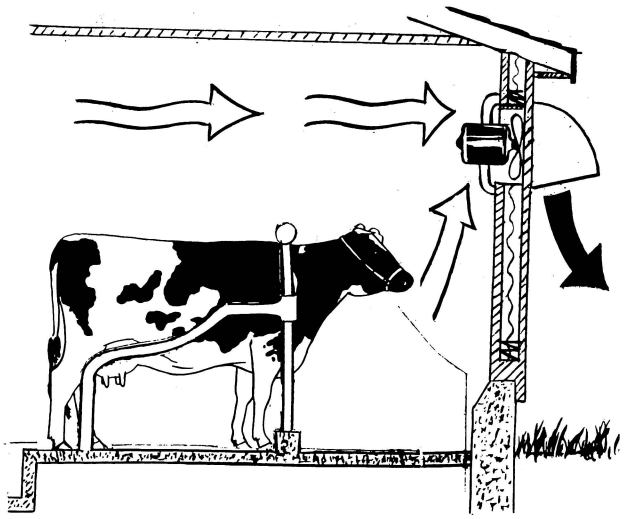
Direct a 250-watt heat lamp toward your hand for a few seconds at a distance of 6 inches. Next, place a piece of insulation between the lamp and your hand. Notice the difference. (Do not touch heat lamp or fixture with bare hands.)

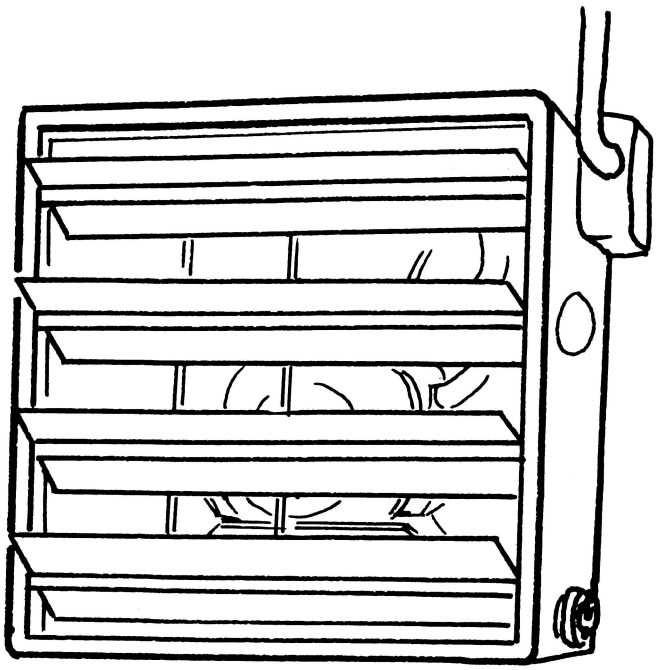
Wet one corner of your sample of insulation, using room temperature water. Put one hand on this wet area, another on a dry area of the material. What difference do you detect? Why?

For More Information

Ask your power supplier representative, electric supply house, or electric heat contractor for literature.

Unit 3





Install An Animal Shelter Ventilation System (farrowing house or poultry house)

Agricultural Engineering research has shown that meat, milk, and egg production can be increased when livestock and poultry are housed in buildings where proper temperature and relative humidity is maintained. Such environmental conditions usually contribute to longer building life as well.

A well designed ventilation system installed in a relatively tight insulated building can achieve good temperature-relative humidity conditions during winter months in Missouri. Such a system would include a sturdy fan with flexible air delivery, (a two-volume fan or two fans) properly located and easily controlled air inlets and one or more thermostats. In some cases it will be advantageous to use both a time clock and a thermostat for proper air movement and temperature control.

Heat and moisture production of livestock varies largely with the kind of animal housed, its primary function and its weight. These and other physiological factors have been studied by agricultural engineers and scientists who, in turn, have developed optimum ventilation rates for satisfactory removal of moisture and best utilization of animal heat. These air flow rates can be found in the references in terms of cubic feet of air per minute per hog, per hen, or per cow, etc. Thus, to determine the total fan capacity for livestock shelters, multiply the number of animals to be housed by the recommended ventilation rate per animal. Several fans will be required for buildings that house large numbers of animals.

