FARM HANDICRAFT
1 - ROPE WORK
4-H CLUB CIRCULAR 51

COOPERATIVE EXTENSION WORK IN
AGRICULTURE AND HOME ECONOMICS
UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING
J. W. BURCH, Assistant Director, in Charge Agricultural Extension Service
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* The Leader's Guide on Farm Handicraft I - Rope work is to be used with this Club Circular.
INTRODUCTION - PRACTICAL USES OF ROPE.

The active farm boy uses a rope and ties knots frequently in doing field work and the farm chores. Many minutes may be saved by having a working knowledge of the proper knots to use under different conditions and the proper way to tie them. The farm lad who grows up using awkward and unsuited knots that come untied, slip or draw into hard knots, makes his work more difficult and adds needless annoyances to his daily life.

ROPE WORK

Rope Materials

Ropes are made from a number of different vegetable fibers, including manila, sisal and cotton. Practically all of the rope used on the farm is manila or sisal fiber or a combination of the two, and is commonly known as hemp rope.

Manila fiber is a product of the Phillipine Islands. It is obtained from the outer layer of the abaca plant, which closely resembles the banana plant. The best grade of manila fiber is light buff in color, has a lustrous appearance, is fine, flexible and from six to twelve feet in length.

Sisal fiber is obtained from the leaves of a plant grown in Yucatan, is from two and one-half to five feet in length, slightly yellowish white in color, straight, and smooth. It is coarser, however, not as flexible and has but about three-quarters the tensile strength of manila fiber.

Rope Definitions and Terminology

Fiber—Threadlike material obtained direct from the plant. (D Fig. 1.)

Yarn—Fibers twisted together. (C Fig. 1)

Thread—Two or more small yarns twisted together.

Strand—Two or more large yarns twisted together. (B Fig. 1)

Rope—Two or more strands twisted together. (A Fig. 1)

Hawser—A rope of three strands, laid up right-handed.

Cable—Three hawsers twisted together left-handed.

Standing Part—Part of the rope upon which the main load will be placed.

The Bight—Where the end is turned back on the standing part.

*Prepared by Mack M. Jones, Professor of Agricultural Engineering and Marion W. Clark, Extension Specialist in Agricultural Engineering, in collaboration with T. T. Martin and E. T. Itschner, State Club Agents.
The Loop--This is made by crossing one side of the bight over the other.

Round Turn--This is where the end of the loop is carried around until it is parallel with the standing end or the standing part of the rope--see Fig. 3.

Splice--To join the ends of a rope together interweaving or interlaying the strands.

End Splice--To weave the end of a rope back into the standing part.

Haul--To pull on a rope.

Taut--Drawn tight.

Method of Manufacturing Rope

Rope is manufactured by special machinery. A number of fibers D Fig. 1, are twisted together in a right-hand direction to form yarns C. (The direction of twist is said to be right handed when the twist is in the same direction as the hands of a clock move when the end is pointed toward the clock. If the twist is counter-clockwise, it is said to be left handed.) Yarns are twisted together in a left-hand direction to form the strand B. Three or four strands are then twisted together in a right hand direction to form a rope A.

The alternate right and left twisting of the fibers, yarns, and strands, produce a balance which tends to keep the rope in proper form and also holds the fibers together by friction when a load is applied to the rope.

Strength of Rope

Any person using rope should have a general idea as to its tensile strength, if that person is to use rope safely and economically. The strength of new manila rope may be calculated roughly by multiplying 7200 by the square of the diameter of the rope. The tensile strength is divided by six or seven (the safety factor) to obtain the safe load. A safety factor of seven is usually recommended although it varies for different conditions. Example: Find tensile strength and safe load for 1/2 inch manila rope.

\[
\begin{align*}
1/2 \times 1/2 &= 1/4 \\
1/4 \times 7200 &= 1800 \text{ tensile strength} \\
1800 &= 257 \text{ pounds safe load}
\end{align*}
\]

Figures arrived at by this rule are only approximate and will vary somewhat from those given in Table I.

The use of rope in pulleys that are too small will greatly increase the wear on the rope. Sharp turns set up internal strain and wear. The diameter of the pulleys should be at least eight times the diameter of the rope. For a guide on strength of rope and diameter of pulleys, Table I is included. It must be remembered that this table is calculated for steady loads on the rope and it will take only approximately one-half the load to break the given rope if it is applied suddenly in the form of a jerk.
Table I. Safe Load, Breaking Load, and Diameter of Pulley for Various Sizes of Three-Strand Manila Rope.¹

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Weight of 100 feet of rope</th>
<th>Length of rope per pound</th>
<th>Safe load</th>
<th>Breaking load</th>
<th>Diameter of pulley</th>
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<tr>
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<td>pound</td>
<td>feet</td>
<td>inches</td>
<td>pounds</td>
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<td>55</td>
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<td>56 700</td>
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</table>

¹C. W. Hunt and Spencer Miller.
The Use of Pulleys

Some knowledge of blocks and tackles will be needed by the farm lad on various occasions. A block consists of a frame of wood or steel in which are fitted one or more pulleys or sheaves which roll under the rope. The tackle is the combination of ropes and blocks for the purpose of multiplying the force exerted. The mechanical advantage of a block and tackle is found by counting the number of strands of rope which support the movable block. Neglecting friction, if a 50-pound down pull is exerted on the end of the rope shown in Fig. 2, a 300 pound upward pull would be exerted on the hook at B. You will notice six strands of rope support any load placed on the hook. Neglecting the friction, each strand will exert the same pull as is applied on the end of the rope, and consequently will lift on the load with six times the force exerted at the end of the rope.

