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Their Uses at Sea

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Author of "Remarks on Modern Seamanship"

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FOREWORD.

HAVING made, during thirty odd years at sea, a rather special study of the Art of Seamanship, I am very desirous of passing on the experience I have gained and the lessons I have learned, for the benefit of those who now and in the future use the sea for business or pleasure. During my time at sea I have witnessed many accidents and waste of rope which subsequent reflection and discussion have convinced me were preventable, and so, having never seen any warnings down in black and white, I have taken upon myself to offer them now. As an example, I shall offer an investigation of the reason why a boat fitted with slings for hoisting at davits should not be hoisted with a span. I believe that this is not generally recognised, and I have certainly never seen an explanation given. A good deal of other matter is, I believe, now printed for the first time.

I have to make grateful acknowledgments to Messrs. Gieve for permission to use both illustrations and letterpress from *Henderson's Seamanship*, and to Sir David Wilson Barker for fig. 42.

To many readers, the following pages will no doubt seem very elementary. Of them I ask patience, remembering that there may be others who have not had the same advantages of education and training as themselves. Further, as the late Commodore of one of our best-known shipping lines said to me recently:—"Even the best of us needs to rub up his knowledge occasionally."

P. J. S.

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ERRATA.

Page 2. Last line but one delete "which."

Page 36. Fig. 66. The end of the seizing shown in the middle should be erased.

Page 98. Last line. For "stern" read "stem."

CORDAGE AND CABLES.

I.—MANUFACTURE.

ROPES for use at sea are roughly divided into the categories of hemp, coir and wire. The former term comprises not only those made from the product of the hemp plant—including sisal—but also that made from the fibre of banana leaves, which is known as manilla.

Coir is the fibre of the husks of the cocoanut. Ropes made of this have the property of floating, and are consequently of great utility as hauling lines for heavier hawsers, but their strength is only about one-fourth of that of hemp of the same size.

Process of Manufacture.—The fibre, when it is taken out of the bales in which it is imported, is first "heckled"—either by hand, or by being fed on to the top of rows of steel teeth which move at an increasing speed as they proceed. This removes all free dirt and foreign substances and makes all the fibres straight and in line with one another.

It next goes twice through a drawing machine, which is similar to the first but with finer teeth, from which it emerges still further attenuated and some dozen times its original length. It is now spun into yarns by a third machine, losing still more dust of solid matter, and on emerging is reeled up on bobbins.

Next it is reeled off these bobbins on to others, so that in the next process it will be moving with the grain and not against it. It then, unless it is to be made into untarred rope, receives its treatment of tar. This is done by causing

it to pass over a roller which revolves in hot tar. It is reeled off on frames from which it can be removed and is then laid aside to mature for six months or longer. The next process is to rewind the yarn on to bobbins ready for laying them up into strands. The number of yarns depends, of course, on the size of the strand required, and some manufacturers twist two yarns together to form a core or heart in the strands. Strands are laid up in a contrary direction to the yarns. As many bobbins as are required are mounted on spindles and the end of each yarn hitched to the central hook of a "jack." When the machinery is in motion this hook revolves rapidly while the "jack" increases its distance from the bobbins. In other machines the strands are spun in a manner similar to that which produced the yarns and the strands are reeled up as they are formed.

The strands are now laid up into ropes. This is done by hitching each strand to a hook in the perimeter of the "jack," and the other ends all on to one swivel. A "top" —a conical piece of wood with grooves cut in it—is put in to keep the strands separate, and then the strands are made to revolve in the same direction as that in which they were made, which causes them to lay up beyond the top in the contrary direction.

Ropes are usually composed of three strands laid "right-handed"—that is, looking along the rope, each strand goes to the right hand. This is called "hawser-laid," but by manufacturers "shroud-laid."

To obtain extra flexibility ropes are made of four strands and in this case there is a "heart" or core in the centre to give the rope a circular shape.

The effect of laying up the yarns and strands gives a certain (though small amount) of elasticity to the rope, (~~which~~) distributes the strain* equally along its constituent fibres and excludes moisture.

* The word "strain" is used here and elsewhere in this work in its popular sense instead of the more scientific word "stress."

Hemp "cables" or "cable-laid" rope consists of three hawser-laid ropes laid up together left-handed. It is roughly two-thirds the strength of hawser-laid rope of the same size but more impervious to moisture. Hawsers are made in lengths of 113 fathoms and cables 101 fathoms.

The size of ropes is measured by the circumference in inches.

Left-handed rope is laid in the same direction as the strands, which makes it very supple and flexible but absorbent. Such rope is generally four-stranded.

"Spunyarn" is made by laying up from three to nine yarns left-handed. Used for lashings, seizings and serving.

"Nettles" are made by first reversing the lay of two or three yarns and then laying them up right-handed. Used for serving, making sennit, etc.

"Junk" is condemned rope 4-inch and upwards, used for making spunyarn, swabs, etc.

"Rounding" is condemned rope below 4-inch used for temporary lashings and such purposes.

"Oakum" is old yarns teased out into fibre, used for caulking deck seams.

"Foxes" are short yarns laid up left-handed.

Wire Ropes.—The wire for these are tested by the manufacturers by tension, twisting and bending, a proportion of samples being tested "to destruction" by each means.

Wire ropes are composed of six strands, laid up right-handed round a hemp heart. The strands themselves are left-handed, and in "flexible" wire have also hemp hearts. Wire used for standing rigging is made of strands with wire hearts.

The number of wires in a strand varies from twelve to thirty in flexible wire, and from seven to nineteen in standing rigging. The smaller the wires and the greater their number in a strand the greater is the flexibility. The number o wires also affects the strength. For instance, 4-inch

wire of 12-wire strands will stand 33 tons, of 19-wire strands 48, 24-wire strands 44 and 30-wire strands 38.*

Generally speaking, wire up to $4\frac{1}{2}$ inch is made of 12-wire strands, 5 and $5\frac{1}{2}$ inch of 24, and above that of 30 wires.

II.—THE CARE AND MAINTENANCE OF ROPES.

Like most other mechanical appliances, ropes can be ruined by careless or inconsiderate treatment. Apart from the value of the rope, the effect of one carrying away (parting) is often so disastrous that no amount of care expended in reasonable precautions can be thought superfluous.

When a new coil of rope has to be brought into use, the best of all ways is to fit into the middle a spindle which can be hung horizontally so that it can revolve freely. The new rope can then be run off and flaked down. As this is not always possible on board ship, the usual plan is to stand the coil with the inner end of the hawser down, then bring this end up through the middle and run it off, flaking it down as before. This takes some of the turns out of it, which are reduced as the operation proceeds.

"Flaking" is simply arranging the rope in long bights, bending the rope alternately to right and left, so avoiding putting turns into it.

The best way of keeping ropes when not in use is to reel them up, but care must be taken that they are not reeled up wet or they will rot. As it is impossible to have reels for every rope (though it is not uncommon to have one for each boat's fall), other means have to be used for keeping them clear and separate. Of these the commonest is "coiling." This is done by twisting the rope against the lay and tracing with it a circle "clock-wise" on the deck commensurate with the size of the rope. Layer on layer is formed until the end is reached which is on top of the coil. This is called "end up."

* From Messrs. Stephens, Falmouth.

Now, in order to have the running part on top, the coil is turned over, left hand over right so as not to put in a turn. This is called "on end." A rope with one free end must first be coiled down, "end up"; (or, "on the bight") never on the end, for then the turns taken in it would not come out.

Ropes should always have the ends whipped to prevent their unlaying. It is usual to finish off all those permanently rove or fitted by "pointing."

Ropes which are required to run easily, such as boats' falls (when these are not on reels) should be either "flaked-down" or "coiled down for running." The former keeps the rope clear of turns, as the rope is turned alternately right and left, and is the best for all purposes, but it takes up much room. Fig. 1 shows the principle of this method,

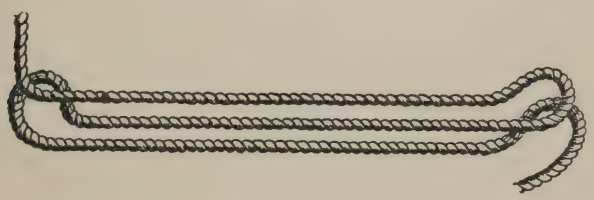


Fig. 1.—Flaking a Rope.

each bight is tucked under those before. To "coil down for running," the rope is first coiled down "end up" then the end is laid on the deck and from that an oval is traced with the bight, which passes inside the end, over last bight and so on. All parts are then pressed close together.

To economise space and to present a neat appearance, ropes are sometimes "flemished down." This is done either in a circular or elongated form, as follows:—

Starting with the rope coiled down "on end," a circle is traced on the deck, working on the bight, and each succeeding turn placed close inside the one before, finishing with the end in the middle. This can be continued for two or more layers, when it is called a "cheese." The elongated

form is made in the shape of a long oval, and by crossing two or three of the inner turns many "fancy" patterns can be evolved.

To cut large rope.—When you have a large hawser to cut through, do not strike the rope with an axe, for nobody but an expert can hit the same spot twice, but hold the axe on the deck edge up, lay the rope across the edge and strike the rope with a heavy piece of wood. In this way you cut straight through and save much time; or else, use a saw or chisel.

In cutting rope, either with a knife or axe, the edge should be wetted or greased.

Ropes become "long-jawed" with use and when any distortion is noticed they should be replaced and given lighter work until condemned.

Condemned rope is "jagged up" in 5 fathoms lengths and tallied with its size and length.

Rope has but little elasticity and such as exists is caused by the opposite lay of the strands and the rope itself. When a rope is stretched, the strands have a tendency to take up a straight position, but this is resisted by their own lay and consequently, when the strain is removed, a partial recovery will take place. But this is only the case with new rope. After a little use ropes are permanently increased in length and diminished in circumference. When this distortion becomes evident to the eye, the condition is called "long-jawed" and the rope should be condemned. But when, as in the case of boats' falls, one end has been subjected to more friction than the other a further period of usefulness can be got out of it by changing end for end. The friction and bending of passing round sheaves is, of course, another factor of destruction. If the section of a rope is considered, it will be obvious that, though the section is roughly circular, at any particular point of contact, only two strands are employed. As the rope moves, the tendency is for these two strands to keep up the contact

and thus take the lay out of the rope. Hence the importance of having easily running sheaves, and the danger of friction with any fixed object—such as stanchions or bollards.

Ropes contract in length as the result of wet and expand again on drying; it is therefore necessary to allow for such contraction to avoid parting or distortion. Ropes should never be left for indefinite periods without "freshening the nip," otherwise permanent distortion will ensue.