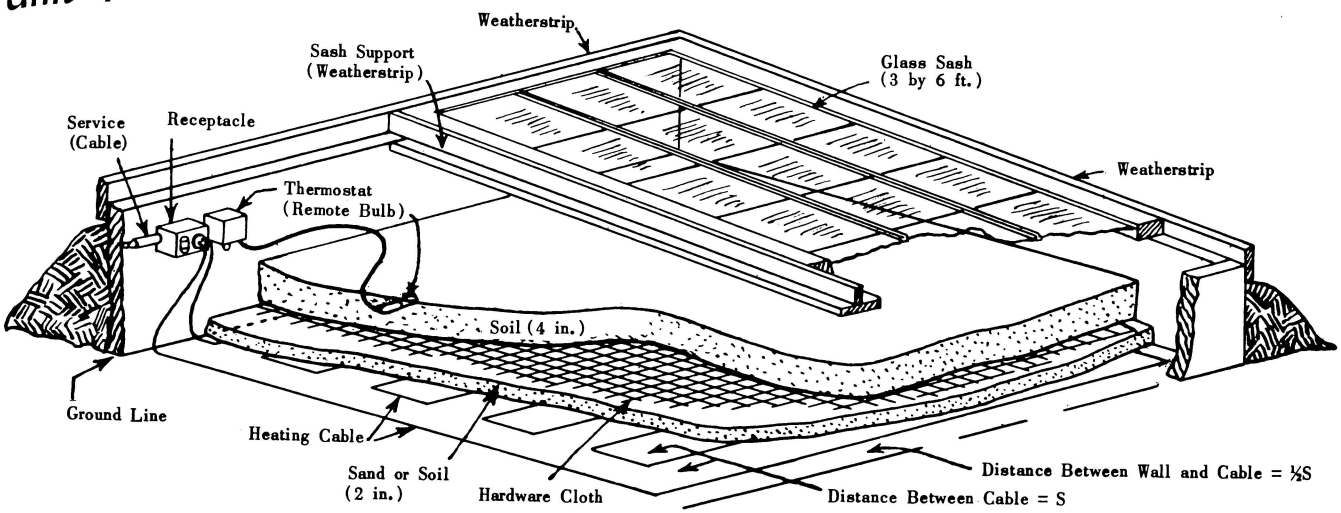
Winter-time ventilation fans are sometimes installed in the cold part of the shelter in order to use the heat in the air to help warm that area. If installed on the leeward side of the structure, however, the fan will usually have to operate against a slightly lower static pressure.

Fans used for the usual ventilation system in farrowing, broiler or laying houses should be selected on the basis of air delivery at ⅛ inch static pressure. Most fan manufacturers list air-deliveries in this manner.

Factors that must be considered when developing any ventilation system are the:

1. type, kind and number of animals housed
2. building construction and amount of insulation
3. optimum air flow per animal housed
4. location and type of controls to be used
5. location, size and type of fans used
6. minimum and/or optimum temperature to be maintained
7. adequate wiring and circuit protection
8. motor construction features and protection.

Unit 4



Build A Hotbed For Better Plants

If either you or your parents have a vegetable or flower garden project, the electric hotbed project may be "just for you." If you are interested in the science of plant development, this can be a most interesting, worthwhile and profitable venture. With a well constructed hotbed and a borrowed electric meter, you can set up your own private research project. Not only can you keep an account of original equipment costs, but also of the operating costs, the growth rate and production of plants grown in the hotbed and those grown under normal conditions, and many other factors which you yourself will want to consider.

An electrically heated hotbed that lets your plants get the jump on the weather has several advantages. Less labor is required, it is economical to build and to operate, and a positive temperature control produces a more uniform high quality plant.

How to Get Started and What to Do

1. Talk with your parents about the different aspects of the construction and operation of an electric hotbed.
2. Write for or otherwise obtain the references listed for Unit 4.
3. Select a good location—one that has good drainage and which is close to electricity and water outlets. It should receive a maximum amount of sunlight or you'll need to provide for special controlled lighting. (See reference on controlled light)
4. Determine size best for your needs
5. Use proper kind and amount of U.L. approved material.
6. Follow all construction details carefully.
7. Operate the bed and any auxillary lighting according to instructions.
8. Keep careful records of all costs.
9. Take pictures of the hotbed and plants at different stages to help tell what you did.
10. Report all costs, all comparisons made, and the net value of the hotbed to you and your family.