The amount of friction in a block and tackle will vary considerably, depending mainly upon the number of pulleys, the type of bearings in the pulleys and the lubrication of the bearings. For blocks and tackles used under average farm conditions, the friction loss may be considered as about 10 percent for each pulley in the tackle.

![Diagram of Parts of Rope](image)

Fig. 1
Parts of Rope
A, Whole Rope; B, Strand; C, Yarn; D, Fibers

Care of Rope

The first thing that is likely to annoy the owner of a new rope is its tendency to kink. One of the most practical and effective methods of overcoming this tendency in a long rope is to unroll it and drag it by one end. The rope may be dragged by hand, behind a horse or even a car if on a surface, such as sod, which will not wear the rope unnecessarily. If the rope is short, one end may be tied to a beam and a weight tied to the free end.

The methods of coiling and uncoiling a rope are important in preventing kinking. When coiling a rope for storage it should be done up in a free, easy coil without abrupt turns or bends. One convenient method is to hold the end of the rope between the
Fig. 2
Block and Tackle
left thumb and finger (palm of hand toward your face) with the end of the rope pointed to the right across in front of the face. Take the rope outward and down, then back under the elbow of the left arm which is flexed, and up in front of the body and then over the thumb to the outside and down as before until all the rope is coiled. This coils a right or clockwise twisted rope in a counter clockwise or against the sun direction. (The working end of rope pointed toward sun or clock face). When casting a large loop for lariat purposes the rope is coiled in this manner and held in the left hand while the lariat loop is cast with the right hand.

Rope is exceedingly easy to mistreat. It is easy to cut and it wears rapidly when pulled over rough or sharp edges. It takes water readily and decays easily. A rope may easily be five to eight times as strong when it is new as after a short period of careless use even though no great amount of damage is apparent. This is one of the reasons for the large safety factor used.

There are three general ways in which ropes are weakened—by internal wear, external wear, and rotting.

Internal wear is detected by the presence of rope dust, fiber ends exposed, and distinct edges on the inside of the strands. This is chiefly caused by the fibers slipping over each other where the rope is bent over small pulleys, etc. For proper pulley diameters see Table I.

External wear is caused by drawing the rope over rough surfaces or rough projections which catch and tear the individual fibers. This can be easily detected by broken fibers and threadbare appearance.

Rotting of the fibers is caused by exposure to dampness, being left wet under poor conditions for drying, etc.

Relaying Strands

If the end of a rope becomes untwisted and the strands stay in good condition they may be relayed in such a manner that the relayed portion can scarcely be identified. A very good method is shown in Fig. 4.

Grasp the rope immediately below the untwisted portion with the left hand. Grasp one strand with the right hand and twist it tightly to the right (see arrow, Fig. 4) and snugly across the face of the rope. Hold it in place with the left thumb. Continue with the other two strands in turn and repeat until the process is completed.

Better results are usually obtained when the rope is not rotated in the left hand, but when this hand is simply moved straight up the rope. If strands are badly frayed out, the practical solution, if possible to spare the rope, is to cut off the end.

Whipping Ends of Rope

Whipping is a neat and effective method of preventing the end of a rope from untwisting. This method is particularly valuable when the end of a rope must be passed through a small opening. One of the best methods of doing this is illustrated in
Fig. 3
Elements of a Knot

Fig. 4
Relaying Strands

Fig. 5
Whipping the End of a Rope to Prevent Fraying
1. Secure a stout cord 2½' to 3' long and unlay one strand of the rope. Place the whipping cord under the strand as far down as it is unlaid, leaving the short end of the cord 8 to 10 inches long, then relay the strand into its place as discussed in relaying strands. Page 6.

2. Let the short end hang down the standing part of the rope while the long end is given one complete turn around the rope. Pull the short end toward the end of the rope and turn it back on itself allowing it to form a bight. The sides of a bight thus formed may be laid along a groove in the rope. Continue to wind the long end of the cord around the rope, starting just above the first complete right hand turn and continue to wrap toward the end of the rope with no vacant places left or no turn on top of another until you have come within a quarter of an inch of the end of the rope. Next pass the end of the cord through the bight and pull on the other end until the bight is drawn under the whipping to about the center, then cut off both ends at the edge of the whipping.

KNOTS

All knots and hitches reduce the tensile strength of a rope somewhat and those which bend the rope most abruptly reduce the tensile strength most. This is because the greatest strain occurs on the fibers on the outside of the turn and when they break the load must be carried by the remaining fibers. Illustrations, descriptions and uses for some of the most important knots that will come into use on the farm are given below. It may be advisable for each club member to pick out a few favorite knots that he believes will be particularly valuable to him and concentrate on these. Sufficient knots are included to allow for individual choice and variation.