New rope should be well stretched before being rove in a purchase.

Wooden blocks are measured by their larger diameter in inches, and the length of a block should be three times the size of the rope rove through it. If a block is too big for the rope the latter tends to flatten on the sheave and will quickly wear out.

Metal blocks are distinguished by pattern numbers. See Table, page 9.

Strength of ropes.—A good working rule for finding the strength of hemp rope (3 stranded, hawser-laid) is to square the circumference and divide by 3, 4 and 6 for the breaking, proof and working strains in tons.

(Rope should never be subjected to more than half its breaking strain.)

The formula for flexible steel wire is $C^2 \times 2$. One-sixth of this can be taken as a safe working load.

Wire hawsers should be kept on reels if practicable and should be oiled periodically. The hemp hearts of wire hawsers and of each strand are saturated with oil in the process of manufacture. This exudes under tension and dries on the surface.

If reels are not available wires should be flaked in a figure-of-eight and not coiled.

Wire cannot be coiled down like hemp, but alternate right and left hand turns are taken in it—forming a series of clove-hitches.

TABLE SHOWING THE PATTERNS OF HOOKS, SHACKLES, THIMBLES, ETC., which are SUITABLE for USE with the SIZES of HEMP CORDAGE shown in Column 1; also, the BREAKING STRAIN of each size of Cordage and the PROOF STRAIN of the Hooks and Shackles.

HEMP CORDAGE.

Size of Cordage, H.L., 3 Strand Tarred	Blocks		Hooks		Thimbles		Shackles		Size of Flexible Steel Wire for Strapping.	Size of Spun-yarn for Service	Standard Breaking Strain of Cordage, H.L., 3 Strand, Tarred.	Proof Strain of			
												Hooks		Shackles	
	Single or Double Thick S.S.	Clump	Tackle	Calliper	Open	Welded	Fore-lock Bolt	Screw Bolt				Tackle	Calliper	Fore-lock Bolt	Screw Bolt
Inches	Inches	Ins.	Patt.	Patt.	Patt.	Patt.	Patt.	Patt.	Inches.	No of Yarns.	Tons.	Tons	Tons	Tons	Tons
1	3		386	345*a*	675		2001	2051	1		$\frac{2}{5}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{3}{4}$	$\frac{3}{4}$
$1\frac{1}{4}$	4		386*a*	345*a*	676		2002	2052	1		$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{5}$	$1\frac{1}{4}$	$1\frac{1}{4}$
$1\frac{1}{2}$	5	3	386*b*	346	677	648	2002	2052	$1\frac{1}{4}$	2	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$
$1\frac{3}{4}$	6		386*c*	346	678	649	2002	2052	$1\frac{1}{2}$	2	1	1	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$
2	6	4	386*d*	347	678	650	2002	2052	$1\frac{1}{2}$	2	$1\frac{7}{20}$	$1\frac{3}{4}$	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$
$2\frac{1}{2}$	8	5	386*e*	347*a*	680	652	2003	2053	2	3	2	$2\frac{3}{4}$	1	2	2
3	9	6	386*f*	347*a*	681	653	2004	2054	$2\frac{1}{2}$	3	3	4	1	$2\frac{3}{4}$	$2\frac{3}{4}$
$3\frac{1}{2}$	11	7	386*g*	347*c*	683	655, 656	2005	2055	3	4	$3\frac{9}{10}$	$5\frac{1}{4}$	$1\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{3}{4}$
4	12	8	386*h*	347*d*	683*a*	657	2006	2056	3	4	5	6	$2\frac{1}{2}$	5	5
$4\frac{1}{2}$	14	9	386*i*		683*b*	660, 661	2006	2056	$3\frac{1}{2}$	4	$6\frac{9}{20}$	7		5	5
5	16	10	386*k*		683*b*	662	2007	2057	4	5	$7\frac{9}{10}$	$8\frac{4}{5}$		$6\frac{1}{4}$	$6\frac{1}{4}$
$5\frac{1}{2}$	17	11	386*k*		683*c*		2007	2057	4	5	$9\frac{3}{4}$	$8\frac{4}{5}$		$6\frac{1}{4}$	$6\frac{1}{4}$
6	18	12	386*l*		683*c*		2008	2058	$4\frac{1}{2}$	5	$11\frac{1}{2}$	11		$7\frac{3}{4}$	$7\frac{3}{4}$
6	19	12	386*l*		683*d*		2008	2058	$4\frac{1}{2}$	5	$11\frac{1}{2}$	11		$7\frac{3}{4}$	$7\frac{3}{4}$
$6\frac{1}{2}$	20	13	386*m*		683*d*		2008	2058	5	5	$12\frac{4}{5}$	$13\frac{1}{4}$		$7\frac{3}{4}$	$7\frac{3}{4}$
7	21	14	386*m*		683*e*		2008	2058	5	5	$14\frac{4}{5}$	$13\frac{1}{4}$		$7\frac{3}{4}$	$7\frac{3}{4}$
$7\frac{1}{2}$	22	15	386*m*		683*f*		2009	2059	5	6	17	$13\frac{1}{4}$		$9\frac{1}{2}$	$9\frac{1}{2}$
8	24	16	386*n*		683*f*		2009	2059	5	6	$19\frac{2}{5}$	$15\frac{3}{4}$		$9\frac{1}{2}$	$9\frac{1}{2}$
$8\frac{1}{2}$	26	17	386*n*		683*g*		2010	2060	5	6	$21\frac{1}{2}$	$15\frac{3}{4}$		$11\frac{1}{4}$	$11\frac{1}{4}$
9	28	18	386*n*		683*g*		2010	2060	5	6	24	$15\frac{3}{4}$		$11\frac{1}{4}$	$11\frac{1}{4}$
							2011	2061						$13\frac{1}{4}$	$13\frac{1}{4}$
							2012	2062						$15\frac{1}{4}$	$15\frac{1}{4}$
							2013	2063						$17\frac{1}{2}$	$17\frac{1}{2}$
							2014	2064						20	20

TABLE SHOWING the PATTERNS of HOOKS, SHACKLES, THIMBLES, ETC., which are SUITABLE for USE with the SIZES OF STEEL WIRE ROPE shown in Column 1; also, the PROOF STRAIN to be borne without injury by various sizes of Chain Cable, Chain Rigging, etc.

STEEL WIRE ROPE.

Size of Rope, Steel Wire, Flexible	Thimbles mild steel † (*see* foot-note).	Slip with Screw for setting up Rigging	Shackles		Hooks, Iron, Tackle	Standard Breaking Strain of F.S. Wire Rope	Standard Proof Strain Slips with Screw for setting up Rigging	Chain Cable		Chain Rigging, Crane, etc.	
			Forelock Bolt	Screw Bolt				Size	Proof Strain to be borne without Injury	Size	Proof Strain to be borne without Injury
Inches	Patt.	Patt.	Patt.	Patt.	Patt.	Tons.	Tons.	Inches	Tons.	Inches	Tons.
$\frac{3}{4}$	1915	58	2000	2122	—	—	—	$\frac{3}{8}$	$2\frac{17}{32}$	$\frac{1}{8}$	$\frac{3}{16}$
1	1915	1916* / 57	2001	2021	386D	$1\frac{3}{4}$	$\frac{3}{4}$ / $4\frac{7}{8}$	$\frac{7}{16}$	$3\frac{1}{2}$	$\frac{3}{16}$	$\frac{13}{32}$
$1\frac{1}{4}$	1916	57	2001	2021	386E	$2\frac{7}{8}$	$4\frac{7}{8}$	$\frac{1}{2}$	$4\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{4}$
$1\frac{1}{2}$	1916	56	2002	2020	386F	4	$6\frac{1}{2}$	$\frac{9}{16}$	$5\frac{1}{2}$	$\frac{9}{32}$	$\frac{7}{8}$
$1\frac{3}{4}$	1917	56	2002	2020	386G	$5\frac{1}{2}$	$6\frac{1}{2}$	$\frac{5}{8}$	7	$\frac{5}{16}$	$1\frac{1}{16}$
2	1917	56	2002	2020	386I	7	$6\frac{1}{2}$	$\frac{11}{16}$	$8\frac{1}{2}$	$\frac{3}{8}$	$1\frac{3}{8}$
$2\frac{1}{2}$	1018	55	2003	2019	386L	$11\frac{3}{4}$	$12\frac{1}{4}$	$\frac{3}{4}$	$10\frac{1}{8}$	$\frac{7}{16}$	$2\frac{1}{4}$
3	1919	55	2004	2019	386N	17	$12\frac{1}{4}$	$\frac{7}{8}$	$13\frac{3}{4}$	$\frac{1}{2}$	3
$3\frac{1}{2}$	1920	54	2005	2018		24	$19\frac{7}{8}$	1	18	$\frac{9}{16}$	$3\frac{3}{4}$
4	1921	54	2006	2018		31	$19\frac{7}{8}$	$1\frac{1}{8}$	$22\frac{3}{4}$	$\frac{5}{8}$	$4\frac{5}{8}$
$4\frac{1}{2}$	1922	53	2006	2017		39	$29\frac{1}{4}$	$1\frac{1}{4}$	$28\frac{1}{8}$	$\frac{11}{16}$	$5\frac{5}{8}$
5	1923	53	2007	2017		59	$29\frac{1}{4}$	$1\frac{3}{8}$	34	$\frac{3}{4}$	$6\frac{3}{4}$
$5\frac{1}{2}$	1924	52	2007	2016		71	$36\frac{5}{8}$	$1\frac{1}{2}$	$40\frac{1}{2}$	$\frac{13}{16}$	$7\frac{7}{8}$
6	1925	52	2008	2016		84	$36\frac{5}{8}$	$1\frac{5}{8}$	$47\frac{1}{2}$	$\frac{7}{8}$	$9\frac{1}{8}$
$6\frac{1}{2}$	1926	51	2008	2015		98	$44\frac{3}{4}$	$1\frac{3}{4}$	$55\frac{1}{8}$	$\frac{15}{16}$	$10\frac{1}{2}$
7		51	2008	2015		113	$44\frac{3}{4}$	$1\frac{7}{8}$	$63\frac{1}{4}$	1	12
$7\frac{1}{2}$								2	72	$1\frac{1}{8}$	$15\frac{1}{4}$
8						148		$2\frac{1}{8}$	$81\frac{1}{4}$	$1\frac{1}{4}$	$18\frac{3}{4}$
								$2\frac{1}{4}$	$91\frac{1}{8}$	$1\frac{3}{4}$	$22\frac{5}{8}$
								$2\frac{3}{8}$	$101\frac{1}{2}$		
								$2\frac{1}{2}$	$112\frac{1}{2}$		
								$2\frac{9}{16}$	$118\frac{1}{5}$		
								$2\frac{3}{4}$	$129\frac{3}{10}$		
								3	$145\frac{4}{5}$		
								$3\frac{1}{4}$	$161\frac{3}{5}$		
								$3\frac{1}{2}$	$176\frac{2}{5}$		

† *Note.*—When the Rope is not served round eye the next pattern *below* should be used.

