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Ropes, knots and splices

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Ropes

KNOTS - & - SPLICES

By J. A. Mallett

FOR hoisting and hauling, for lashing loads, restraining livestock and a hundred other farm tasks, good ropes are unexcelled. They are light to handle, take up little storage space and—if given fair usage and reasonable care—will last for years.

Many types of vegetable fibres are used in rope-making, but the three most popular are hemp, manilla fibre and sisal.

Hemp (*Cannabis sativa* L.) is met with in a wild state almost throughout Asia and has been cultivated for centuries in that continent and also in Europe. The stalks of the plants when "retted" yield a soft, but strong fibre widely used for rope-making and for weaving into canvas and sacking.

Manilla fibre, or abaca, is often called "manilla hemp" but it is not a true hemp and is obtained from the leaves of a member of the banana family (*Musa textilis*) which grows in the Philippine Islands. This plant yields long fibres which make up into strong, soft-handling ropes.

Until the dollar shortages restricted the importation of the raw material, most Australian-made ropes were composed of Manilla fibre. Today, only small quantities of this fibre are available and these are reserved for special purposes such as the manufacture of life-saving lines.

Sisal fibre is used for about 95 per cent. of the ropes now made in Australia. It is obtained from the leaves of *Agave sisalana*, a member of the Amaryllis family, and is already familiar to farmers who have used this fibre for years in the form of binder twine.

Most of the sisal used in this State is imported from Tanganyika, with smaller quantities from Indonesia. Sisal fibres are much shorter than those of manilla hemp. Ropes made from sisal are harder than manilla ropes and lack some of their tensile strength, but with the many improvements in rope-making technique now in vogue, they are giving satisfaction in many spheres.

Coir, a fibre from the husk of the coconut, is used for the manufacture of large-diameter ropes used for "springs" when mooring ships at exposed open-sea jetties. The lightness and elasticity of the fibres makes them particularly suitable for this purpose.

Cotton fibres make a smart, soft-handling white rope, popular with yachtsmen. Flax makes light and very strong ropes for special purposes, but is too costly for general use.

ROPE-MAKING

The first operation in making a rope is to comb the fibres into parallel ribbons and then twist them into "yarns" or "threads". Binder twine is typical of a single thread as used in rope-making.

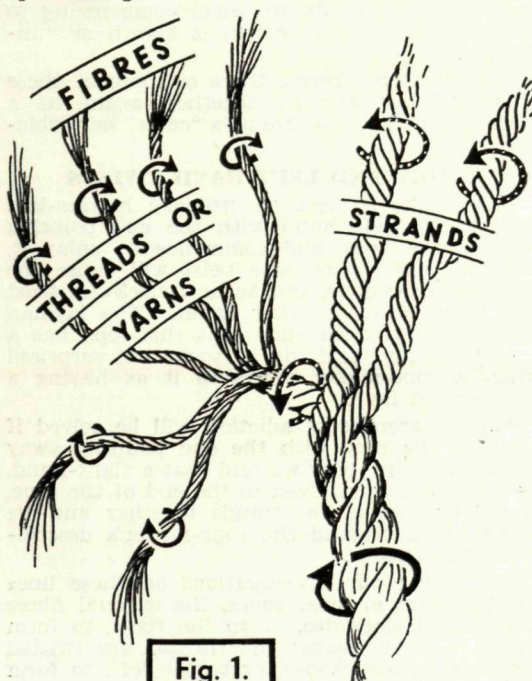
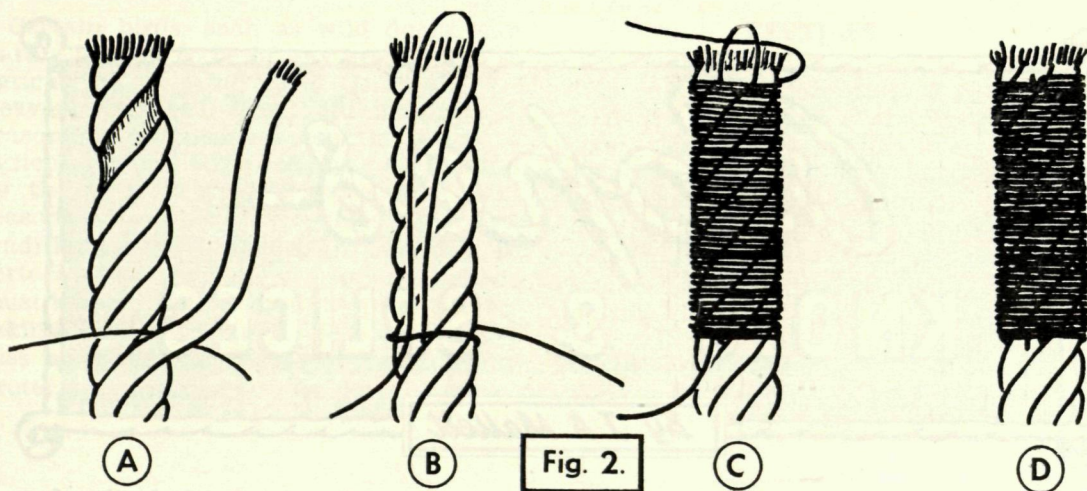


Fig. 1.

1.—Showing the make-up and the direction of twist in a common type of three-strand hawser-laid rope.



2.—“Whipping” the end of a rope to prevent fraying.

Numbers of the “threads”, according to the size of the rope in making, are then twisted together in the opposite direction to the twist of the original yarn and formed into “strands”.

Three, or sometimes four, of these “strands” are next twisted together to form a rope. The twist is in the reverse direction to that of the strands or in other words in the same direction as the twist of the original threads or yarns. (See Fig. 1.)

This twisting of the strands is known as “laying” the rope, and a rope made in this manner is known as “hawser-laid”. When we separate the strands, as when commencing to splice a rope, the operation is known as “un-laying”.

For very large ropes, three or more of these “hawsers” are twisted together—again in a reverse direction—to give us a “cable” or “cable-laid rope”.