Overhand Knot

The overhand knot is often considered the simplest of all knots, yet it is a very useful knot. It is used in many other knots and also in long splices. It is used commonly to form a knot on the end of a rope and to prevent the rope from untwisting. See Fig. 6.

Fisherman's Knot

The Fisherman's knot is also very simple and is used mainly for joining silk lines or guts on fish tackles. In making this knot the ends should be laid side by side and then each end tied around the other using an overhand knot. See Fig. 7.

The Square Knot

The square knot is probably the most frequently used knot with the possible exception of the overhand knot. It is used to join the ends of two ropes or twine together and is very secure when ropes of about the same size are tied together. The knot is fairly easy to untie and does not slip once it is properly tied and drawn up.

The ends of the rope are placed along side each other and
Fig. 6
Overhand Knot

Fig. 7
Fisherman's Knot

Fig. 8
Square Knot
one end held while the other end is taken across and under the first. Curve the first end back and then continue with the second end over the bight thus formed and back through, each end lying along side its standing part. Fig. 8. The club member may develop his own method of tying after he has learned to recognize the true square knot. This knot is often mistaken for the granny knot which may slip, come untied and be altogether undependable.

**The Slip Knot**

This knot is sometimes called the running knot. To tie this knot a bight may be made and an overhand knot tied in one side of the bight around the other side much the same as in the fisherman's knot. This knot will draw tight, but is very convenient for some uses because it is simple and easily made. Fig. 9.

**The Tom Fool's Knot or Double Bow Knot**

This knot is sometimes called a trick knot although it is a very useful knot. It is often used for ringing hogs. One loop is slipped over the hog's upper jaw and the standing end of that loop is fastened to a post. The knot is untied and the hog released by pulling the opposite end of the rope. This knot may be tied by tying a slip knot, leaving the end of the rope long, then by putting the end back through and drawing up the knot. Fig. 10.

**The Hitching or Manger Knot**

Pass the rope around a post thus forming a bight and grasp both sides of the bight with the left hand, Fig. 11a. With the right hand throw the end of the rope over the bight and reach through this loop thus formed and pull the end of the rope back through toward you. Before the end of the rope is pulled out of this loop, draw the knot up snugly. Put the end of the rope back through the lower loop as shown in Fig. 11c. If this tie is used on a post that is smooth and there is danger of it slipping to the ground, it should be left so that the pull would be made to one side. This will tighten the rope and hold it securely. Fig. 11e. If it is left as in Fig. 11d the pull will not tighten the knot and it may slip down. Instead of passing the short end down through the third bight, it may be carried around and an overhand knot tied in itself around one side of the last bight.

**The Bowline Knot**

The bowline knot is often called the king of knots. It is one of the most useful knots and is not hard to tie after it is once learned. It will not slip and will not draw tight. To tie this knot, make a loop (Fig. 12a) then bring the end up through the loop, around the standing part, then back through the loop again as shown in Fig. 12b.

**Anchor Bend Knot**

The anchor bend knot is very good for fastening a rope into an iron ring or over a beam. The rope is doubled which prevents excessive wear on the part which comes in contact with the ring or the beam. Whip the end of the rope Fig. 13d. to the standing end. This tie is particularly good for swing ropes.

**The Miller's Knot**

The miller's knot is an easy knot to tie and does not give
Fig. 9
Slip Knot

Fig. 10
Tom Fool's or Double Bow Knot

Fig. 11
Hitching or Manger Knot

Fig. 12
Bowline Knot
Fig. 13
Anchor Bend

Fig. 14
Miller's Knot
Fig. 15  
Weaver's Knot

Fig. 16  
Figure "8" Knot

Fig. 17  
Bowline on the Bight
or allow the sack to come untied. It does not form a hard knot. It is indeed unfortunate that so small percent of farm folks really make use of this knot. This is probably due mainly to the lack of a working knowledge of the knot. In mills and elevators (granaries and different stores) this knot is used almost exclusively. To tie the knot, grasp the top of the sack with the right hand and lay a short piece of cord 16 to 18 inches long across the sack, work it under all fingers except the index finger. Fig. 14a. Take the left hand and carry the end around and under all fingers of the hand. Make one more complete circle this time, stopping opposite the index finger; pull the end of the cord, Fig. 14c, through the place occupied by the index finger and draw both ends taut as shown in Fig. 14d.

Weaver’s Knot or Sheet Bend

This knot may be used for joining two ropes together, is easily tied, does not draw tight and is easily untied. To tie it, make a bight in one rope and pass the end of the other rope through this bight around both sides of the bight and back through beneath its standing part. A short, stiff wooden stick or toggle may be placed into the knot as shown in Fig. 15, to allow it to be more easily tied after an extreme pull.

The Figure “8” Knot

This knot is often used to prevent the end of the rope from pulling through holes, or through eyes or pulleys. To tie this knot a loop is formed near the end of the rope, the end is then put around the standing part and back through the first loop. The knot is completed by drawing it tight. Fig. 16.