* For $1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. Guard ropes.

F r proof strain of shackles and hooks, *see* table for Hemp Rigging.

Wire must always be whipped before being cut and each strand whipped before unlaying.

When going into dock, it will be noticed that the turns are taken with the guy ropes on the bollards opposite ways on the two sides, right-handed on the starboard side and left-handed on the port.

This is in order that as the ship moves ahead the rope tends to "leave" the bollard instead of the opposite, which by increasing the amount of rope on the bollards, and consequently the friction, would, with the same force holding on behind the bollard, tend to part the guy.

Going out of dock the turns are taken the opposite way on the two sides.

The principle of this should be grasped and borne in mind for it applies to other cases than docking.

When making a hawser fast to a double bollard, the first turn should be taken round the nearer arm. If there is an eye in the hawser it should be placed over this arm only.

III.—TO SHOW THE DANGER OF A "TAUT SPAN."

The Strength of a Span.—A rope, wire or chain attached to two fixed points approximately in the same horizontal plane is called a span.

It is a convenient and therefore frequently used means of supporting a weight, but its employment must be undertaken with circumspection and a knowledge of the stresses involved, otherwise accidents are the certain consequence.

Let A and B (fig. 2) be two fixed points and $A\ F\ B$ a rope attached at its ends to them. Let W be a load suspended by a rope hooked to the bight of the span. Then if $D\ F$ represents the weight of the load in magnitude and direction, $F\ E$ and $F\ C$ will represent the tensions in the rope which support the weight.

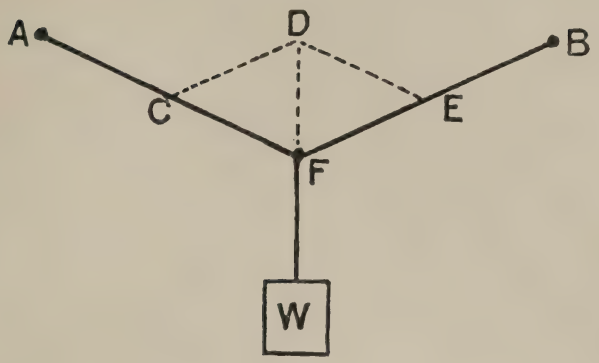


Fig. 2.

Let $D\ F = W$ and $C\ F = E\ F = t$ (tension).

In the triangle $D\ E\ F$,

$$D\ F : F\ E :: \text{Sine}\ D\ E\ F : \text{Sine}\ F\ D\ E$$

and, in the triangle $C\ D\ F$,

$$D\ F : F\ C :: \text{Sine}\ D\ C\ F : \text{Sine}\ C\ D\ F$$

or, $$\frac{W}{t} = \frac{\text{Sine}\ D\ E\ F}{\text{Sine}\ F\ D\ E} = \frac{\text{Sine}\ D\ C\ F}{\text{Sine}\ C\ D\ F}$$

As the angles at D are equal to the angles at F, it follows that the larger the angles at F, that is to say, the nearer $C\ F\ E$ is to a straight line, the greater is ratio of t to W, or, the tauter the span the greater the tension.

When the angle $C\ F\ E = 120°$, then $t = W$, *i.e.* the tension in the span is equal to the weight.

It is evident from this how reprehensible is the common practise of hooking tackles for lifting weights on to jackstays and other tightly stretched lines, because of the excessive weight which is brought on the rope and on the fastenings by which its ends are secured.

This is the chief disadvantage of the triatic coaling stay.

The principle of the span is, however, very useful when a last pull is required on an already taut rope. By "swinging off," or pulling at right angles to the rope, a very small force exerts, as just shown, a very considerable tension in it.

A span need not necessarily be subjected to a weight at its centre. If one leg is longer than the other, the shorter

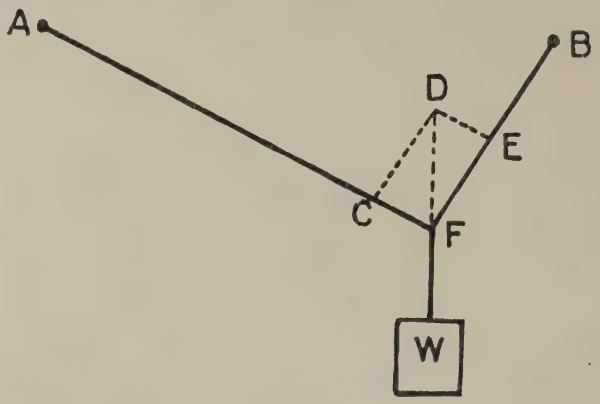


Fig. 3.

leg bears the greater weight. This can be seen from the above diagram (fig. 3), in which *E F* is greater than *C F*.

IV.—BENDS AND HITCHES.

Fig. 4.—**Half-hitch**—right or left-handed. The basis of all hitches, but should never be used by itself without seizing the end down as it will jamb or slip.

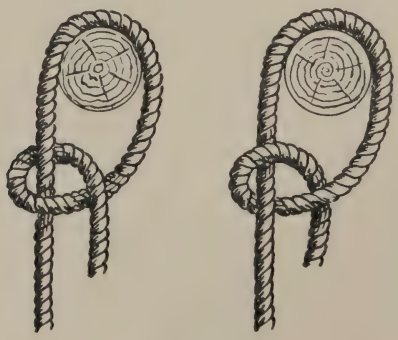


Fig. 4.

Fig. 5.—**Two Half-hitches**—one right and one left. Used for securing a rope's end temporarily.

FIG. 5.

Fig. 6.—**Round Turn and Half-hitch** (end seized down). Used for securing a hawser to the ring of a buoy, a rope's end to a ringbolt or spar, etc.

"...ound Turn.")

Many of the illustrations of knots are closely copied from Nares "Seamanship" Speaking solely from memory I would include figs 7, 8, 12, 15-18, 20, 22 23, 24, 30, 37, 40, 41 49, 49a

Perhaps mediately from Henderson's "Seamanship" See introduction.

ed from a half-hitch by
e rope. Used for securing

Fig. 8.—**Half-hitch and Timber Hitch**—for towing a spar or sending a spar aloft.

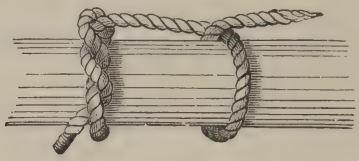


Fig. 8.

Fig. 9.—**Clove Hitch**—right or left-handed. Used for securing ratlines to shrouds. Right-handed in starboard rigging, left-handed in port, so that the crossing turn leads down and aft.

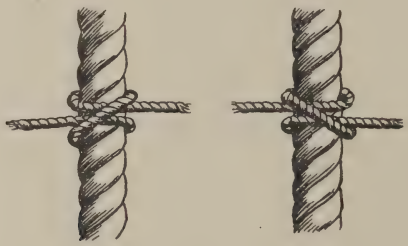


Fig. 9.

Fig. 10.—**Cow Hitch, Magnus Hitch or Lark's Head**—right and left-handed hitches. For securing a rope's end temporarily. Will not jamb like a clove hitch.

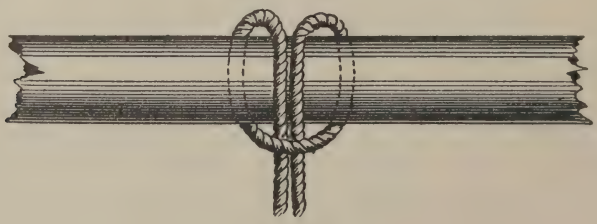


Fig. 10.

Fig. 11.—**Rolling Hitch**—made like a clove hitch with an intermediate round turn. Used for securing a rope to a

spar or another rope, the pull being towards the double part.

Fig. 11.

Fig. 12.—**Roband Hitch** is formed in the same way as a rolling hitch but the intermediate turn is passed through the cringle or eyelet in which the end is secured. (Robands are the "stops" fitted in the head of a square sail for securing to the jackstay on the yard.)

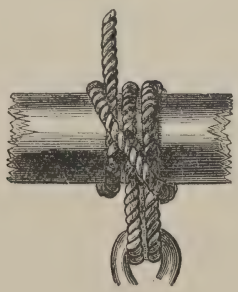


Fig. 12.

Fig. 13.—**Fisherman's Bend**, formed like a half-hitch with an intermediate turn. Requires a seizing on the end. Used for securing a hawser to the ring of an anchor.

Fig. 13.

Fig. 14.

Fig. 14.—**Halliard Bend**, formed from a fisherman's

bend. Instead of bringing the end down for seizing, pass it over one part and under the other, of the hitch already formed. This allows the yard to come close up to the halliard block and it cannot jam.

Fig. 15.—**Blackwall Hitch**
Fig. 16.—**Double Blackwall Hitch**
Fig. 17.—**Midshipman's Hitch.**

For securing a rope to a hook.

Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.—**Catspaw**—for shortening slings or securing a hook to a rope.

Fig. 18.

Fig. 19.—**Overhand Knot**—for shortening slings. Formed by crossing the two parts of the sling as in fig. 19a, then passing bight *a* under and over bight *b*.

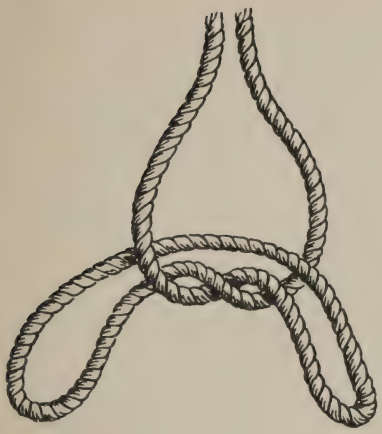


FIG. 19.

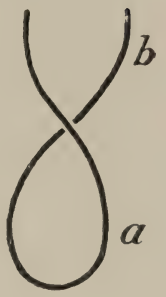


FIG. 19a.

Fig. 20.—**Bowline**—to prevent this knot from jambing, pass the end, or a piece of wood, under the two parts that form the hitch.

Fig. 21.—**Double Bowline** (Original)—less liable to jamb than ordinary bowline. To form it, take two round

FIG. 20.