RIGHT AND LEFT-HAND TWISTS

If we take a piece of ordinary hawser-laid rope in the left hand with the end pointing towards the body and commence to unlay it, we find that a clockwise twist will cause the strands to separate, and an anti-clockwise twist will bring them together again. The layman would naturally conclude that this rope has a “left-hand lay” and will be somewhat surprised when a rope-maker refers to it as having a “right-hand lay”.

The apparent contradiction will be solved if we hold the rope with the end pointing away from the body. Now we find that a right-hand, or clockwise, twist given to the end of the rope, “lays” or twists the strands together and we begin to understand the rope-maker’s description of his wares.

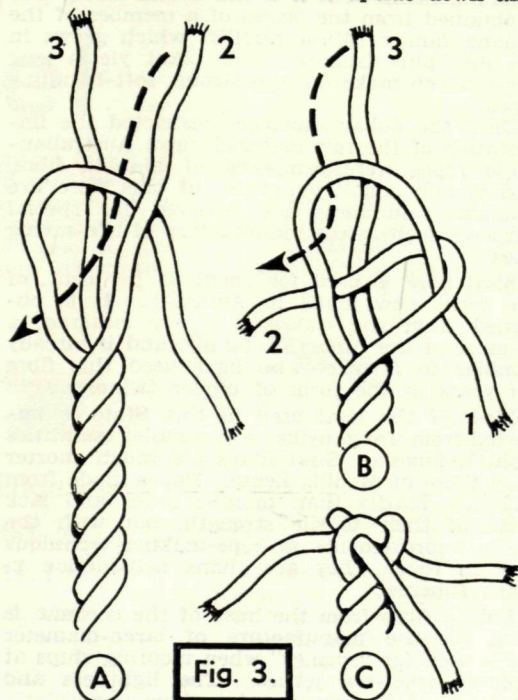
Continuing our investigations on these lines we find that in most ropes, the original fibres are twisted clockwise, or to the right, to form the threads or yarns; the threads are twisted together anti-clockwise, or to the left, to form the strands; the three strands are twisted together clockwise, or to the right, to give us the hawser-laid rope. If we twisted three hawsers

together, the twist would again be anti-clockwise, or to the left, to give us a cable-laid rope.

Most hawser-laid ropes have the right-handed lay and this is important as it governs the method of coiling and uncoiling.

CARE OF ROPES

Coiling and Uncoiling.—When new rope is received in a coil, it should be unwound from the centre of the coil in an anti-clockwise direction, if it is the type of hawser just described, with a right-hand lay. If the rope unwinds clockwise the coil is upside down and



3.—The crown knot.

we must turn the coil over and pass the end through the centre so that the rope comes away in an anti-clockwise direction.

If unwound clockwise, there will be a kink in each loop and kinks weaken the fibres by imposing uneven strains.

When coiling ropes they should be coiled in a clockwise direction to minimise kinking.

Short lengths of new rope should be suspended by one end with a light weight hung on the free end. This allows the strain on all the fibres to become equalised. Longer ropes may be dragged slowly over a well-grassed paddock so that the free end can revolve and equalise the twists in the various parts of the rope.

Avoid Abrasion.—Never drag a rope over sandy or gritty ground, in fact keep it from contact with any abrasive substances which may work into the twists and cause serious internal wear.

Never draw ropes over rough or angular objects and do not allow them to be bent sharply, especially under load, as this soon causes internal wear similar to that resulting from kinking. When pulleys are used, the diameter of the pulley sheaf should not be less than eight times the diameter of the rope passing over it.

Avoid Moisture, Chemicals and Fumes.—While it is not always possible to keep ropes dry, they should not be allowed to remain wet longer than is absolutely necessary. After use

hang in loose, open coils on wooden pegs or arms in a dry, well-ventilated spot, so that they will have an opportunity of drying out quickly. Dampness causes rotting of the internal fibres and reduces the strength of the ropes. Tarrd or specially-treated ropes should be used for wet work.

Chemicals, or fumes from chemicals will soon weaken a rope. Never store ropes near fertilisers or disinfectants or where they can be affected by farmyard manure or rotting vegetable matter.

SIZES OF ROPES

When ordering a rope, remember that the standard sizes of fibre ropes as quoted, refer to the circumference and not the diameter or thickness. The circumference of a circle is about three times (actually 3.1416 times) the diameter.

If you want a rope about an inch thick for instance, do not ask for a coil of 1in. rope or you will receive something about three-eighths of an inch thick. Order a coil of 3in. or 3½in. rope.

To make things more difficult, wire ropes are usually sold in measurements according to diameter and not circumference.

BREAKING STRAINS, ETC.

The following table of technical data on their sisal ropes was kindly supplied by the West Australian Rope and Twine Company Pty. Ltd.

Circumference.			Approximate Length per Coil.			Approximate Weight per Coil.			Approximate Weight per 100 Feet.			Approximate Breaking Strain.		Circumference.	
Ins.	ft.		cwt.	qr.	lb.	cwt.	qr.	lb.	tons.	cwt.		ins.			
3/8	2,700				18			3 3/8				3/8			
1/2	2,700				20			4 1/8		2 1/2		1/2			
5/8	2,250		1		3			1 1/8		4		5/8			
3/4	1,800		1		7			2		5 1/2		3/4			
7/8	1,200		....		27			2 1/4		6 1/2		7/8			
1	960		1		2			3 1/8		8		1			
1 1/8	960		1		10			4		8 3/4		1 1/8			
1 1/4	960		1		20			5		9 1/2		1 1/4			
1 3/8	990		1		27			5 1/2		12		1 3/8			
1 1/2	990		2		9			6 1/2		14 1/2		1 1/2			
1 3/4	960		2		26			8 1/2	1	....		1 3/4			
2	960		3		25			11 1/8	1	4		2			
2 1/4	960	1	....		21			14	1	12		2 1/4			
2 1/2	960	1	1		25			17 1/2	2	....		2 1/2			
2 3/4	960	1	3		16			22	2	8		2 3/4			
3	960	2	1		....			26 1/4	2	16		3			
3 1/4	930	2	1		26			2	3	4		3 1/4			
3 1/2	930	3	....		18			1	10	12		3 1/2			
4	900	3	3		6			1	19 1/8	4		4			
4 1/2	900	4	3		19			2	5 1/4	6		4 1/2			
5	930	6	1		....			2	19 1/4	7		5			
6	870	9	....		....	1	....	1	11	4		6			
7	870	11	3		....	1	1	11	14	16		7			

SAFE WORKING LOAD.—The safe working load of the rope is approximately ONE-FIFTH of the breaking strain. If requiring a rope to lift a certain load, multiply the load by 5, and pick from the table hereon, the rope which has the resultant breaking strain, e.g., required to lift 5 cwt., the rope required would have a breaking strain of 25 cwt.—2in. circumference.