Bowline on the Bight

This knot is made in the middle of a long rope or in the end of a rope that has been doubled. (While this knot is not used as frequently as some others, it is important as it is used for casting horses and cattle.) It is a safe knot, can be tied easily and does not draw tight. To tie it put a loop in the doubled rope in the same manner as tying the single bowline. Run the bight up through the loop the same as for the bowline but bring the bight down and slip over the loop and back up around the standing parts. Fig. 17d. The knot can be adjusted by feeding the standing parts of the rope through in either direction and working the loop up or down accordingly.

Sheep Shank

The sheep shank is a very desirable means for shortening a rope either permanently or temporarily. To tie this knot grasp the rope making a double bight as in Fig. 18a. The length of these bights may be increased or decreased as the occasion demands to shorten the rope. Next put the standing parts around both bights as shown in Fig. 18c and d. When the end of the rope is accessible, the standing part may be run back through the end of the bight as in Fig. 18e (right) to make a permanent knot; or if the end of the rope is not available a short, stout stick may be placed in the bight as in Fig. 18e (left). Still another method is to whip the bight to the standing end with cord. Too much dependence should not be placed on the temporary form of the sheep shank.
Fig. 18
Sheep Shank

Fig. 19
Lariat Knot
Lariat Knot

This knot is used to make a temporary lariat. A better lariat can be made with an eye splice around a metal eye if it is available. On most farms, however, a lariat is not used sufficiently to justify this and the lariat knot is given to take its place. Tie two overhand knots, (Fig. 19) one at the end of the rope and drawn tightly, and the other a short distance from the end and not drawn up. The end of the rope is passed around the standing part of the rope and through the loop. The knot may be drawn up on the lariat if very temporary use is expected; if more wear is expected, the knot should be doubled or the end passed through the overhand knot loop twice before it is drawn up. This affords two wearing surfaces in the eye instead of one which is commonly used.

Hitches

Hitches are in the main temporary knots used to fasten ropes, or cable around timber, pipe or other objects where more or less a continuous pull is exerted. One of their advantages over knots in these conditions is a great saving of time. The diversity of the farm boy's work makes it desirable that he know a number of these hitches.

Half Hitch

The half-hitch is a very temporary fastening unless used with other more secure knots. It is a very useful fastening, however, and where the pull is kept constant it may sometimes be used alone in moving logs, poles, etc. Figure 20a shows the half-hitch as it appears ready to slip over the end of an object, such as a post. Figure 20b shows the half-hitch as it is used around logs or timbers, the lower end of the rope being fastened with another knot.

Timber Hitch

This hitch is made similar to the half-hitch, but is made by winding the short end back around itself once or twice instead of just being placed under itself. Timber hitch is shown in Figure 21. It is a very useful hitch in handling logs, lumber and ties. The timber hitch and half hitch combined, as shown in Figure 22 is much safer than either of these knots used alone. The half-hitch may be made first, then the timber hitch; or at the end of a log the timber hitch may be made and the half hitch thrown as shown in Figure 23a.

The Clove Hitch

The clove hitch is considered very useful in fastening a rope to a stake or post. One of the principal uses is to fasten tent ropes. If used on a pipe or pole it should be one that will not roll, else the hitch may fail under extreme tension. To tie this hitch around a post when a pull is being exerted, give the end of the rope one turn around the post and then cross the standing part as in Figure 23a, and pass the end of the rope again around the pole and under itself where it crossed the standing part of the rope. The clove hitch can also be tied in the middle of a rope and thrown over the end of a post. Study the illustrations (Fig. 23 upper) and you will note that it only involves get-
Fig. 20
Half-hitch

Fig. 21
Timber Hitch

Fig. 22
Timber Hitch and Half-hitch Combined

Fig. 23
Clove Hitch
Fig. 24
Blackwall Hitch

Fig. 25
Scaffold Hitch
Fig. 26
The Pipe Hitch

Fig. 27
Taut Line Hitch

Fig. 28
Snubbing Hitch
ting sufficient slack to make two loops.

The Blackwall Hitch

This hitch is a temporary fastening used to fasten a rope over the end of a steel hook. Figure 24a shows the single hitch and Figure 22b the double hitch. Either of these hitches is effective as a temporary measure and will hold securely as long as the short end is bound between the hook and the standing end of the rope. This is best accomplished by keeping the rope taut.

The Scaffold Hitch

This hitch is used to support hanging or suspended scaffolds. First, pass the rope under the plank and back up and around the standing part. Then put the short end of the rope back underneath the plank and up far enough on the other side to make a bight. Pass the end over the plank and through the bight as the arrow indicates in Figure 25b. The end is then carried up to the standing part of the rope and tied with a bowline knot. The board is then leveled and the hitch drawn tight.

The Pipe Hitch

This is an important hitch to use in lifting a pipe from a well. To make it, make one complete turn around the pipe with the end of the rope crossing the standing part at the completion of the turn. (Fig. 26) Make a second complete turn just under this turn and complete the turn by again going over the standing part. A third complete turn is made this time with the end of the rope passing below the standing part and up through between the last two turns. To further insure the knot a clove hitch should be tied below. The rope should be wet and drawn as tightly as possible and the pull kept parallel with the pipe. Made in this manner this hitch can be relied upon to lift wet, slippery pipes.

The Taut Line Hitch

The taut line hitch may be used as an emergency hitch. It can be used when a rope or cable has a broken strand and tension cannot be released to repair.