FIG. 21.

FIG. 21a.

turns as in fig. 21a, then bring the end, left-handed, up through both, round standing part and back down through.

(If this is made right-handed in the ordinary way, there will be a turn in the bight.)

Fig. 22. **Running Bowline.**—For making a "running noose" in the end of a rope.

Fig. 23. **Bowline on the Bight.**—For slinging a man in. He sits in the larger bight, the shorter passes under his arms and round his back.

Fig. 24. **Single Sheet Bend** (or "Swab Hitch").—For securing a rope's end to a cringle or joining two ends together. Used in net-making, by the name of a "Weaver's Knot." (*See* "Net-making.")

Fig. 22.

Fig. 23.

Fig. 24.

Fig. 25. **Double Sheet Bend.**—For similar purposes. Less liable to jamb than the single kind.

Fig. 26. **Reef Knot.**—For joining two ends together. Note that the bight on each side contains two parts, other-

Fig. 25.

Fig. 26.

wise a "Granny" is formed. A reef knot can be "capsized" by pulling the two parts on one side apart.

Fig. 27. **Carrick Bend.**—For joining two hawsers together. Note that the two ends are on opposite sides—one to right and one to left—otherwise a "Granny" will be formed. The ends must be seized back.

Fig. 27.

Fig. 28. **Double Carrick.**—For the same purpose, but no seizings required. To form this, make a bight in one end (*A*). Place this over the other end *B*. Then reeve *B* over *C*, under *D*, over *E*, under *F* and over *G*.

Fig. 28.

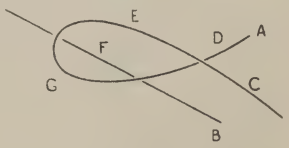


Fig. 28A.

Fig. 29. **Figure-of-eight.**—To prevent a rope unreeving from a block. (An "overhand knot" should not be used on account of its liability to jam.)

Fig. 29.

Fig. 30. **Sheepshank.**—For shortening a rope temporarily.

Fig. 30.

Fig. 31. **A Stopper.**—To pass a stopper, take the end in the left hand, bight in the right. Pass the end round the rope to be stoppered, under the bight and dog with the lay.

To stopper a wire, have a hook welded into the end of a short length of chain. Pass this end round the wire, two or three times and hook on to its own part. The standing part should be lashed to a bolt, not shackled, for when the strain is on, it cannot be relieved. This will be found most useful for clapping a purchase on a wire.

Fig. 31.

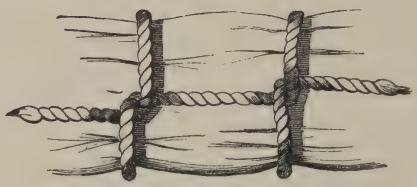


Fig. 32.

Fig. 32. **Marling Hitch.**—This is a series of half-hitches, of a jambing form, as the end is always underneath. Used for lashing up hammocks, securing boats' sails to yards and similar purposes.

Fig. 33. **Ropeyarn Knot.**—For joining yarns. Each yarn is split, then married, and one half on each side is brought round and tied as in a reef knot.

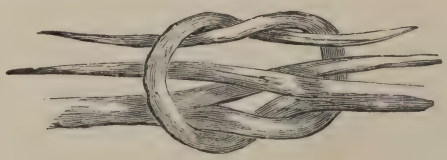


Fig. 33.

Fig. 34. **Mousing a Hook.**—To prevent unhooking.

Fig. 35. **To Sling a Cask on End.**—Place the bight of a rope under the cask, half-knot the two ends, open out the knot thus formed and place one part each side of the cask. Join the two ends with a reef knot or make a bowline.

Fig. 34.

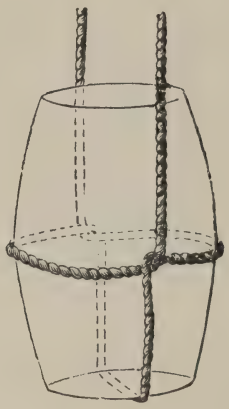


Fig. 35.

Fig. 36. **Bale Slings.**—Of universal utility.

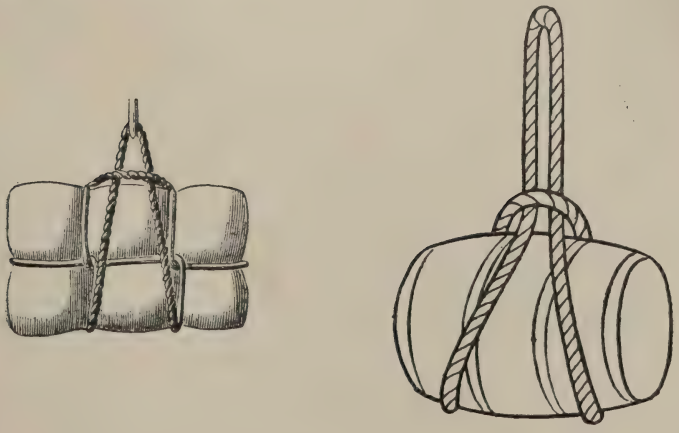


Fig. 36.

Fig. 37. **Butt Slings.**—For lifting a cask where there is not room to use bale slings.

Fig. 38. **Figure-of-eight-Sling.**—For a similar purpose.

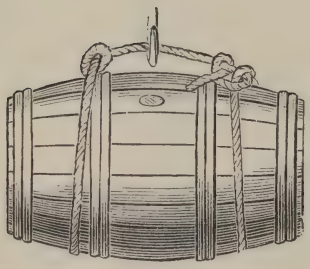


Fig. 37.

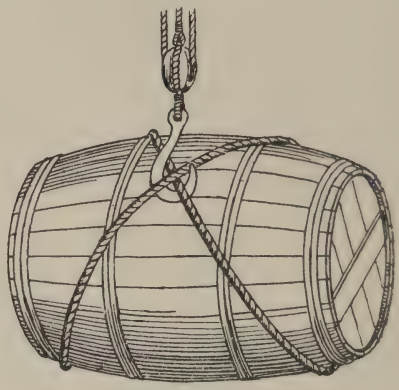


Fig. 38.

Fig. 39. **Can Hooks.**—For lifting a cask out of its tier. They should never be used for a larger lift on account of the liability of the chines to break.

Fig. 40. **Parbuckle.**—For raising or lowering a cask or a spar on an incline.

Fig. 39.

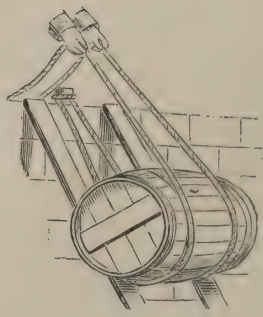


Fig. 40.

Fig. 41. **A Strop on a Rope.**—Started in the middle of a strop and both bights worked round.

FIG. 41.

Fig. 42.—The right and the wrong way to belay a rope, to avoid a jamb. Note that the rope should make an acute angle with the axis of the cleat.

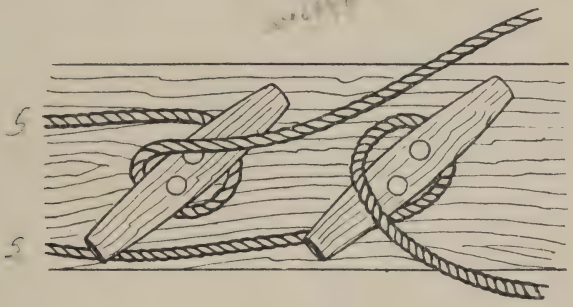


FIG. 42.

Figs. 43, 44, 45.—Extempore methods of securing a hawser with a "long eye."

FIG. 43.

FIG. 44.

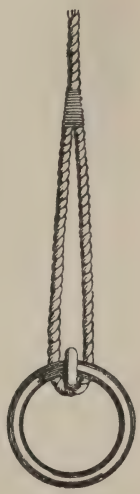


FIG. 45.

Fig. 46.—Shows a method of making a rope fast with a slip knot. To form it, make a bight *D*, reeve the end through, then pass the bight of *A* over *B* and *C* and up through *D*. By pulling the short end, the rope is freed.

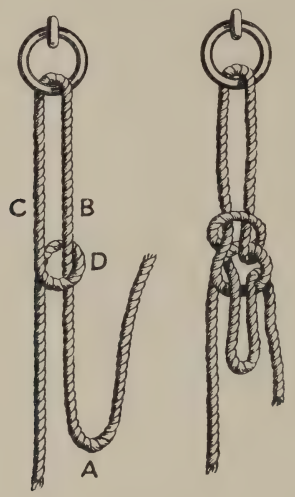


Fig. 46.

V.—KNOTS AND SPLICES.

Before unlaying the strands to make the following knots, put a whipping round the rope. Grease each strand after unlaying.

Fig. 47. **Matthew Walker.**—Take the first strand round the rope and up through its own bight, leaving it well open.

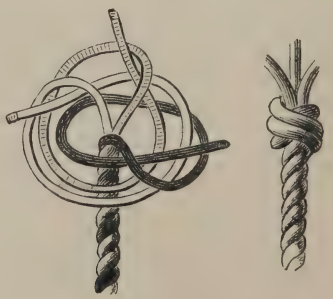


Fig. 47.

Take the next strand on the right round the rope and up through two bights. Third strand round and up through all three. Left hand cut shows the process. Work the parts round well by hand, pulling the ends taut gradually, then relay the strands, whip and cut them off.

Fig. 48. **Wall Knot.**—Make a bight in first strand, laying end to the right. Pass second strand round this end, and third strand round end of second and up through bight of first.

Fig. 48.

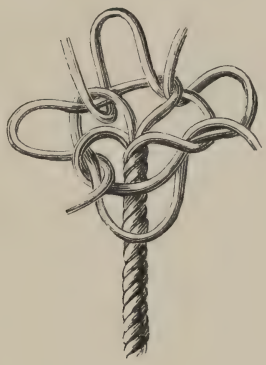


Fig. 49.

Fig. 49a.

Fig. 49. **Stopper Knot.**—Made from a wall by passing each end through the next bight to the right. Finish by relaying the strands, whip and cut them off.

Fig. 50. Shows how to crown a rope. This can be done either over a wall, as in the figure, or on the end of the

Fig. 50.

rope. It is just the opposite to a wall. Lay first strand over the next on the right, second strand over first and third, and third over second and down through bight of first.

Fig. 51. **Manrope Knot.**—Make a wall, then a crown and then, with each strand, follow the part next to it. This is the simplest form of "Turk's Head."