SECURING THE ENDS

Much deterioration of ropes commences with the fraying and untwisting of the ends, but this can be prevented with very little trouble, by any one of several different methods.

Perhaps the easiest, for the beginner, is to "whip" the ends with strong cord—fishing line is the ideal material. There are several different methods of whipping but that shown in Fig. 2 will give good service.

If a few inches at the end of the rope have already become frayed or loose, do not cut them off but re-lay them by holding the rope in one hand and twisting each strand to tighten it

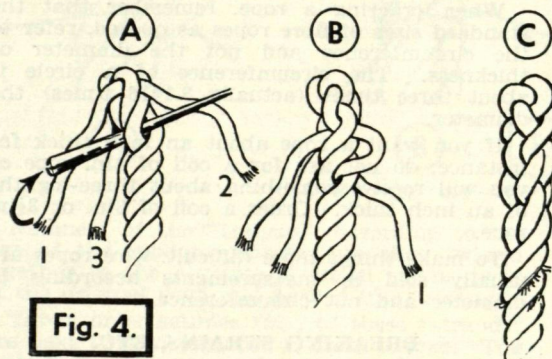


Fig. 4.

4.—The crown knot and splice.

Wind the cord round the rope tightly and evenly, working up towards the end, where the cord is passed through the U loop (C).

Now pull on the short end of the cord, drawing the loop and long end down to about the centre of the binding. Cut off protruding ends of the cord and the rope will be neatly whipped and secured against fraying or untwisting (D).

The Crown Splice.—A useful preliminary lesson in splicing may be gained by using the crown knot and splice to secure the end of the rope.

Start by unlaying the three strands about five or six turns and proceed to make the crown knot. (Fig. 3.)

This is done by bringing strand 1 over between strands 2 and 3 to form a loop (A).

Strand 2 is passed round behind the loop and in front of strand 3 (B).

Strand 3 is now passed through the loop and the strands are then drawn tight (C).

To dispose of the three loose ends we splice them back into the main rope. (Fig. 4.)

First of all, it is a good idea to whip or otherwise secure the ends of the strands to prevent them from loosening and untwisting while they are being spliced. A few turns of thread will suffice or a convenient method is to encircle them with small rubber rings. If the threads

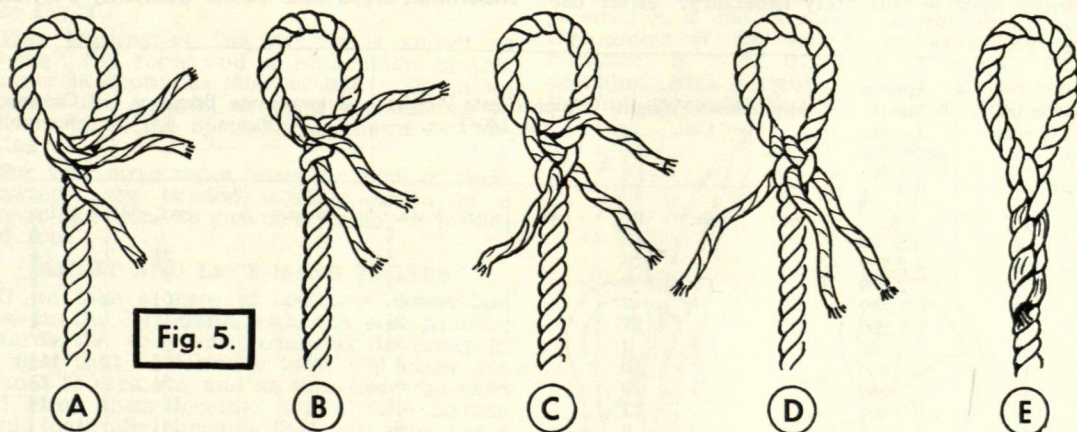


Fig. 5.

5.—The eye splice.

then wrapping it part of the way round the rope. Now twist the next two strands in turn, wrapping each round in its correct position until the rope is neatly re-laid.

Whipping.—Unlay one strand as shown in Fig. 2 (A) and place one end of a 3ft. length of cord under the raised strand which is then re-laid.

Allow the short end of the cord to hang down and then take one turn of the long portion of the cord round the rope. Pull on the short end until you have sufficient to pass up above the rope-end and turn back to form a U or bight (B). It is best to place this bight in one of the grooves of the rope.

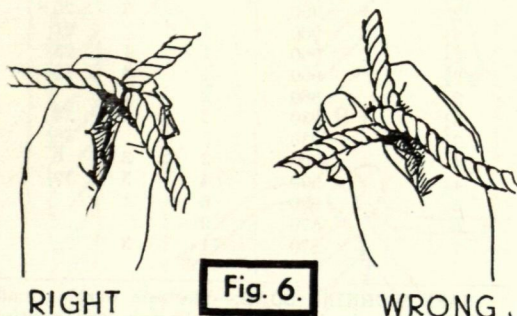


Fig. 6.

6.—The right and wrong ways of separating the strands preparatory to splicing ropes together.