Unit 5

Install Electric Heat Cable For Comfort, Protection and Safety

In addition to heat for hotbeds, electric heating cable has many other home and farm uses. These insulated electric resistance wires can be buried about 1 to 1½ inches under the surface of concrete in farrowing house floors to prevent the chilling of new-born pigs. Similar cables have been used for constructing chick brooders and for use in floors of milking parlors to keep the operator comfortable while milking.

Electric cables are used under the surface of concrete ramps, driveways and sidewalks to eliminate or remove dangerous ice conditions and make farm living more safe. Electric cables are used in sheltered eave-spouts of homes to melt and remove heavy snow and ice accumulations that might "back" water under the roof to cause serious damage to the home interior. Electric cables are ideal for wrapping around exposed water pipes to prevent freezing.

Any one of these applications can be used as a unit for Electricity 4 but you will need much more information with which to plan, select, install, and operate the cable installation. The type of cable, cable spacing, wattage per square foot of floor area and other factors may be different for each of these applications. So you must be sure to get the information that pertains specifically to that application which you choose. Then you should consider:

1. The surface area to be heated or pipe length to be protected
2. The surface temperature desired or amount of heat needed
3. The kind, length, wattage and voltage of cable required
4. The type and number of thermostats and switches needed
5. How best to install cable, insulation and concrete
6. Whether equipment is U.L. approved for this application.

Unit 6

Build a Hi-Fi Set

The person who has both an appreciation for good music and an interest in electronics will find this project a rewarding experience. The term hi-fi or high-fidelity can mean many different things. The three basic forms of hi-fi are plain hi-fi, stereo, and reverberation.

Hi-fi is a term applied to an audio component, amplifier or system. High fidelity, in itself, means true, exact and complete reconstruction of the original sound. Naturally, this can never be obtained, but we try to come as close as possible to it. In other words, hi-fi is the ability to reproduce, with a very minimum of distortion, the full audio range of frequencies, generally agreed to be approximately 20 to 20,000 cycles.

Stereo or stereophonic sound is a kind of reproduced sound which not only has depth and direction, but which to a great extent, captures the acoustics of the place of performance. It is recorded with two microphones, one placed toward the right and one toward the left of the orchestra or performers. The sounds picked up by each are kept apart throughout the recording and the playback processes. Playback is through separate amplifiers (or a stereo amplifier) and through two speaker systems.

Reverberation is a succession of echos caused by reflections of sound within an enclosed space. A ***reverberation unit*** is an electro-mechanical device used with audio amplifiers to add an echo or reverberating effect to the sound being reproduced. Regulating the amount of reverberation provides an auditorium effect when reproducing sound even in small, or acoustically "dead" rooms.

If you choose to construct a hi-fi set, you may wish to have a console unit, a built-in unit or even a central unit with sound "piped" throughout the house. ***Stereo*** is probably the most popular type at the present time. ***Reverberation,*** new in hi-fi, is always present in the concert hall.

This material, of course, is only an introduction to the many possibilities in the field of hi-fi. We will leave the rest to you. You can obtain details about this subject, however, from a dealer, a repairman or from the list of references assigned to this Unit. Probably the best way to make your final decision regarding a specific project for this work unit is to look at and listen to many of the different music reproduction machines now available.

Many books and pamphlets may be obtained at your local library; or if ***your*** library has no material on the subject, ask the librarian to order some from the state library at Jefferson City. Tell the librarian about the particular subject in which you are interested and if you know the title of a particular book provide this information. The only charge will be for postage.

Two good sources of material supply are the Government Printing Office, Washington 25, D. C., and the reference booklets listed in almost all the radio supply catalogs. The cost of these publications will be from 10¢ to $2.00 depending on content.

Some rather basic publications can be obtained from commercial sources, a few of which are listed as Unit 6 references.

Unit 7

Transistors and Transistor Projects

The transistor is a device that amplifies electrical signals. It is a relatively new invention, developed after World War II in the course of a research program at the Bell Telephone laboratories which was seeking a better understanding of semiconductor devices.

Transistors are very small, long lived and efficient and are finding extensive use in electronic systems of communication (radio, television, intercom), automatic control and high speed computers. The transistor compares in flexibility with the thermionic electron tube; but, because of its smaller size, lower power consumption and improved reliability under adverse conditions of shock and vibration, it actually supplements the electron tube and makes the operation of small electronic equipment feasible. It is, largely because of the transistor that we have small pocket radios and inter-com systems available to us at a very reasonable cost.

You will need to become acquainted with many technical aspects of transistors—their structure, behavior, construction and performance if you are to use and operate them properly. But it is not our intent to go into detail on any of these aspects.