To make a Turk's Head on the bight of a rope, as for a guess-warp, take a long and a short piece of line, splice the

Fig. 51.

Fig. 51a.

short into the centre of the longer piece, open the strands of your rope and insert the line so that one part comes out between each two strands. Make a wall, then a crown and follow the ends round till you have three parts all round. The knot should be formed loosely, then bring the ends underneath, next to the rope, work all parts round separately to tauten them and cut off. (Fig. 51a shows the knot completed.) With four-stranded rope (for Jacob's Ladder) use four ends.

To form a Turk's Head on anything but rope, there are different ways of starting for

(*a*) Three parts.

(*b*) Four parts or any greater even number.

(*c*) Five parts or any greater odd number.

(*a*) Start by taking two turns as shown in diagram 1.

then dip the bight *B* (at the back) under the bight *C* and reeve the end *D* up through it. The end *D* then simply goes over one and under one until it meets the end *A*, which it follows for three or more turns. If the diameter of the article being treated is large, a better appearance is obtained by repeating the process of crossing the bights (at the back) as often as required.

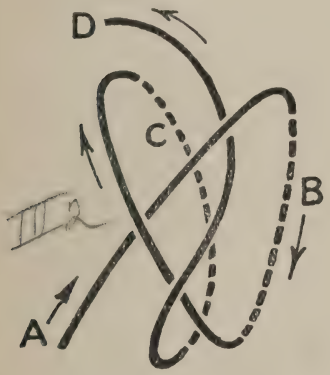


Diagram 1.

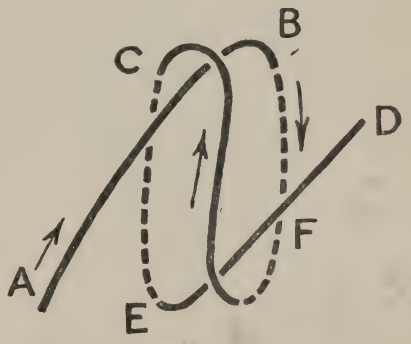


Diagram 2.

(*b*) Start by taking a round turn as in diagram 2. Pass over and under first turn (forming an overhand knot). The end *D* is then rove over *B*, under *C*, over *E*, under *F* and so on, over one and under one. Care must be taken to keep one set of crosses "up" and the other "down," and always follow the last turn, but going "over" where it goes "under" and *vice versa*.

(*c*) Begin as for three parts, but instead of crossing the bights behind, bring the end straight round and follow the last turn, going "over" where that goes "under" and *vice versa*. Keep one set of crosses up and one set down as in (*b*).

A back splice is made by forming a crown, then tucking each end over one and under one strand of the rope, twice and a half, and cutting off the ends. Used instead of a whipping on the end of a rope.

Figs. 52, 53.—**Diamond Knot** in the making and complete. Make a bight of each strand, laying the ends down the rope and hold them there. Take the end of each round the next on the right and through the next bight but one. Work them round taut and relay the rope.

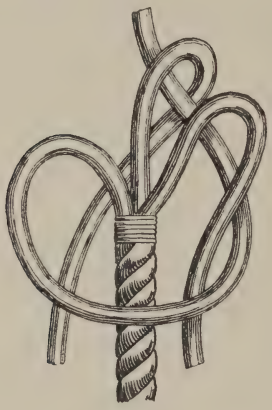


Fig. 52.

Fig. 53.

Fig. 54.—**A Diamond Knot** can be made with two ends by forming a "Double Carrick" (fig. 28), then take each end round the other and up through the centre.

Fig. 54.

Fig. 55.—**A Selvagee Strop** is formed by taking yarns round and round two points and then marling all together.

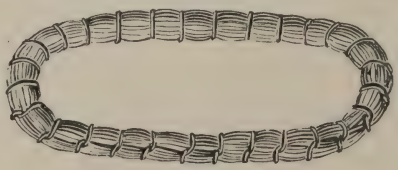


Fig. 55.

Fig. 56. **Shroud Knot.**—Unlay the strands and marry them (fig. 58). With the strands of each end make a wall round the main part of the other end. Worm the ends in the lay and serve over.

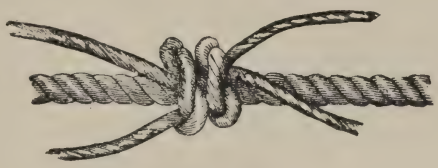


Fig. 56.

SPLICES—HEMP.

Fig. 57. **Eye Splice.**—Unlay the strands to about four times the circumference of the rope. Bend it to the size required—or round a thimble—then lay the strands across the rope with the middle one on top. Raise a strand of the rope with a marlinespike and reeve the middle strand under it. Stick the left-hand strand under the next, then

Fig. 57.

Fig. 57a.

turn the rope over and stick the right-hand strand under the third. Then tuck each strand over one and under one, halve them and tuck one half of each again to taper the splice. All tucks are made from right to left, that is, against the lay. Grease the strands so that they will fit in. Beat the splice over gently and cut the ends off. With four-stranded rope, tuck the left-hand strand under two.

Fig. 58. **Short Splice.**—To make a strop. Unlay both ends of a length of rope to about four times the circumference, take half a turn out of the rope and marry the two ends by intertwining the strands. Tuck each strand on one side, over one and under one, twice, then tuck each strand on the other side over one and under one, once. If the splice is to be tapered, tuck a half of each strand once more. But for heavy work, instead of tapering, split the strands and seize half of each to half of the next one.

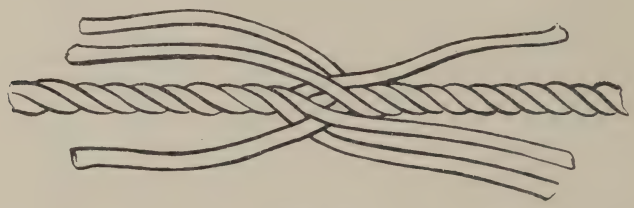


Fig. 58.

Fig. 59.

Fig. 60. **Long Splice.**—To splice a rope so that it will go through a block. Unlay the ends to at least 12 times

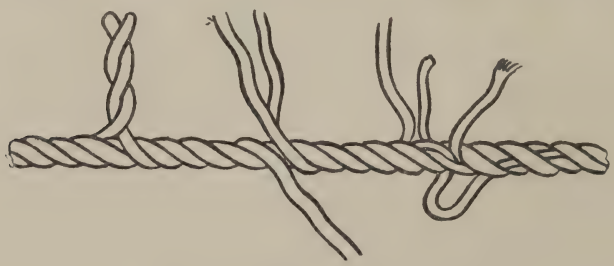


Fig. 60.

the circumference. Marry them and lay up one strand of each end together. Then unlay a strand on one side laying up the opposite one in its place until you have just enough

end for tucking. Repeat this process the opposite way with the third strands. Split each strand, knot half of each together and then tuck once and a half over one and under one. The spare halves can be tucked once back-handed—that is left to right. Rub all down and cut the ends off close.

Fig. 61. **Cut Splice.**—Each side is treated in a manner similar to an eye-splice.

Fig. 61.

Fig. 62.—**Horseshoe Splice**, similar to a cut splice but shaped differently by making one end longer than the other.

Fig. 62.

Fig. 63.

Fig. 63. **Grummet.**—Take a single strand out of a rope, being careful not to lose the lay, three and a half times the round of the strop required. Middle it, lay the right end over the left and lay it up. Then lay in the other end until the rope is re-formed of three strands. When the two ends meet, finish off as in a long splice.

Splicing weakens a rope about one-eighth, and the weakest spot is the end of the splice.

WIRE-SPLICING.

In tucking the strands of wire rope, the marlinespike must not be withdrawn until the strand has been rove in its place. The end of the strand is entered in front of the spike and hauled through as the latter is drawn out. The spike should be put in pointing slightly back from the ends, as so it will be less likely to pierce a strand. Marlinespikes for wire should have a rounded, flattened point of oval section.

A whipping must be put on the end of each strand before unlaying, and one round the rope at the point where the unlaying is to cease. *In making a short splice this latter seizing shonld be cut off after marrying.* The omission to do so is a very common fault.

After tucking each strand the strand which was lifted is hammered back in place. On completing the splice the ends of the strands are either cut off short with wire pliers, or the wires separated and broken off by twisting, or left about 8 inches long, marled down and served over.

Three-inch wire and above should be tucked three times full and tapered to one-third.

When splicing an eye round the thimble the part laying round the thimble is parcelled and served.

The thimble is seized to the wire and the latter bent into shape by means of "rigging screws" supplied for the purpose.

A good spunyarn seizing is then put round both parts and the "rigging screw" removed.

All tucks are made against the lay, *i.e.*, from right to left.

EYE-SPLICE.

There are a number of ways of making the first tuck to form an eye-splice in wire, but where strength is the first consideration the best way is as follows:—

Commence with the third strand from the right and tuck under one strand, then the remaining strands on the right, under one each, then the third and second from the left. Tuck the left-hand strand under two. Then tuck each strand over one and under one, twice. Take out one-third of each strand and the heart, tuck the remainder again, and then half them and make the last tuck.

Large wire hawsers are not spliced close round the thimble, but a seizing is put on between the thimble and the splice.

All eye-splices in wire are parcelled and served.

WIRE GRUMMET.

A wire grummet is made as follows:—

Take a length of wire, equal to two and a half times the circumference of the strop you want. Middle it and mark the centre with a whipping. Carefully unlay the strands at one end, stop three together with the heart, and three without, being careful not to lose the lay. Unlay these two halves from one another as far as the centre whipping. Then stop the heart in where it lies, cut it, and stop it to the other three strands. Cut off the centre whipping, and unlay the remainder, putting a stop round each half before separating them. Each of the halves will make one strop. Now, taking one half, turn it to the size you want, and mark where the end of the heart (in the middle) comes opposite the heart in the other end. Put on a whipping at this spot and cut off the end of the heart. (The best way to secure the heart is to open out the strands and whip it to the centre one.)

Now lay the two ends into the space in the bight, working both ways, so as to cover up the ends of the heart, and taking care that the heart lies in the place it came from—which can generally be seen. When the two ends meet, marry them and finish off with a long splice. Before tucking, halve each strand and take out the heart: tuck one half under one strand and one under two, then each under one.

Separate the wires and twist each one till it breaks off, which it will do close down—much closer than you could cut it.

Note.—A single strand of wire twisted round to make three parts is not a grummet and is NOT SAFE.

VI.—POINT, GRAFT, SEIZING, LASHINGS, SERVING, FLEMISH EYE.