To make this hitch make two full turns with the relief rope about the taut rope, wrapping downward toward the break as shown in Fig. 27. Next pass the end of the rope up over the two turns and make a third turn as shown in Fig. 27. This hitch will not hold unless it is very firmly tied and then tightened while the new rope is having the load shifted to it.

Snubbing Hitch

The snubbing hitch is usually needed in connection with the use of a lariat knot. This hitch is used in snubbing animals to assist in holding them or to draw a lassoed animal up close to a hitching post.

A hitch is made by throwing the end of the rope around a post passing the free end over the standing part then under and back through the loop formed, holding the free end as shown in Figure 28a. The animal can be easily held in this manner and any slack can be taken up or the animal given more rope. The com-
Fig. 29
Short Splice
pleteed hitch can be made as shown in Figure 28c. This knot can be moved toward the animal, taking up slack, but will not slip back toward the post by the pull of the animal. Like most all other hitches this should not be used as a permanent tie.

ROPE SPlicing.

The types of rope splices in common use are: (1) the short splice, with two other forms of the same type, the eye splice and end splice; and (2) the long splice. The long splice is made in a different manner and is particularly designed to put two ropes together permanently and in such a way that the splice may be run through pulleys or small openings where the short splice would be objectionable because of the added bulk. The long splice shortens the rope more and if there is only a little rope to spare, the short splice may sometimes be used instead of the long splice. There is little difference in the strength of the two splices when both are properly made.

Short Splice

1. To make the short splice, first unlay the two ropes for 6 to 8 turns, (Fig. 29a), being sure that the strands all branch out directly from the rope and no strands are crossed in front of the rope.

2. Next put these two ends together as in Figure 29b, in such a way that the strands from one rope alternate with the strands from the other rope. In other words, each two strands in one rope are separated by a single strand from the other group.

3. After these ropes are worked firmly together in this manner, wrap a string or cord tightly around all six strands, Figure 29c, to hold the ropes together temporarily.

4. Next pick one strand, say 1, Figure 29d, and put it over the strand next to it (No. 4, Fig. 29d) and under the second strand, as shown. Each strand in turn should be taken over one strand in rope Y then under the next. The strands of X work around the rope keeping almost at right angles to the strands of Y, which means the strands 1, 2, 3 move diagonally around the rope Y. After these strands are woven under the strands in rope Y at least 3 times the whipping cord may be removed. Ends 4, 5 and 6 are to be treated likewise. The ends may be thinned or tapered out in order to allow the splice to taper back gradually to the normal size rope. To give a smooth finished splice, it may be rolled under a block or under the foot.

Long Splice

When the spliced rope is to be passed through a pulley as previously mentioned, the long splice is the desirable splice. Its size is not materially increased. Its strength, if properly spliced, is decreased very little, if at all, but the rope is shortened 5 to 6 feet depending some on the size and type of rope. Directions are given here for splicing three-strand ropes. Four-strand ropes may be spliced in a similar manner, however.

1. Unlay each rope 15 to 20 turns and put the ends together in the same manner as given under short splices. (These strands need not be bound as in the short splice.) Continue to
Fig. 31
Mathew Walker Knot
Fig. 32
Crown Knot

Fig. 33
Crown Splice
unlay one strand and follow it by neatly relaying in its place the strand from the other end of the rope which laid along side it when the two ends were pushed together. Continue this until all but about 6" of the relayed strand is used. Fig. 30. Tie an over-hand knot in these two strands, being careful to cross the strands so the knot will lie smoothly. If the strands are crossed in the wrong way in making the overhand knot, a large bulky knot will result. One strand is then unlaid from the center back on the other rope and followed by relaying the strand next to it neatly in its place. These two strands are tied with an overhand knot. Two strands along side and parallel to each other are left in the center. Fig. 30d. The strands are cut off to about 6" long and an overhand knot tied in each pair and the knot worked down neatly into the rope. (Fig. 30e.) The ends of the strands are then woven over the first strand and under the next, as in the short splice. This is repeated twice more making at least three tucks for the ends of all strands. A finished splice is illustrated in Figure 30b. The smoothness of the splice can be materially improved by tapering the strands (as shown in short splice) and by rolling the rope for the length of the splice.

Replacing a Broken Strand

Oftentimes a rope that would be good otherwise has in it one seriously damaged strand. To repair this unlay the damaged or broken strand, secure a good strand from a similar rope, preferably one that has been used sufficiently for it to be stretched, and relay this strand into the place occupied by the broken strand. This should be done the same as directed for the long splice except here only one strand is dealt with. At each end of the strand tie an overhand knot and weave the end as directed for long splices.

Wall Knot and Matthew Walker Knot

These knots are particularly useful in preventing the end of a rope from untwisting and in preventing the end from being pulled through a small hole. They also form a neat hand hold on the end of a lead.

1. To make a wall knot, unlay the rope as in a short splice then loop one strand over between the other two strands, Figure 31. Cross B over A and behind C, then bring strand C over B and back under strand B and A, then up through loop 1 as shown by the arrow in Figure 31. If the ends of the strands are drawn up firmly and evenly at this stage a wall knot is the result, Figure 31.