For completion of this unit you should complete one of the following suggested projects:

1. Auto, truck or tractor tachometer (construct or install)
2. Garage door opener
   a. horn activated
   b. light activated
   c. radio controlled
3. Remote electronic thermometer
4. Burgler alarm
5. Fire alarm
6. Stroboscope
7. Electronic power supply for photo-flash
8. Boat horn
9. Rain alarm
10. Radio with four or more transistors
11. Other projects of comparable complex

All of the above projects are relatively simple and can be completed from the material given in the references. All projects taken under No. 11 should be similar to the projects listed in 1 through 10.

Unit 8

Amateur Radio Project

Amateur Radio is probably the one most popular field of electronics today. In this project we are trying to give those who might be interested in this field a place to start. The requirements of this project will be those set down by the FCC for the acquisition of a Novice Operators license. They are as follows:

1. Build a code practice oscilator
2. Learn code and radio theory
3. Obtain novice license
4. Set up your transmitter and receiver.

The license obtained under this project will be temporary so it will be necessary for you to progress to one of the higher grades if you wish to continue operating. You will probably want to do this anyway as the novice license is code license only. Therefore, if you wish to advance to voice communications, you will need to obtain at least your Amateur standing.

Many of the technical aspects of this project can be obtained from the references listed under Unit 8.

For amateur radio license material write the Federal Communications Commission, Washington 25, D. C. Other materials can be obtained from your local or state libraries.

Unit 9

Rewire the Shop (From a 2-wire to 3-wire, 115 volt system)

Whether you live in town or country, most 4-H er's have access to a farm or home shop that may have a few or *many* portable tools. If you use tools like electric drills, saws, or sanders, we hope that you have learned to handle them properly. Using ungrounded portable tools in the shop and around the yard can, however, be hazardous, and especially so when the operator is standing on or near moist surroundings. Every year newspapers report several accidental deaths attributed to ungrounded faulty tools.

If *your* portable tools are relatively new, and if they meet present National Electric Code requirements, they will be equipped with a 3-conductor, 115 volt cord and plug. None of the plug terminals should ever be cut or damaged. The third wire and terminal provides a means of grounding the portable tool so that if any internal electrical "short" occurs, the circuit fuse will blow, protecting the operator.

Make your shop a safer place to work by rewiring it with 3-wire, 115 volt cable and outlets designed to receive the grounded tool plugs. Place a 3-conductor weatherproof outlet at points around the yard or farmstead where portable tools are frequently used. If it is impractical to run 3-wire cable to one of these remote locations, drive a good ground rod nearby and use a clamp, ground wire and an adapter to ground the tool. You can make you Mom's work safer too, by providing a 3-conductor grounded outlet for the washer which is quite often operated in wet surroundings.

References listed under Unit 9 will be found quite helpful to you in the completion of this work.

While rewiring the shop, check all motors to see that they are properly protected and adequately oiled. Check all belts for alignment and for tension.

Unit 10

Wire A Small Building (Poultry House or Swine Barn)

With the rapid changes taking place in today's agriculture, many farmers cannot use older buildings because of their obsolete design or their obsolete wiring systems. Look around your farm and see whether you have a building that needs rewiring—perhaps because you wish to house one of your 4-H livestock projects in it. Unused poultry houses can often by converted into farrowing houses. But regardless of the reason for the rewiring, a few important points for consideration are listed below:

1. Determine all present uses of electricity and anticipate future electrical loads for the building.
2. Develop an adequate wiring plan and lay out on graph paper.
3. Consult your electrician for his approval and work under his supervision or other qualified electrical worker.
4. Purchase only U.L. approved wiring and equipment and use only where it is intended by manufacturer to be used. Install in accord with National Electric Code and/or local codes. Be sure to install an adequate service entrance and building ground.
5. Have complete wiring job inspected before energizing any part of the job.
6. Take photographs of work done and of individuals involved.
7. Prepare summary of costs and benefits involved.

The listed references will serve as a guide to planning, equipment selection and installation.