To Point a Rope.—Put on a whipping at one and a half the circumference of the rope from the end. Unlay the rope down to this and divide the strands into yarns. Pick up the outside yarns and double them back over the whipping, securing them for the time. Form the remaining yarns into a heart, scrape them down to taper them and marl them down hard. Now take the outside yarns and lay them up in pairs into nettles. Lay these alternately up (over the whipping) and down (along the heart). Make a clove hitch with twine over these lower nettles, close up, and then double them back, bringing the former upper ones down in their place. Hitch the twine (which is called "filling") as before and continue the process till the end is reached. Finish off by hitching each upper nettle round the filling and cut all ends closely.

If a becket is required in the end of the rope, form this of a short end of small line, appropriate to the size of the hawser, unlay the ends and lay them up in three pairs. Form three strands out of the inner yarns of the hawser and short-splice these to the becket. Then proceed with the point.

Cross-Pointing, *vide* "Coach Whipping."

Grafting, which is used to finish off an eye-splice neatly, is made in the same way as pointing, working from the splice down the rope.

It is also sometimes used for decorative purposes—covering stanchions, tillers or yoke lines.

SEIZINGS AND LASHINGS.

Figs. 64, 65. **A Flat Seizing.**—Splice the end of a length of spunyarn—or whatever material is to be used*—into an eye round its own part, forming a running eye

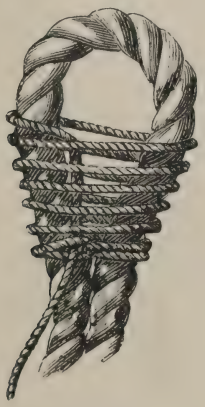


Fig. 64.

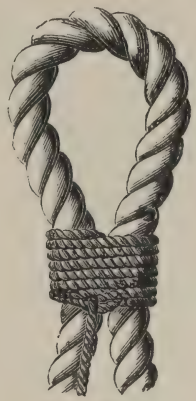


Fig. 65.

round the parts to be seized. Then turn this round and round till sufficient turns—from six to nine—are passed, keeping all slack. Bring the end back under the upper turns and up through the eye-splice. Then heave each turn taut with a mallet, by taking a turn round the shaft and using the head as fulcrum of a lever. Take care to keep the end fair in the middle. Work from the smaller part towards the larger. When all turns are taut, haul through the end (fig. 65) and pass two turns round the seizing, then finish by reeving the end under one of these turns outwards, over both and under one inwards, as in fig. 66. Haul through taut, cut off the end, leaving enough to crown and wall for a finish.

A Round Seizing differs from the above by having an extra layer—or "riding turns." After the end is hauled through the eye, pass "riding turns," one less in number than the under turns, so that each turn lies between two of

* For wire rope, iron wire is used for seizing.

the first. Bring the end down through inside the last lower turn as in fig. 65a, and finish as before.

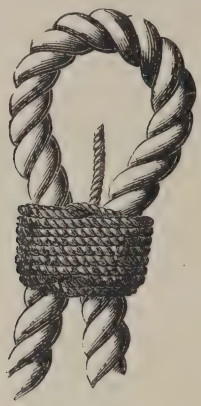


Fig. 65a.

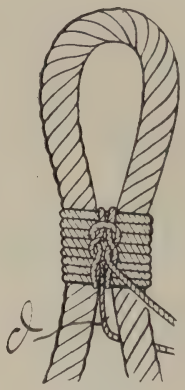


Fig. 66.

Fig. 67.—Shows how **Racking Turns** are passed. To make a racking seizing, the first turn is passed round both parts as in a flat seizing, then racking turns are passed to the number required, the end taken inside the last turn, then riding turns passed and finished as in round seizing. This is used to prevent the rope slipping.

Fig. 67.

Fig. 67a.

A Racking Seizing is used for the throat-seizing for turning-in an eye. With bare wire (not served) the best way is to start with whipping turns on one part, as many as

are required to prevent slipping. Otherwise, it will be found that, as the turns are hove taut, they will slip away from the larger part.

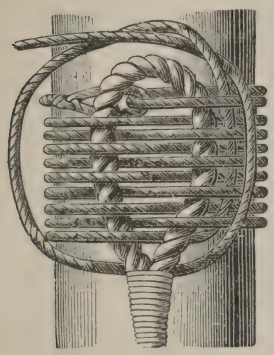


FIG. 68.

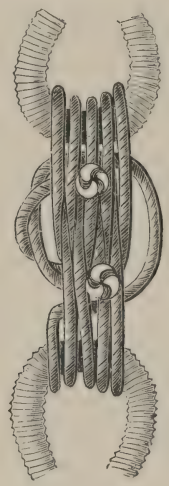


FIG. 69.

Fig. 68.—Shows a **Rose Seizing** for lashing an eye to a spar.

Fig. 69.—Shows **Rose Lashing** for lashing two eyes together. This is made by passing both ends as racking turns, and finished by taking both ends from the same eye between the two parts of the lashing in opposite ways on each side of the cross, twice round and knotted together.

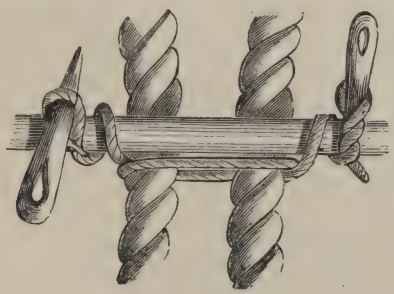


FIG. 70.

Fig. 70.—Shows a **Spanish Windlass** for forcing two

parts of rope together. The strand used must be well greased.

Fig. 71.—Shows a **Marlinespike Hitch.** This is sometimes used for heaving the turns of a seizing taut instead of a mallet. The point of the spike is pressed against the work to obtain leverage.

Fig. 72.—Shows how a rope is whipped. Note that the turns are passed "against the lay."

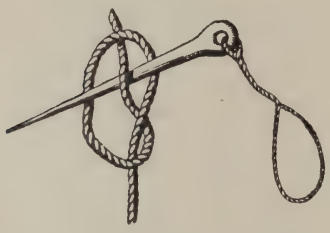


Fig. 71.

Fig. 72.

To Worm, Parcel and Serve.—In order to preserve hemp rope used as standing rigging, it used to be customary to worm, parcel and serve it throughout its length. Wire rigging does not require such treatment. Worming is scarcely ever used now, unless for decorative purposes. It consists in filling the interstices between the strands of a rope with smaller line ; after being passed by hand it is made taut by a soft strop passed round it and hove round with a lever. Parcelling consists of long strips of tarred canvas and is passed round the rope with the lay. Service is spunyarn hove on taut against the lay of the rope. If it was passed with the lay, there would always be a tendency to slip, and not only that, but spunyarn being left-handed the action of heaving it on against the lay hardens up the spunyarn instead of unlaying it.

Wire ropes are parcelled and served where they are spliced round a thimble, and over the splices to prevent the ends of the wires causing damage and to keep out moisture. (Wire rope is sometimes served with iron wire.)

Service is hove on with a "serving mallet" or "serving board" and requires a man to pass the ball of spunyarn round the rope in addition to the man heaving it on. In establishments where a lot of such work is done, they have mallets which carry a spool of spunyarn which make it a one-man job.

The service is finished by easing the last three or four turns, passing the end back under and heaving them taut singly, then hauling the end through.

A Flemish Eye (fig. 72a) is used for making a small eye in the end of a rope, as for instance, in the lower end of man-ropes to take a laniard. To make it, put on a whipping about six inches from the end, unlay the rope and separate the strands into yarns. Divide the yarns into two halves and lay them up in two-yarn foxes. Then hang up a bar, the size of the eye you want, horizontally—a belaying pin will do very well—and, taking one fox out of

Fig. 72a.

the centre of each half, knot them together on top of the bar. Then take the other foxes in turn, one from each

half, and half-knot them together round the bar, making each knot a little to one side of the one before so as to have a uniform thickness. Put a twine whipping round the ends at the shoulder of the eye and put a stop round the foxes at two or three places in the eye to keep them together. Then marl over the eye tightly and serve it over. The service can be continued over the shoulder of the eye, or this can be grafted with the ends of the foxes.

Ratline Seizings.—Ratlines are seized to the foremost and after shrouds with the eye horizontal. This eye is spliced, and a nettle is spliced into it. Take two turns round the shroud and through the eye, then turning the eye horizontal take two more, the same way round the shroud but the opposite way through the eye, and finish by reeving the end up through the space left under the seizing between ratline and shroud, back round the shroud, down the other side and round again, hauling these two turns taut singly to jamb between the shroud and the seizing.

Ratlines should be seized on so that the "crossing strand" of the splice is on top. Otherwise there will be a cavity which will hold moisture and hasten decay.

VII.—SENNIT. NET-MAKING.

Fig. 73.—**Common Sennit** is made with any odd numbers of parts. Single yarns, spunyarn, nettles or line can be used. Secure the ends and divide the parts with one more on one side than the other. Take the outer part on the side having the larger number and bring it over to the middle, thus putting the majority on the other side. Then treat the other side similarly, bringing the outside part over to the middle and so on. Finish by forming a bight in one part, with the end under and up, and reeve the remaining parts as they come into the middle, down through this bight, then pull the bight taut down on them and cut the ends off.

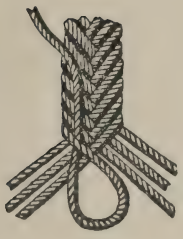


Fig. 73.

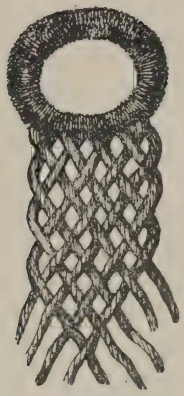


Fig. 74.

Fig. 74.—**Flat or French Sennit** is made in a somewhat similar way, with an odd number of parts, but instead of bringing the outside part over all others on its own side, weave it over and under them alternately, bringing it over to the other side.

Fig. 75.—**Square Sennit** is made with eight parts. Divide them into two fours, then take the uppermost part on one side, underneath, up inside the two outer parts on the other side and back to its own side. Then do the same

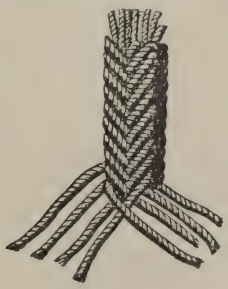


Fig. 75.

with the uppermost part on the other side, and continue the process, bringing each part up inside two of the opposite side and back to its own side. Finish as in common sennit, bringing each end, as it comes into the centre, down through a bight.

Half Round Sennit is made in the same manner, using six parts instead of eight. Each part is brought up inside two outer parts of the opposite side.