2. To make the Matthew Walker Knot, the strands are left loose, Figure 31. The end of Strand B is then carried on around and put under C and A and up through loop 1. Next, the end of strand C is taken over strand A and then under both A and B then up through loop 2. The next move is to put strand A under B and up through loop 3.

3. Work the strands up snugly by drawing first one then the other. The knot may then be wet and drawn tight. The ends are cut off about 1/2 inch from the knot.

Crown Knot

Completing the crown knot is the first step in making an end splice.
**Fig. 34**
Eye Splice

**Fig. 35**
Non-Adjustable Halter
1. To make the crown knot unlay the strands as in the short splice and make a bight in strand 1, placing it between strands 2 and 3, (Fig. 32).

2. Bring strand 2 across over 1 and between strand 3 and the bight.

3. Run the end of strand 3 over strand 2 and through the bight as shown in Figure 32; draw this up by pulling on the ends of the strands alternately.

Crown Splice

To make the crown splice first make the crown knot as shown in Figure 32.

1. Next raise the strand diagonally across from where strand 1 comes out. Figure 33. This may be more easily done with the aid of a sharpened stick if working with a stiff rope.

2. Place 1 through, following the spike. (Note that this is over one strand and under the next.)

3. In like manner pass the second strand over one strand of the standing part, and under the next.

4. Then pass the third strand over one strand and under the next in the standing part. There may be a little difficulty in placing this third strand properly. It should come out at the same place that the first strand went in, and when done properly the three strands will come out of the standing part equi-distant from each other and no two at the same place.

5. The weaving of the strands is then continued as in the short splice. The finished crown splice is shown in Figure 33c.

Eye Splice

An eye spliced into the end of a rope will be handy for a number of uses which include placing the loop over a hook or through a halter ring, or splicing a metal eye in a loop for use as a lariat. To make the eye splice, unlay the strands for about four or five turns. Then put strand 1 under a strand in the standing part of the rope as shown in Figure 34a. Place strand 2 over the strand under which strand 1 was placed, and under the next strand of the standing part. In a similar manner place strand 3 over the strand under which strand 2 was placed, and under the next. All three strands are now woven under once, and if done properly no two strands will come out together between the same strands of the standing part. Continue weaving the strands as in the short splice and the crown splice.

When it is desirable to splice one rope into the middle of another, the splice is made in the same manner as given for the eye splice.

HALTERS.

Every farm lad should know how to make and correctly use at least one permanent type of rope halter and one emergency type
Fig. 36
Adjustable Halter

Fig. 37
Rope Halter with Guard Loop

Fig. 38
Emergency Halter
halter. The purpose for which a halter is used determines largely the type of halter desired. In general rope halters are much stronger than leather halters largely due to failure of the leather at the buckle tongue. Consequently, rope halters are often used for handling wilder animals. However, good rope halters are also used with good results on well broken horses and cattle, but are not ordinarily recommended for well broken horses. A well made rope halter has a neat appearance.

Non-Adjustable Rope Halter

This halter is used for cattle without horns, and for horses, although if put on young animals it may be safer to use it only temporarily because of the danger of the nose piece working loose and allowing the halter to drop down over the neck. In some cases this would allow the animal to choke itself should it become frightened.

Table II. Suggested Sizes and Lengths for Rope Halters

<table>
<thead>
<tr>
<th>Animal</th>
<th>Diameter of rope</th>
<th>Total length</th>
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<tr>
<td></td>
<td>Inches</td>
<td>feet</td>
<td>A to B</td>
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<tr>
<td>Large horse</td>
<td>5/8</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Medium horse</td>
<td>1/2</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Small horse</td>
<td>1/2</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Large cattle</td>
<td>1/2</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Medium cattle</td>
<td>3/8</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

*Taken from Illinois Ext. Cir. 301

Table on Correct Size and Length for Rope Halters

To secure the proper fit for a halter refer to Table II, or measure the animal that is to wear the halter. A much better fit can usually be secured by measuring the animal.

1. To make this halter, secure the proper measurements and outline the rope as in Figure 35.

2. Raise two strands at C and pass the long end of the rope through (Fig. 35) leaving a loop 1 and 1/2 to 2 inches long.

3. Next raise two strands in B at D (Fig. 35) and pass A through. Draw up close.

4. Unlay the end about 5 turns and splice into the long rope in the same manner as the eye splice, page 14.

5. Turn the rope so that the smoother part of the loop splice will be against the animal's jaw and run the long end through the eye to form the completed halter, Figure 35j.

Adjustable Halters

The adjustable halter is particularly good for use on cattle with horns and where used on several different animals of varying sizes.
Fig. 39
Emergency Halter

Fig. 40
Calf Club Halter
This halter is started in the same manner as the non-adjustable halter, Figure 35, except A in Figure 35f is slightly longer. This is to allow for the eye splice forming the loop 2 in Figure 36. Follow directions for the non-adjustable halter to this point, then make the eye splice as directed on page 14. The halter is completed by putting the long end of the rope through loops 1 and 2, Figure 36b.

**Rope Halter With Guard Loop**

This halter is made to prevent the animal from working the halter off his nose and to prevent the nose and head piece from drawing up tight on the animal. It is recommended for use as a permanent halter on horses.