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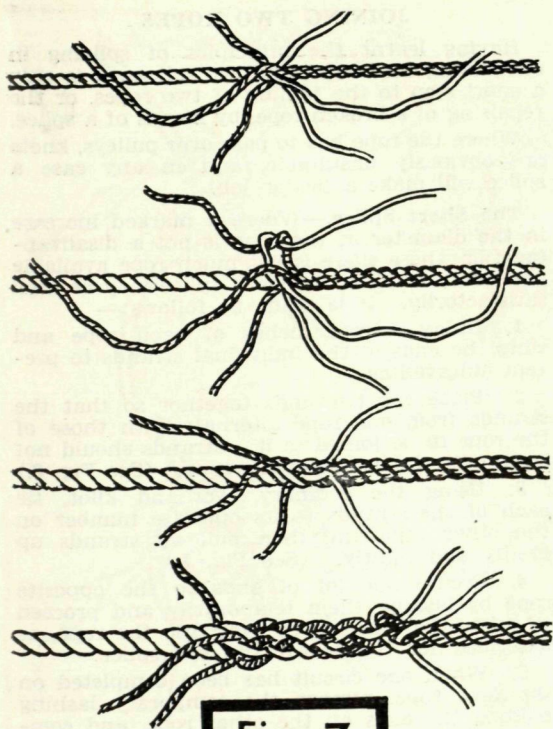


Fig. 7.

7.—The short splice.

or rubber rings are of different colours, the beginner will find it easier to keep track of the strands when splicing.

Now untwist the main rope slightly, below the crown knot, open the strands with a marlin-spike and place strand 1 over the first strand in the main rope and under the second strand.

Take strand 2 and pass this over the first adjacent strand and under the next, and follow up by passing strand 3 over and under in the same manner. If you have not mixed your strands, strand 3 should come out where strand 1 went in.

Splicing is not unlike plain weaving; the strands on the main rope being likened to the "warp" and the loose strands to the "weft" which crosses it.

The interwoven strands should cross as near as possible at right angles and should be spiralled round the rope.

As in weaving, two adjoining "weft" strands should not go over or under the same "warp" strand. If one goes over the "warp", the next goes under, and so on.

Pull the strands tight and continue to weave the loose strands over and under. When each strand has been tucked under several times, the ends are cut off about a quarter of an inch from the main rope.

A neater finish may be obtained by cutting away part of each strand, continuing for another tuck, then removing more of the strand before continuing the splice. This will give a tapered finish.

The Eye Splice.—Where a loop or eye is needed at the end of a rope, the eye splice is a handy method of finishing off the end of a rope.

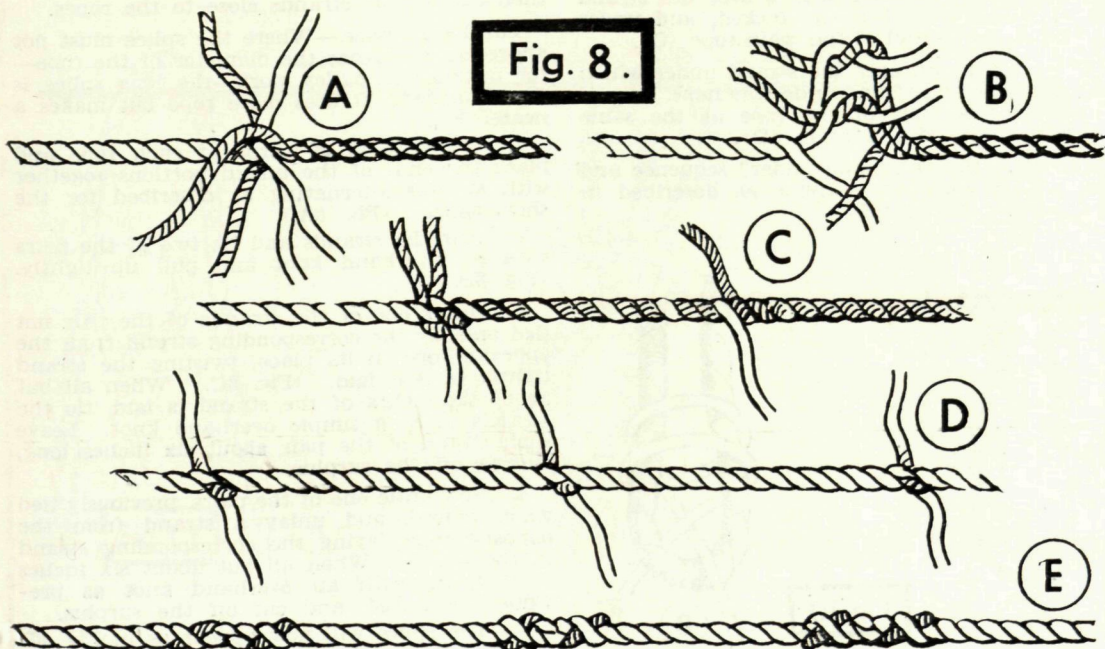


Fig. 8.

8.—The long splice in easy stages.

JOINING TWO ROPES

Having learnt the principles of splicing in completing the crown and eye splices, it is only a short step to the joining of two ropes, or the repairing of a broken rope, by means of a splice.

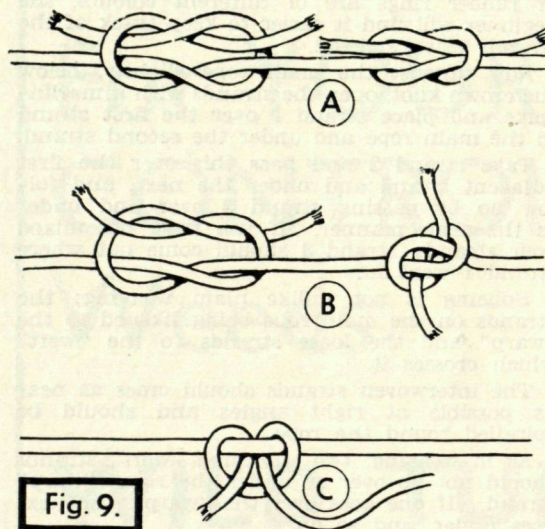
Where the rope has to pass over pulleys, knots are obviously unsuitable, and in any case a splice will make a neater job.