Round Sennit is used for decorative purposes, as covering a rope to make yoke-lines or man-ropes. Any multiple of four nettles or lengths of small line are used. These, when the heart is stretched out, are secured round it and then divided into four equal parts—pairs, threes, fours, etc. Commencing with the pair (for example) on top on the right, lay them across the heart to the left. Then the pair on top on the left, to the right over the first pair. Then the pair below on the left, under the heart and over the last pair. Then the lower pair on the right under the heart and over the last pair. All parts now appear on top of the heart and the process is continued in a manner similar to square sennit, the uppermost pair on each side alternately, being taken under the heart, between the two pairs on the opposite side and back to its own side.

The only difficult part of this business is getting the nettles or lines round the heart, and the best way of doing this is to make fast one end of a length of twine (or thread in the case of small stuff) and hitch this round each nettle in turn, taking care that they lie close together. When enough are so hitched to go round the heart, they can be seized on in this manner—the seizing afterwards covered with a Turk's Head.

"Coach Whipping" or "Cross Pointing."—This is used for the same purpose as round sennit, which it resembles in pattern. But, as by round sennit you only work with four sets of nettles, when the number required to go round the heart is more than sixteen, that is to say four parts of four, the result would be unpleasing. For coach whipping, any even number of nettles is required and these are used singly, in pairs, threes or any other combination. Suppose we have twenty-four nettles and propose to work them in

pairs. Having seized them on to the heart (which may be a rope, stick, staff or telescope, etc.) divide them alternately up and down. Take any upper pair and lay it down over the lower pair on its right, and bring this pair up to its left. Go all round like this. Then take the upper pairs down to the left of the lower and bring the lowers up to the right. And so on, working right round to the right and left alternately.

It is a two-man job, one to hold the upper nettles and one the lower.

It can be worked with strips of hide, cotton, canvas or anything of the sort instead of nettles. A rope can be pointed in this way.

Fig. 76. **Hammock Clews.**—Take twelve lengths of nettle stuff, middle them and seize all together to form an eye. Serve over the parts forming the eye. Then divide the nettles, half up and half down. Bring the

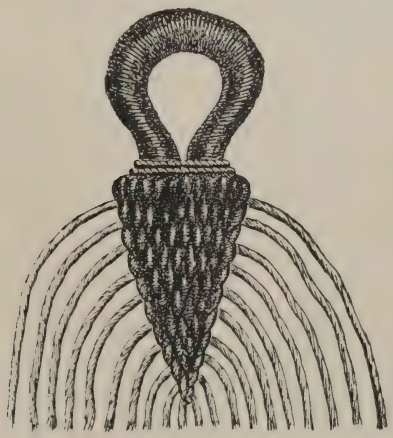


Fig. 76.

outer one on each side across to form the filling, leave the ends out, and cross the nettles over it. Then bring the outside nettles across again as at the first and repeat the

process, leaving a pair of ends out each time until there are only two left. Knot these together.

A Jacob's Ladder is made by sticking the ends of wooden rungs through the centres of two wires or four-stranded hemp ropes. Turk's Heads are worked under each end to keep them from working down.

The proper way to go up or down a Jacob's Ladder is by one side, with one foot in front and one behind.

Jacob's Ladders are chiefly used for providing ingress and egress to or from boats at the booms or davits.

Net-making.—Having provided a needle (or shuttle) (figs. 78 or 79) and filled it with twine, stretch a rope along for a head-rope, or make a loop with the end of the twine and hang it up. Regulate the size of the mesh by using second and third fingers of left hand (the former in last mesh and the latter in the one forming) or by using a flat piece of thin wood, itself called a "mesh"—short for mesh-gauge.

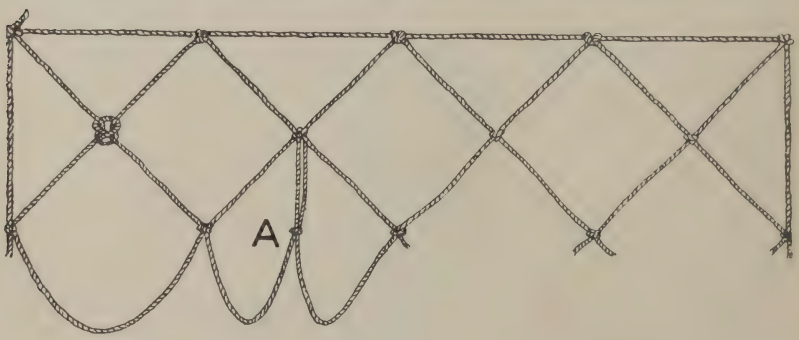


Fig. 77.

If using a head-rope as in fig. 77, start by hitching the twine to it at equal intervals, forming the first row of "meshes." The next row (and the first row in the other case) is formed over your finger (or gauge) up through the bight, hold it with the thumb and first finger, throw a bight over to the left and bring the needle under both parts and up through this bight. Don't let go with the thumb till the hitch is formed. Haul

taut and pass on to the next. It will be seen that a single sheet bend is thus formed. The number of meshes in a row depends upon the width of the net required. Having finished one row of meshes, slew the work over, or get round on the other side of it and work back, always from left to right, reeving the needle through a mesh in the row above—and look out not to miss one. To increase the number of meshes in a row, make a false mesh as at (*a*) (fig. 77) and to decrease, reeve the needle through two meshes and make the hitch round both.

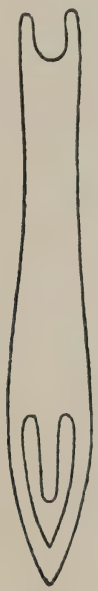


Fig. 78.

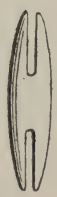


Fig. 79.

To join on more twine, make a "Weaver's Knot" as follows:—Hold the short end pointing from you between left thumb (on top) and forefinger. Place the new end under and crossing the other, pointing to the left. Take the bight of the new piece—over the thumb, under its own end, over the other end and stick this (the short end) up through the bight over your thumb and haul taut. This

forms a hitch like all the others and can be made very quickly and with a very short end.

To mend a damaged net you do not—as is laid down in some books—"cut away till you get a straight row of meshes and replace them," but proceed as follows:—

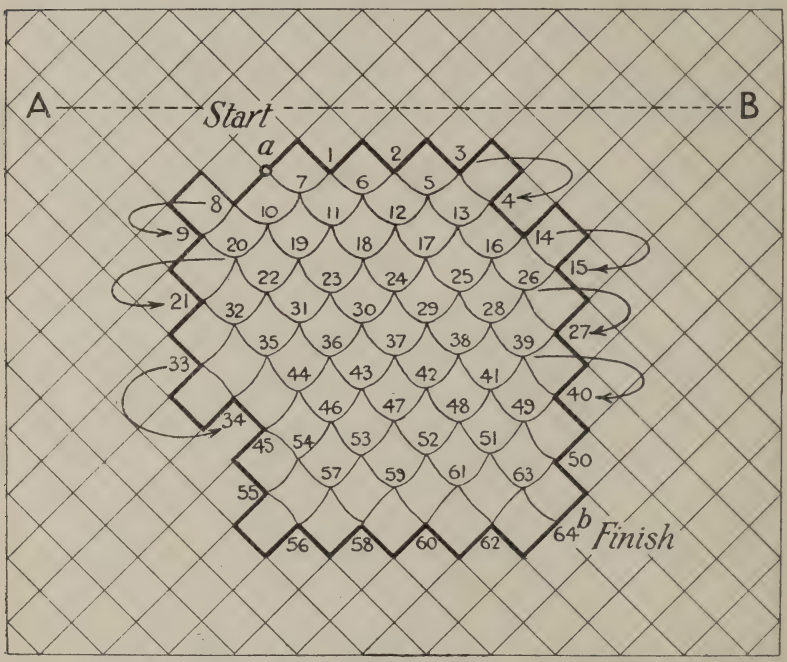


FIG. 80.—Net-mending.

First gather up the net on a straight row of hitches as at *A B*. Pass a hook or a stick through these and hang the net up at a convenient height for working. The hole has now to be "cut-out" making it larger still. Now, in the upper row of meshes broken see if there is a "three-legged mesh" sometimes called a "Halver," that is, one of this shape ⊥ at (*a*) one side; if so, that is your starting place, if not you must cut a mesh and make one. Then go round the hole and see that there are no more "three-legged"

meshes, they must all be cut out, but leave one at the bottom at which to finish (*b*)*. Make your twine fast at the starting place (*a*). If using a "mesh" reeve it through an adjacent mesh in the net and proceed as in net-making, looking out to pick up the meshes at the sides and bottom as you come to them. Note that with every hitch you form a "three-legged" mesh, and the last hitch joins two of these.

The thick line in fig. 80 shows how the hole has to be cut out and the figures show the order in which the new hitches are made. Note that at 4, 9, 15, 21, 27, 33, 40, 45, 50, 55, meshes have to be picked up from the side, and at 34, 56, 58, 60, 62 and 64, meshes are picked up from below.

VIII.—BLOCKS, TACKLES AND PURCHASES.

Wooden blocks are either turned out of a solid piece of elm (fig. 81) or built up as in fig. 82. The sheaves are either of lignum vitæ or metal. Those of the former material have metal bushes for extra strength and the reduction of friction on the pin. Where it is important to reduce friction to a minimum (as in yachts) the metal bush is fitted with ball or roller bearings.

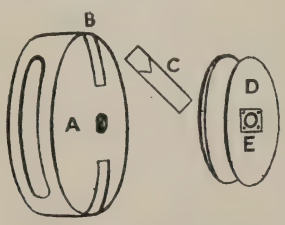


Fig. 81.—Wood Block.

A. Shell
B. Score
C. Pin
D. Sheave
E. Bush

The pin of a block passes through the shell and the sheave, the head is square to prevent turning and lies flush with the side (called the "cheek"). In stropped blocks the

* The result of cutting out is shown by a firm line in fig. 80.

strop prevents the pin falling out. The "swallow" of a block is the space through which the rope is rove.

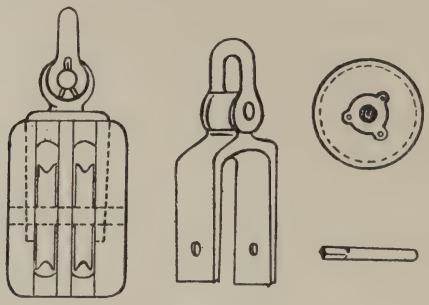


Fig. 82.