1. See Table II for proper dimensions of halter or measure the animal's head.

2. Make the halter the same as directed under non-adjustable halters to the point where 1 is unlaid for splicing, in which case about 13 to 14 inches of the end is unlaid, Figure 37a.

3. Next make the splice as directed under the "eye splice”. Weave the strands of 1 into the rope at 3, Figure 37, leaving the loop made by rope 2 the proper size for the particular horse. Weave the strands 3 times at splice 4.

4. Relay strands in the rope 1 as directed under "relaying strands" 6 inches to the point 5, Figure 37.

5. Slip the long end through the loop and splice 1 into the long end again. The completed halter is shown in Figure 37d.

**Emergency Halters**

Emergency halters are used just as the name implies (when a halter is needed and no halter is available) and are easily and quickly made. One such halter is shown in Figure 38. An overhand knot is tied in the doubled rope at 1 (Fig. 38a) and a bowline knot is tied at 2.

Another emergency halter is shown in Figure 39. A bowline is tied in the end of the rope at 1 and a bight made in the standing part of the rope at 2. This bight is passed through the loop at 1 and slipped over the animal's nose.

To free the animal, slip the rope from its nose. This halter may be found very useful in dehorning cattle.

**Halter Especially Recommended for Club Calves**

A halter designed for club calves is shown in Figure 40. The head piece is non-adjustable and adjustments in other parts fit snugly so that an animal finds it very difficult or impossible to work the nose piece off and cause the halter to hang around the neck. The snug fit also prevents the likelihood of the calf rubbing it off over the head. If this habit is developed in a calf, a small rope throat latch may be woven inside the head piece and a small ring and snap used to fasten the latch.

1. Use about 12 feet to 14 feet of 3-strand, 1/2-inch manila rope. Raise 2 strands about 33 inches from one end and
Fig. 41
Leading or Tying Tackle

Fig. 42
Casting Harness
push the other end through, (Fig. 40a). Pull 1 through until a loop about 3/4-inch to 1-inch in diameter is left.

2. Raise two strands in 1 next to where it passed through 2 (Fig. 40a) and pass 2 through. Draw up firmly.

3. Unlay the end of 1 for about 8 inches. Then keeping the loop to the right (Fig. 40c) place the center strand 3 back of rope 1 and place strands 4 and 5 in front.

4. Put the end of strand 4 back under rope 1 and up through between strand 4 and strand 5 (Fig. 40d). Do similarly with strand 5. Next bring strand 3 forward under rope 1, up and back under strand 5 (Fig. 40d). Draw the strands up tight, twisting them as they are drawn.

5. The ends of the strands are woven back into rope 1 using the same method as in making an eye splice or a short splice. Care must be exercised to get the strands drawn to the same degree of tightness around rope 1 and get them woven evenly into the standing part as directed under the eye splice. The completed halter looks as shown in Figure 40e.

LEADING OR TYING TACKLES

A simple and effective method of handling a horse that has the habit of pulling back or breaking halters, is to use the leading or tying tackle shown in Figure 41. This tackle is also valuable in breaking colts to lead. To use this tackle:

1. Place a strong leather halter on the animal.

2. Secure a long rope and tie a loop in the end with a bowline knot, or tie an iron ring in the end. The loop around the body should be so that it will loosen as soon as the tie rope is slacked.

3. Slip the rope over the horse's back just behind the withers and run the long end through the loop under the horse's girth, then up between the horse's front legs and through the chin piece of the halter. Figure 41. This gives needed control over the horse's head. If a halter breaker is tied to a low manger his pulling back would tend to pull his head down. This may be resisted by the horse to the point of breaking the leather halter. In this case a short rope loop, Figure 41, may be put in the halter ring, and the rope passed through this loop instead of the ring, allowing the horse to keep its head in a more normal position and lessen the strain on the halter. Other methods often used to break horses from pulling back when tied are, (1) pass the tie rope through the halter ring as in Figure 41, but instead of passing the rope around the body, loop it around the horse's tail similar to a crupper, and (2) pass the rope through the halter ring and then down and tie it around one front pastern. This latter method raises the horses foot when he pulls back.

Casting Horses

The casting arrangement shown in Figure 42 is good to throw a horse or colt with safety to both the animal and workman. It may also be used to hold the animal's hind feet while trimming hoofs without throwing it.
Fig. 43
Casting Cattle

ASSEMBLY

Fig. 44 Rope-Making Machine
To cast a horse with this tackle a rope 35 to 40 feet long is needed. Double the rope in the center and tie a bowline on the bight. Place this loop over the colt's neck and adjust to the size of the neck then pass the two ropes back between the colt's front legs. Place one rope through each ankle ring to prevent rope burns and run the rope back on itself and make one complete turn around that part of the rope leading to the ring. Return to the loop around the horse's neck and run one rope under the loop and back to the rear. Run the other rope under the neck piece and forward. The rope is to be run forward on the same side that the colt is to be thrown on. The colt is then caused to back and the persons pulling on the ropes cause the legs to be drawn toward the body. As soon as the colt is down one person should twist the animal's nose upward as far from the ground as possible to prevent the animal from getting up. The ropes may also be tied to the neck piece to prevent the horse from getting completely up.