The Short Splice.—Where a marked increase in the diameter of the rope is not a disadvantage, or where there is not much rope available to make the splice, the short splice may be used satisfactorily. It is made as follows:—

1. Unlay several inches of each rope and whip the ends of the individual strands to prevent unravelling.
2. Place the two ends together so that the strands from one rope alternate with those of the rope to be joined to it. Strands should not cross over the centre of the rope. (See Fig. 6.)
3. Using the ordinary overhand knot, tie each of the strands to its opposite number on the other rope and then pull all strands up evenly and tightly. (See Fig. 7.)
4. Secure one lot of ends to the opposite rope by lashing them temporarily and proceed to splice the other three ends into the rope, as described for the crown and eye splice.
5. When one circuit has been completed on the first rope, remove the temporary lashing holding the ends on the other rope, and complete a circuit there. Alternate the circuits in this manner, pulling the strands up tightly and neatly as the work progresses.
6. Having completed the required length of splice, taper off by cutting a few yarns from each strand at every circuit. Alternatively, roll the splice under the foot on a smooth floor and then cut off the strands close to the ropes.

The Long Splice.—Where the splice must not appreciably increase the diameter of the rope—for instance in pulley work—the long splice is recommended. It uses more rope but makes a neater job.

1. Unlay 15 to 20 turns of each rope and place the ends of the unlay portions together with strands alternating as described for the short splice. (Fig. 8A.)
2. Pair the strands and tie **two** of the pairs with an overhand knot and pull up tightly. (Fig. 8B.)
3. Unlay one of the strands of the pair not tied and lay the corresponding strand from the opposite rope in its place, twisting the strand tightly as it is laid. (Fig. 8C.) When all but about six inches of the strand is laid, tie the strands using a simple overhand knot. Leave each strand of the pair about six inches long, cutting off the surplus.
4. Now untie one of the pairs, previously tied when paired, and unlay a strand from the opposite rope, laying the corresponding strand in the groove. When all but about six inches is laid, tie with an overhand knot as previously described, and cut off the surplus.
5. The splice will now appear as in Fig. 8D with the three pairs of strands tied at different points.



9.—Reef knots and a "granny knot."

With an eye splice at one end and a crown splice at the other, the rope is secured against fraying and is in a handy form for noosing, lashing or joining to other ropes.

The construction of the eye splice is shown in Fig. 5.

Unlay about five turns of the rope and secure the strands as previously described. Place the unlay strands as shown to form a loop of the required size (A).

Tuck strand 1 under a strand of the main rope as in (B). Put strand 2 over the strand under which strand 1 was tucked, and under the adjoining strand of the main rope (C).

Strand 3 is laid over the strand under which strand 2 was tucked and under the next. Strand 3 should come out of the rope at the same point that strand 1 went in (D).

Continue the "over-and-under" sequence and cut off or taper the strands as described in making the crown splice.

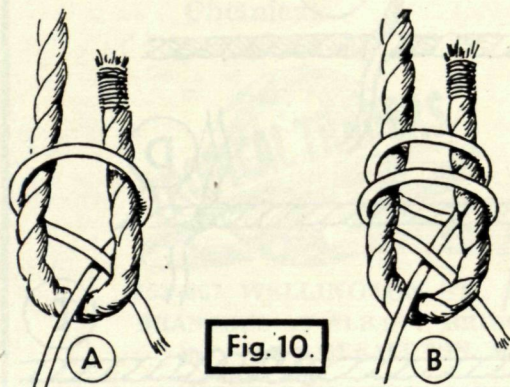
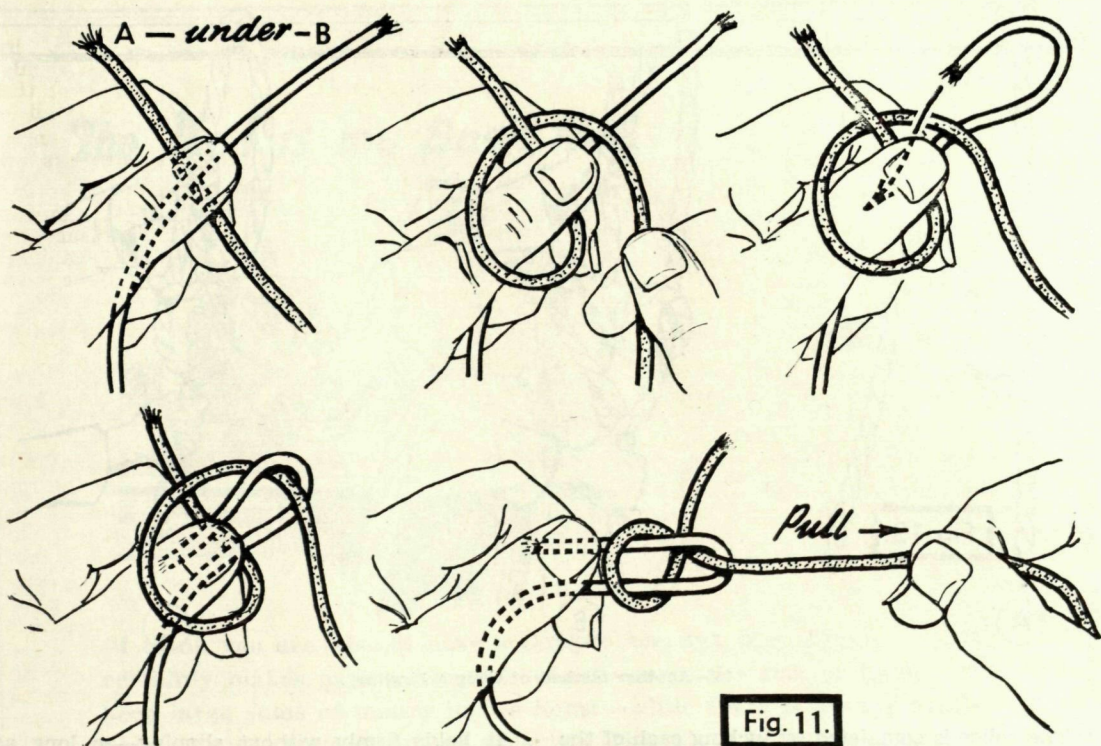
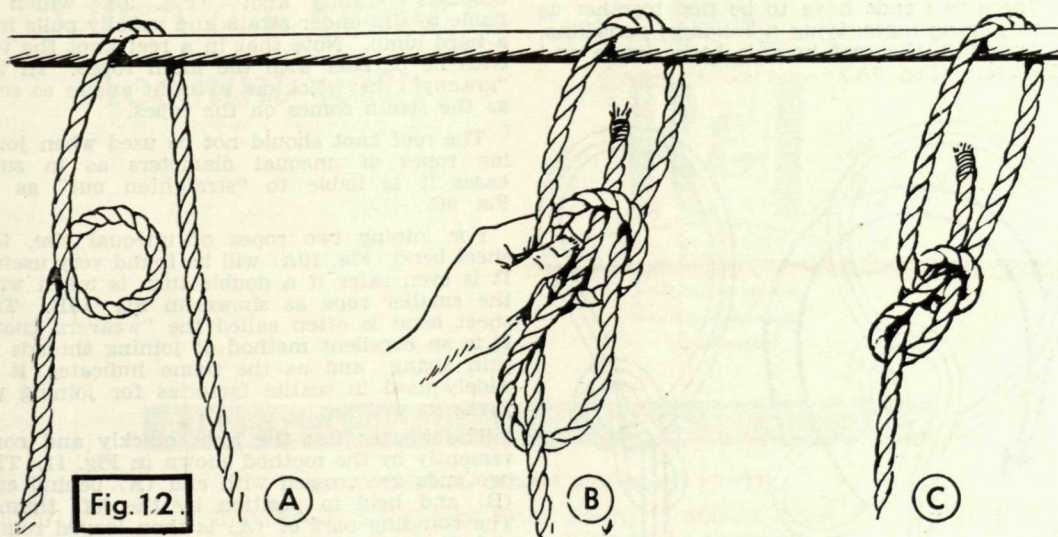