Unit 11

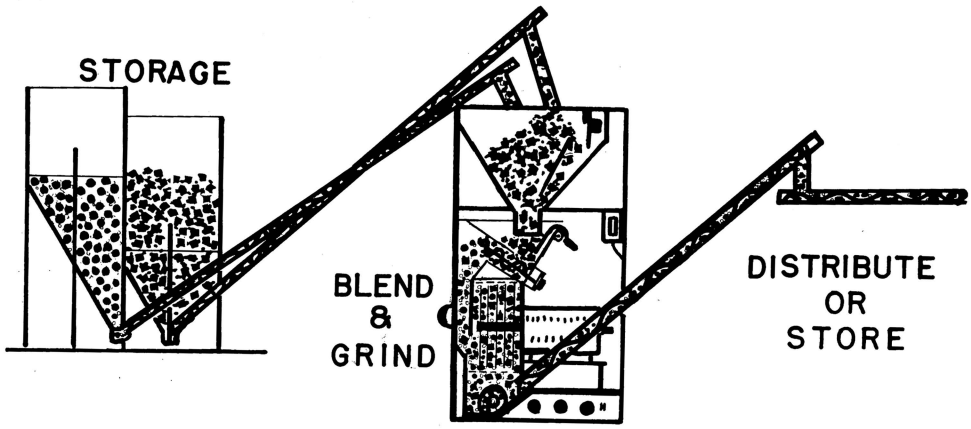
Install A Feed Handling or Distribution System

Automatic electric feed handling systems can be simple and low in first cost or elaborate and expensive. Before making application to "enroll" in this Unit, both you and your parents should discuss fully the specific needs for reducing man-hours and labor on your farm, the approximate cost of equipment needed to eliminate this work, how the hours saved can be put to more productive use and specific arrangements for equipment purchase and payment. Thus, you should begin with a proposed plan, asking your extension agent for help which he can provide.

Many hours of labor can be eliminated on livestock farms by the purchase and installation of small distribution augers or other conveyors that will move grain or ground feed from bin to self-feeders located right in the feedlot. Such laborsavers can be used even where commercial feeds are delivered to the farm in bulk trucks. In some cases, a storage bin, one or more 4 or 5-inch diameter augers with drive assembly, motors and pressure switch(es) are all that are needed to get the feed to hogs or other animals with little or no labor.

Once you and your parents have decided how far you can go, and you have your plan made up, you'll need to decide what equipment you need to buy and what parts you can make in your own shop. You may, for instance, wish to make up your own bin cut-off switch;

A CONTINUOUS FLOW SYSTEM



SIMULTANEOUS PROPORTIONING
FEED MIXED · THEN GROUND
LOW CAPACITY COMPONENTS
CONTINUOUS FLOW
AUTOMATIC OPERATION

you may want to do your own wiring or even build your own holding bin. But don't let these ideas limit your imagination. You may even want to install a complete storage-mixing-processing ***and*** distribution system incorporating the use of an automatic mill similar to that shown in Unit 4 of Workbook *3.*

Regardless of the extent of work done under this plan, be sure to:

1. develop a detailed plan with a scaled drawing
2. get an electrician or power supplier ***and*** extension agent approval
3. select U.L. approved equipment and wire according to National Electric Code and any local codes
4. do all wiring work under the supervision and guidance of an electrician or power supplier representative
5. make a report on cost and benefits of the project with specific information on time and travel saved and how this "saved" time was used to advantage. Use pictures for your report.

Unit 12

Your Choice

This unit is included so any 4-H boy or girl enrolled in Electricity 4 may further develop his knowledge in some ***specific*** phase of the broad field of electricity.

It is anticipated that some 4-H'ers may use Unit 12 as one of the two required for project completion. Consequently, we expect the club member to learn all he can about his particular subject. It is also expected that some type of equipment will be constructed. The quality of construction of the equipment will serve to show how much and how well the technical information has been studied by the 4-H club member.

As we do not expect every leader to be well versed in all topics in which fourth year Electric Project enrollees might be interested, it is important that the member know where he will obtain his technical information ***before*** he starts this unit.

Acknowledgements

Planning and organizational assistance was given by the Missouri State 4-H Electric Program Planning Committee:

Kenneth L. McFate, Associate Professor, Agricultural Engineering and Co-Chairman of Committee

Nelson Trickey, Extension Youth Specialist and Co-Chairman of Committee

Edward J. Constien, Extension Agricultural Engineer

William Spinabella, Sho-Me Power Corporation

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Carl Shubert, Kansas City Power and Light Company

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OPEN UNIT - APPROVAL FORM

I would like to study about _____

_____

I would, after investigation and study, be able to build _____

_____

_____

I would obtain my technical information from the following people, books and references:

_____

_____

_____

_____

In Electricity 1, 2, and 3, I built _____

_____

_____

_____

In the following paragraph, I have outlined why I am particularly interested in this topic and why I feel I am capable of completing it.