Casting Cattle

Casting club calves may sometimes be necessary for trimming and dressing their hoofs. Figure 43 shows a simple and effective method of throwing the animal. Place one end of a long rope around the animal's neck and tie a bowline knot in the rope, forming a loop around the animal's neck. Pass the rope back and around the body of the calf just behind the forelegs, making a half hitch and letting it draw up in the front flank. Pass the rope on back and put it around the body at the hips. Allow the rope at (d) to go behind the hip bone and at (c) to come in front of the hip bone. To throw the calf pull to the rear and toward the side upon which you wish it to be thrown. When the calf is down turn its nose around and up to prevent rising.

MAKING ROPE AT HOME

The process of making rope is exceedingly interesting. Binder twine left overs may be made into halters and lead ropes with the aid of the simple homemade machine illustrated in Figure 44. Only a small amount of time is required to make both the machine and the rope.

The parts required for the machine are as follows:

(a) Handle, either hard or soft wood, 3/4" x 3" x 12"
(b) Main frame, either hard or soft wood, 3/4" x 4" x 24"
(c) Crotched stick (sling shot fork will answer purpose)
(d) Three hooks, each made from 6-inch pieces of No. 8 or No. 9 wire. Holes in handle bar and main frame should be 3 inches apart.

Standard binder twine is used to make the rope. Two persons will be required to operate the machine. Three may sometimes be used to an advantage. The person holding the crotched stick should pace off the required length for the finished rope and take his stand. If the rope is to be made small and with only one machine operation, the crotched stick should be held approximately 1.2 times as far from the main frame as the desired length of the finished rope. If three of these small ropes are to be made into one larger rope the crotched stick should be held approximately 1.8 times as far from the main frame when making
Fig. 45
Making Halter Ring or Eye into Rope
the small ropes as the desired length of the finished larger rope. (This varies somewhat, depending on how tight the rope is twist-
ed.)

The second person places the twine in the left hand hook (x), Figure 47 (left hand to the person holding the crotched stick) then carries the twine to the crotched stick, places it under the left shoulder on through behind the crotched stick and back through the crotch, then back to and over the center hook (y), continuing back through the crotch and down under the right shoulder, returning to the outside hook (z) over same and back to the crotched stick going around the crotched stick just below the shoulders and return to the hook (x) where the twine is cut off. The first end is then removed from the hook and the two ends tied together and looped over the hook (x). This will make a rope com-
posed of six strands of binder twine. This process may be re-
peated once, doubling the size of the rope. The operator now
turns the handle bar to the left, the crotched stick being held
with a firm pull to prevent knotting of the strings. The machine
is turned until the strands are well twisted and one is conscious
of the strands tending to kink (but do not allow them to kink.)

While the operator turns slowly, the person holding the
crotched stick moves it slowly forward with one hand and with the
other hand pulls the strands back of the crotch, allowing them to
twist into a rope but at the same time keeping enough pull on
them to take up the slack. With the proper precautions a perfect,
hard, tight-twisted rope will result. Slip the crotched stick
out and remove the strands from the hooks. The ragged ends may
be cut off and whipped.

With a lighted match or other flame singe the rope to dis-
pose of loose fibers. If desired the rope may be rolled on a
bench top with a block of wood, or on the floor under your foot.

When ropes are to be made that require more than 12
strands of binder twine, they should be made by first making
small ropes of 6 strands of binder twine then putting three such
ropes in the machine and twisting in the right hand direction to
make the larger rope. The larger ropes can be made by continuing
to thread the binder twine through the machine until the number
of strands of twine desired in the rope are in the machine and
made in one machine operation but a lower quality rope will re-
sult than when made as first described.

**Fastening Halter Ring, Hook or Eye Into End of Rope**

This may be neatly and securely done at the time of making
the rope.

1. The machine should be set up and the rope making start-
ed in the regular manner.

2. As the final or desired size of rope is being made, stop the process when about 10 inches of the rope has been com-
pleted, (Fig. 45). Slip the ring or the eye of the hook on over
the end of the rope and up to the crotched stick.

3. Tie two bands firmly around the rope with good string
or cord, on each side of the ring or eye. This section may be
whipped and left permanently to save the iron ring from wearing
on the rope fiber.
4. Cut the extreme end of the rope and unlay the strands to the whipped portion. Turn the handle bar back to untwist the strands that have not yet been made into the final rope.

5. Cut the unlaid ends so they will be of different lengths. For instance, leave one the original length, cut strand two 1 inch shorter and strand three 2 inches shorter than 1. The shortest should have at least 5 inches to 6 inches to twist back into the rope. (Large ropes will require longer strands for twisting back.) Next taper the strands or thin them out near the end. Place each strand alongside of one of the standing strands. About 1 inch from the end of the laid back strand separate the standing strand and run the turned back strand through the opening. Repeat this process at least once for each strand, then tie the end of the turned back strand alongside the standing strand with a rope fiber.

6. Put the crotched stick back firmly against the whipped loop and twist the strands as before. Finish the rope in the regular manner and you have the halter ring or hook made right into the rope. When extra reinforcing is needed in the eye additional strands may be worked into the untwisted rope and through the eye at some sacrifice of neatness.

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