Fig. 10.

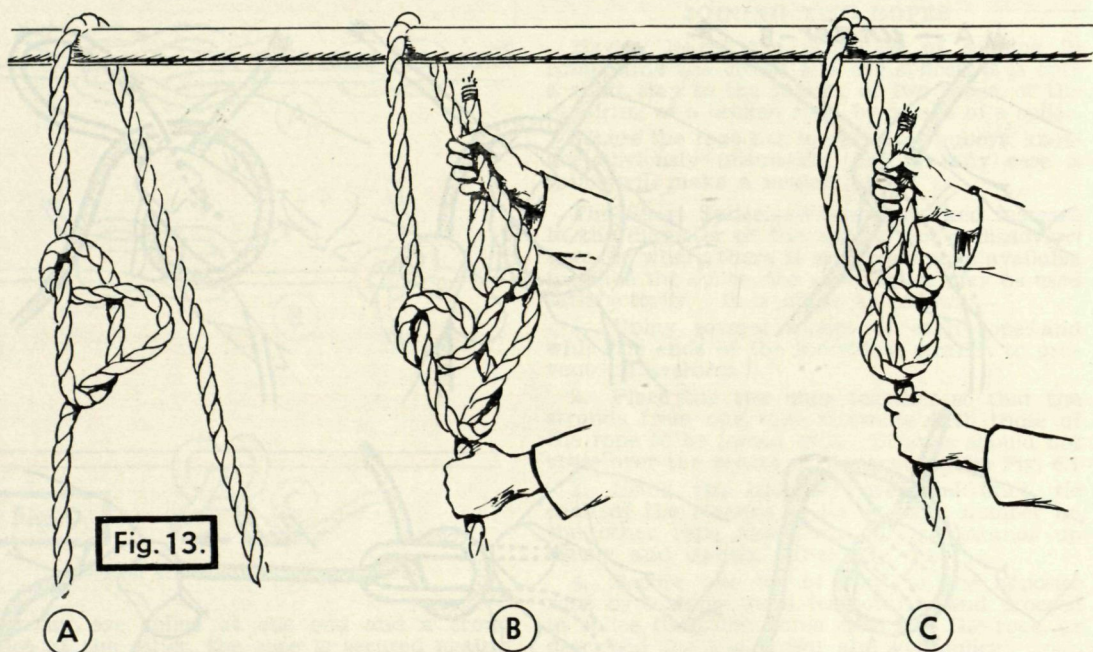
10.—The sheet bend and double sheet bend.



11.—Tying the "Weaver's knot."



12.—Tying a bowline.



13.—Another method of tying a bowline.

The splice is completed by tucking each of the six loose ends over the first adjoining strand of the main rope and under the next in the usual splicing manner. (Fig 8E.) The strands are tapered off and finished by having the ends tucked into the rope.

THE REEF KNOT

Where two ends have to be tied together as when joining ropes, tying a bandage, parcelling, or bundling, the reef knot is both simple and effective. (Fig. 9A.)

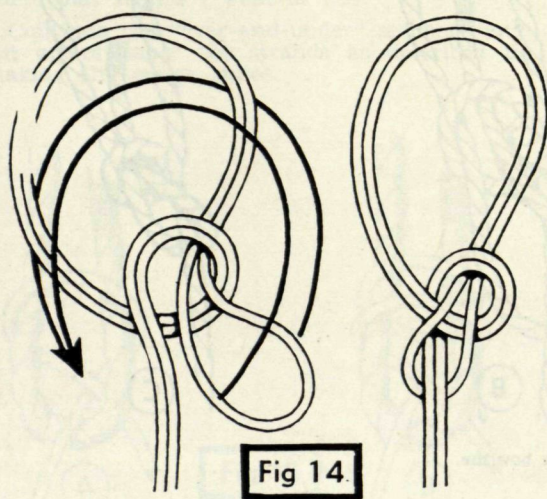
It holds firmly without slipping—so long as the two ends are of equal size—and it does not pull into a hard knot that is difficult to untie. It is tied easily if one remembers “right over left, then left over right,” when making the knot.

Until one has mastered the knack, most attempts to tie a reef knot result in the despised “granny knot” (Fig. 9B) which is liable to slip under strain and usually pulls into a hard lump. Note that in a reef knot the two ends lie parallel with the main ropes. In the “granny”, they stick out at right angles as soon as the strain comes on the ropes.

The reef knot should not be used when joining ropes of unequal diameters as in such cases it is liable to “straighten out” as in Fig. 9C.