_____

_____

_____

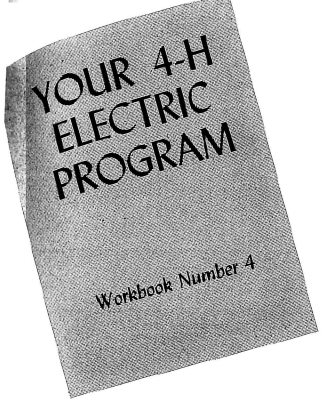
Member _____ Address _____

Based on the information above and an understanding of the member's attitudes and aptitudes, I feel he (she) can follow Unit 12 through to completion. I, therefore, approve this Unit for credit in Electricity 4.

_____ _____

Project Leader Date

Issued in furtherance of cooperative extension work, acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. C. B. Ratchford, Director, Cooperative Extension Service, University of Missouri, Columbia, Mo.



ELECTRICITY PROJECT IV

Record Blank

Name _____ Address _____

Age _____ Club _____

Years Enrolled In Electricity _____ Leader _____

Parents Name _____

Who Furnishes Electricity to Your Home? _____

My Participation:

Club meetings attended during year___. Project meetings held___. Project meetings attended____.
Number of demonstrations given at: project meetings____, community club meetings____, county meetings____, district meetings____, and state meetings____.
Number of times participated in judging work in: project meetings____, county____, district____, state____, interstate____.
Number of exhibits made in: community____, county____, district____, state____, interstate____.

Participated In:
County Achievement Day____, District Achievement Day____, State Achievement Day____, national contests____, county fair or show____, district fair____, State Fair____, Interstate Show____, marketing days____, county camp____, district camp____, State Club Week____, National Club Congress or National 4-H Conference____.

Number of news stories published____. Number of radio and T.V. programs participated in____. Number of public speeches made____.

Served on _____ standing committee in club.

-- PROJECT REQUIREMENTS --

1. Attend a majority of project meetings held and six community meetings.
2. Complete at least 2 units.
3. Perform at least one demonstration before a group of people.
4. Write a short story on page 3 telling "How Electricity Has Benefited Me This Year".
5. Turn in workbook or project record to your club leader by_____, 19___.

I certify that _____ has met the requirements of this 4-H
Member's Name
project as outlined.

Signed _____
Project Leader

SUMMARY OF ACHIEVEMENT

Number of project meetings held by club leader _____.

Number of project meetings attended by you _____.

Number of surveys completed _____.
(attach all survey sheets to the back of this report)

Number of demonstrations performed _____. List these and related information below:

Title	For Whom Given	When Given	Number in attendance

List pieces of equipment built and exhibited:

Item	Value	How Obtained	How Used	When Exhibited

What additional activities, where electricity was used, did you and/or your club engage in during the year: (be specific)

_____

_____

_____

_____

_____

_____

_____

_____

In your own words write a short story telling how electricity has benefited you this year. Include such things as the amount of time and labor that one or more pieces of equipment have saved, the cost of operation, safety, health and other factors, if they apply to your particular situation. You can think of many other advantages and you'll want to report these ideas in a concise manner. Use pictures if they are available.

-- ACHIEVEMENT AWARDS AVAILABLE --

Ribbons are presented to electric project members who demonstrate or exhibit at County Achievement Days. Top demonstrators represent their county at district and state achievement days where additional ribbons are presented.

Be a 4-H Star! Each year about thirty 4-H boys and girls will be chosen to give an electrical demonstration in the 4-H Electric Theatre at the Missouri State Fair. Details may be obtained from your County Extension Agent.

County Achievement Pin. Awarded for completion of project requirements.

-- NATIONAL AWARDS PROGRAM --

County Medal: Awarded to the top four boys and girls in each county who fill out and turn in the standard report forms.

State Award: One boy or girl is selected from county electric program medal winners for an all expense paid trip to the National 4-H Club Congress in Chicago each year.

National Awards: Six $400 scholarships to state trip winners in blue award group.

Your county will be awarded a handsome plaque if it reports the most outstanding Electric Program in the state. You can help your county win this award by doing more than just the requirements in your project.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING
C. B. Ratchford, Director, Agricultural Extension Service. Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914

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