For joining two ropes of unequal size, the sheet bend (Fig. 10A) will be found very useful. It is even safer if a double turn is taken with the smaller rope as shown in Fig. 10B. The sheet bend is often called the “weavers knot”. It is an excellent method of joining threads or thin string; and as the name indicates, it is widely used in textile factories for joining up yarns in weaving.

The weaver ties the knot quickly and conveniently by the method shown in Fig. 11. The two ends are crossed with end (A) behind end (B) and held in position by the left thumb. The standing part of (A) is then looped round end (A) and brought in front of end B. End B is then bent over and passed through the bight and the knot tightened by pulling on the standing part of (A) while holding the bight of (B) in the left finger and thumb.



14.—The bowline on a bight.

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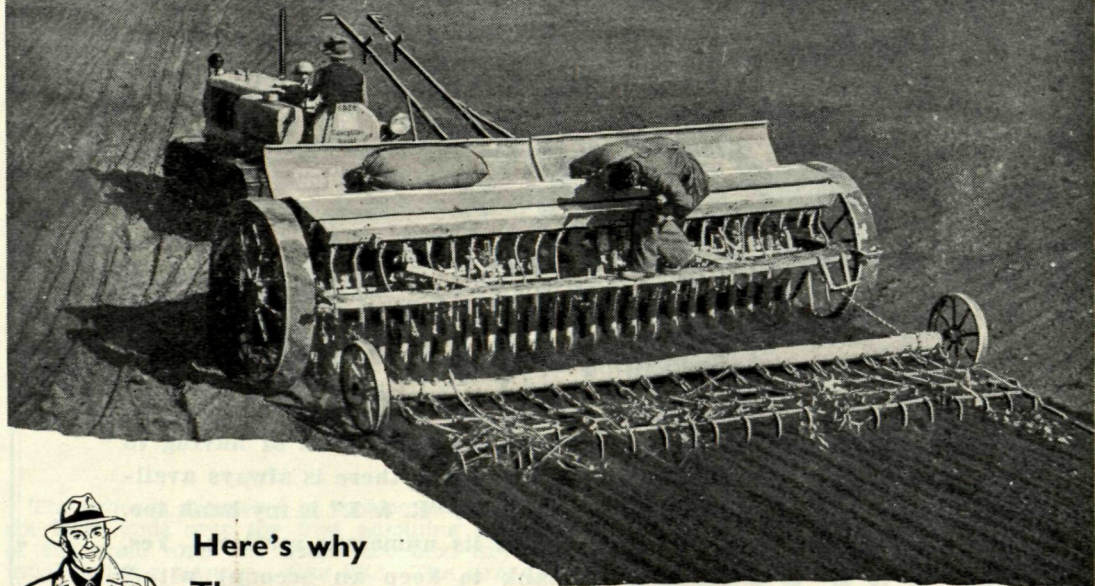
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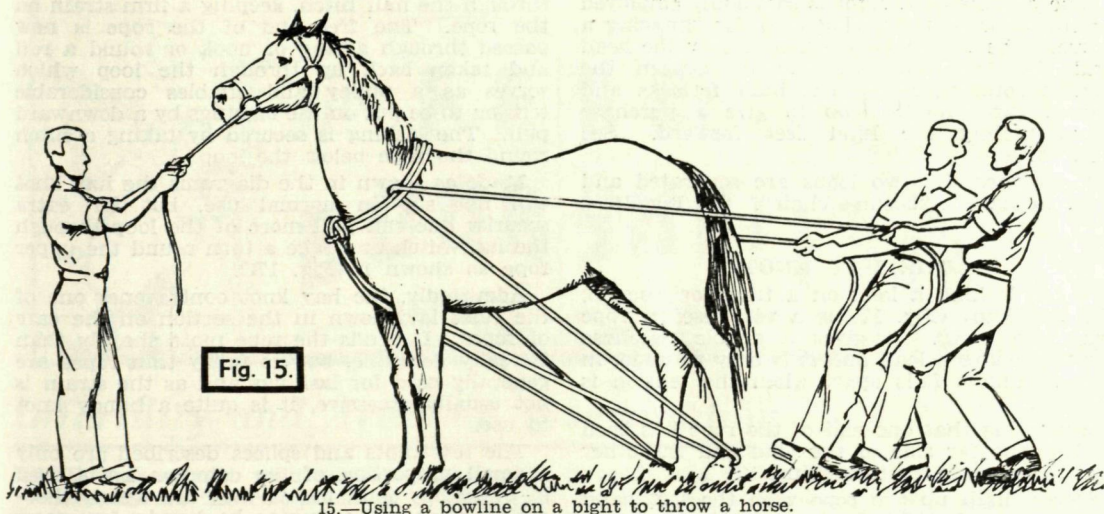


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There are so many different knots that an expert can usually select the ideal one for any specific purpose, whether it be for tying a tiny hook on a fishing line; slinging a weighty balk of timber; lashing a load of hay; tying up a horse; mooring a boat or any one of a thousand other tasks.

Unfortunately few of us are in the expert class—most of us only know two or three fairly simple knots and usually we are not by any means certain of tying them properly at the first attempt.

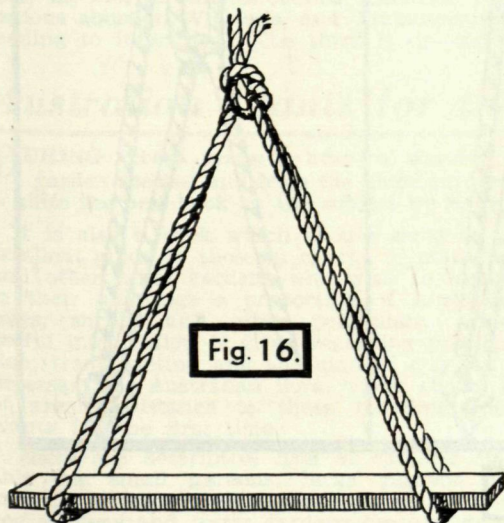
However limited our knot-tying repertoire may be, it should at least include the bowline as a good "general purpose" knot. The bowline has an important point in its favour—it will never jam tightly and be difficult to

undo. However great a strain is placed upon it the bowline knot will neither slip nor pull tight.

As a non-slipping loop, the bowline has many uses. It is handy for putting round the neck of a horse when no halter is available; it is a useful means of attaching a halter rope to a rail or ring, while its non-jamming virtues make it ideal for attaching tow ropes when hauling disabled vehicles or extricating bogged cars or trucks.

As with many other knots which do not receive mention in this article, there are several ways of tying a bowline. The method I learnt over 30 years ago is shown in Fig. 12. The end of the rope is passed over the rail or through the ring and a half-hitch is made with the left hand as shown in (A). The resulting loop is held in position with the left hand while the end of the rope is slipped through the loop from below under the main part of the rope below the loop and turned back on itself to pass through the loop once more (C). To illustrate how an entirely different method may be used to obtain the same knot, look at the diagrams in Fig. 13. Here the rope is passed over the rail in the same manner but a slip knot is made in the long portion of the rope (A). The short end of the rope is now passed through the loop of the slip knot (B) and turned back on itself where it is held in the right hand. Now take hold of the long portion of the rope in the left hand, pull out the slip knot and you will find that you have a bowline knot which is basically the same in construction as the one obtained by the method illustrated in Fig. 6.

A useful relative of the ordinary bowline is what is known as the "bowline on a bight". This is made with a doubled rope and started off in a similar manner to the bowline shown in Fig. 14, except that the double rope is used throughout. When the bight is passed through the loop however, it is spread out and slipped over the remainder of the knot as shown in the diagram.



16.—Bowline on a bight used to make a "bosun's chair."

The bowline on a bight is commonly employed as the basis of the tackle used for throwing a horse. The double loop is placed over the head and the two ends are passed between the horse's forelegs, round the hind fetlocks and passed through the loop to give a purchase when pulling the hind feet forward. See Fig. 15.

Sometimes the two loops are separated and used to make a "bosun's chair". See Fig. 16.

THE HAY KNOT

When lashing a load on a truck or waggon, the hay knot (Fig. 17) is a very useful "rope trick" to know. It gives a double purchase for tightening a load and it is easy to undo, in fact it almost falls apart when the tension is relaxed.

Supposing that one end of the rope has been tied at the far side of the load and the other end tossed over for tightening.

Reach high up the rope with the left hand and make a half-hitch, then double the slack of the rope into another loop and pass this

through the half hitch, keeping a firm strain on the rope. The free end of the rope is now passed through a ring or hook or round a rail and taken back up through the loop which serves as a pulley and enables considerable tension to be put on the lashings by a downward pull. The lashing is secured by taking a hitch round the rope below the loop.

Made as shown in the diagrams the hay knot will not slip in normal use, but for extra security one can pull more of the loop through the half-hitch and take a turn round the upper rope as shown in Fig. 17C.

Admittedly, the hay knot contravenes one of the rules laid down in the section on the care of ropes. It bends the rope more sharply than is really desirable, but as fairly thin ropes are generally used for lashings and as the strain is not usually excessive, it is quite a handy knot to use.

The few knots and splices described are only a small proportion of the common knots used in every day jobs, but if they are learnt thoroughly they will prove to be handy for many farm tasks.

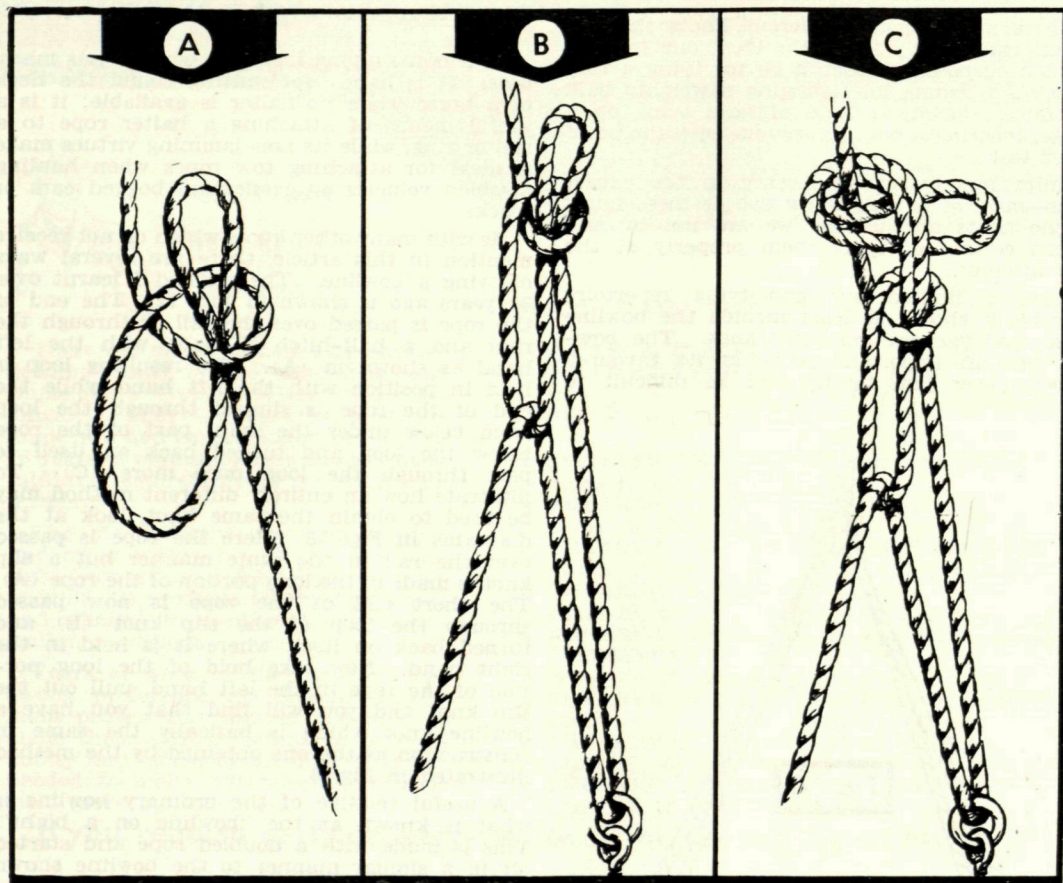


Fig. 17.

17.—The "hay knot" or "double purchase knot."