A groove is cut at the two ends of a block, called the "score" to keep the strop in place. Wooden blocks are distinguished by their longer diameter in inches. This is three times the circumference of the rope that is rove through them and they are stropped with rope of the same size as the rope they take, (if hemp). For wire strops *see* table (page 9, col. 10).

In metal blocks the pin is kept in place by a split pin. They are distinguished by pattern numbers.

Blocks are single, double, treble or fourfold according to the number of sheaves.

Fig. 83.—**Snatch Blocks** are single internal-bound wood or metal blocks with an opening on one side over the

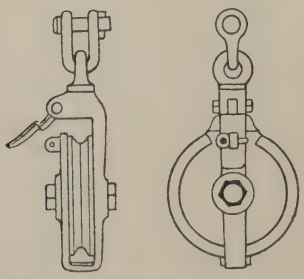


Fig. 83

swallow, which can be closed by a clamp and fastened with a hook or pin.

Gin blocks are metal pulleys in skeleton metal or iron frames (fig. 84).

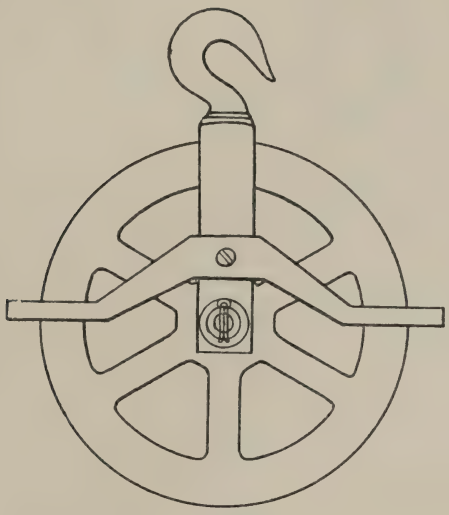


Fig. 84.

Stropping Blocks.—Strops for blocks are either "single" (fig. 85), "bale sling" (fig. 86), which is used when it is

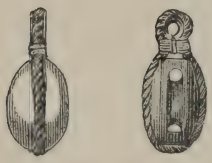


Fig. 85.

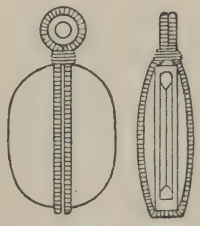


Fig. 86.

required that the sheave should lie in the same plane as the thimble ; or "double" (fig. 87) which is two single strops.

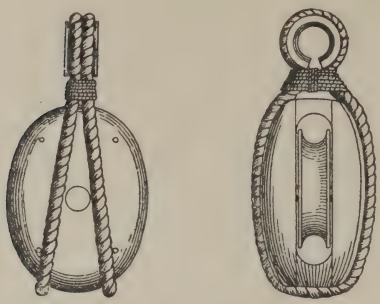


Fig. 87.

The single strop shown in fig. 85 is known as a short strop. A long strop (fig. 88) is only fitted for special purposes.

Fig. 88.

A short strop is made by joining the ends of a length of hemp or wire rope with a short splice.* To find the length required, measure once round the block, once round the thimble and once round the rope, and allow enough end for the splice.

Having made the splice, fit it into the score at the seat (or breech) of the block, place the thimble in the bight and get it on the stretch. Heave the two parts together between

* The strop is made of the same size rope as the fall.

thimble and block with a "Spanish Windlass" (fig. 70) and pass the first turns of a seizing (fig. 64) working from the thimble towards the block. Keep the opening in the thimble fair in the middle towards the block. Pass enough turns of the seizing to fill the space nicely, and complete as a "round seizing."

The common practice of stropping blocks with a strand of wire laid up three times and served over is most pernicious and should never be allowed. Strops should not be served over, except that wire strops should be parcelled and served round the thimble, and round the ends of the splice to prevent any wire ends causing damage.

Hemp strops are sometimes wormed.

Blocks are sometimes stropped with a grummet, but this is not as strong as a short splice and is only used for a neat appearance.

Tackles.—When a rope is rove through blocks for the purpose of gaining power, it is called a "tackle." But when only one block is used it is called a "whip" if the block is fixed, and a "runner" when the block moves. The rope is called the "fall."

The power or "purchase" gained is equal (but for friction) to the number of parts of rope at the moving block. Friction may be taken as 10 per cent. of the weight for each sheave, so it is important to take care that all sheaves revolve freely.

It is most important that the lead of the fall should be absolutely in line with the sheave and not chafing on the shell of the block. This entails great care in placing leading blocks, and the trouble of doing so is sure to be well repaid. For this cause, also, two single blocks are often better than a double block.

Although leading blocks add nothing to the purchase, but rather reduce it by the added friction, their use is often an advantage because men can apply their weight better to a fall from a fixed block than to one at a constantly changing angle.

When one tackle is applied to the fall of another, the resulting purchase is the product of the one multiplied by the other.

It has already been stated that a rope rove through a single fixed block is called a "whip."

A "double whip" is composed of two single blocks—purchase 2 or 3 according to which is the moving block.

A "luff tackle" is composed of a double and single block with the standing part spliced round the strop of the single block—purchase 3 or 4.

A "burton" is similar to a luff, but the double block has a hemp or wire strop seized into the thimble of the double block in addition to a hook. This strop is fitted to go round a spar and to come to the hook.

A "gun tackle" consists of two double blocks. The fall is generally four-stranded, left-handed rope, and it is customary to use iron blocks—purchase 4 or 5.

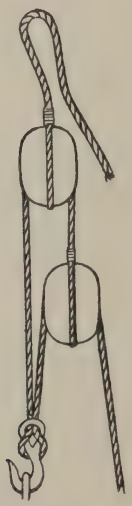


FIG. 89.

A "runner and tackle" is composed of either a luff or a double whip of which the moving block is secured to the

end of a runner. The runner doubles the power of the tackle.

A "Spanish burton" consists of two single blocks (*see* fig. 89)—purchase 3.

A "jigger" or "handy billy" is a small tackle, usually a luff. The double block is sometimes fitted with a hemp tail, when it is called a "tail jigger."

A "threefold purchase" is composed of two treble blocks, used for catting anchor or for working cables when steam or other power is not available.

When heavy threefold tackles are in use, the lay of the rope causes them to twist, and in order to minimise this it is a good plan to reeve them so that the hauling and standing parts each lead from the centre sheave of one of the blocks.

To achieve this, the blocks must be placed opposite ways, that is to say, one with sheaves horizontal and the other with sheaves vertical.

The fall is then rove as follows:—Suppose that the moving block is horizontal and the fixed block vertical and that the fall is required to lead on the midship side of both; reeve the fall through the centre sheave of horizontal block, from inboard-out, through outboard sheave of vertical block, from down-up, through upper sheave of horizontal block from outboard-in, through inboard sheave of vertical block, from up-down, through lower sheave of horizontal block, from inboard-out, through centre sheave of vertical block, from down-up, and secure to neck of horizontal block with two round turns and the end seized back.

IX.—DERRICKS AND SHEERS.

Permanent derricks are fitted in ships for hoisting boats or heavy weights in and out, for coaling, working cargo and other purposes.

In all cases they are fitted with a "topping lift" for raising and lowering them, with a "purchase" or a "whip" for lifting the weight and with two or more "guys" for

moving them laterally. The topping lift should, if possible, be taken to a point vertically above the heel of the derrick. If this condition is not fulfilled the topping lift will always act as a guy tending to bring the head of the derrick under itself, and this means an increased strain on the opposite guy. The fall of the purchase or whip should also lead through a block in the same vertical plane as the heel of the derrick, or else this too will tend to pull the derrick over.

The guys should have as large a "spread" as possible so as to keep the derrick rigid in any position. When tackles are fitted as guys, short "pendants" which may be of wire or chain are used to connect them to the derrick head to prevent the block being "bound" against the derrick. If the guys have to pass round standing rigging or other obstructions, pendants should be fitted there too, to prevent the parts of the tackle being "girt"—or else the guy should consist of a long pendant taken through a leading block on deck and brought to a deck tackle. (An example of this is the after guys of the "main derrick" in most men-of-war.)

It may sometimes be necessary to rig a temporary derrick for lifting a heavy weight over a ship's side. This would consist of a single spar with a topping lift and purchase lashed on at such a distance from the heel that it will plumb outboard when the derrick is topped to about 60°. The heel of the derrick is stepped on a shoe of some sort such as a beef-block, placed over a bulkhead, or a beam and stanchion if possible to distribute the weight. If no stanchion is suitably placed it is advisable to shore-up the deck from below. The heel is kept steady by three or more horizontal tackles. Guys are fitted over all. As has already been stated, the topping lift should be led to a point vertically over the heel, but as this will seldom be possible with a temporary derrick unless it can be stepped against a lower mast, it is better, having raised the derrick with a tackle from the mast, to depend on two back guys led across the ship making a small angle with each other at the derrick head. The

distance from the heel to the places where these are secured should be not less than the length of the derrick. The purchase fall should be led through a block at the heel of the derrick—unless there happens to be a good position plumb over it. Such a derrick should not be swung, but when the weight has been lifted it should be hauled inboard with another derrick or a pair of sheers.

To rig a pair of sheers, select two spars and cross their heads, first placing their heels as near as possible to the positions they will occupy when raised. Prepare a shoe for the heel of each in the same manner as described for a derrick. The distance of the heels from each other is one-third of the length from heel to cross. This is called the "splay" of the sheers. Put a good round lashing round the cross and place a strop or lashing for the purchase over it. Also secure a block for a small single whip to one of the spars. (This is in case it is necessary to trice a man up when the sheers are raised.) Fit guys and topping lift (or back guys) as in the case of a derrick. A tackle must be placed between the heels to prevent their "spreading," and each heel must have two other tackles to keep it in place.

Sheers should be as nearly vertical as possible. The purchase fall should be led midway between the sheer legs so as to avoid an undue proportion of the weight coming upon one of them.

X.—BOATS' FALLS, ETC.

Boats carried at davits are hoisted by means of permanent tackles called "falls." These are either luff tackle, twofold or threefold purchases. In the Navy, instead of a double block at the davit head as used in merchant ships, two single iron blocks are fitted, bolted to the horizontal bar of an inverted T-shaped crosshead, of which the vertical leg passes through the davit head and is secured with a nut on top. The inner of these two blocks is a swivel block to allow the fall to lead straight to a leading block (when

hoisting) without chafing on the cheek of the block. The outer block is fixed, to prevent turns coming into the purchase. The lower block of the purchase is a wooden one, fitted with an eye which goes over the hook in the slings. If the lower block were fitted with a hook there would be a danger of its catching a man's clothes and dragging him out of the boat, or catching under a thwart and causing damage.

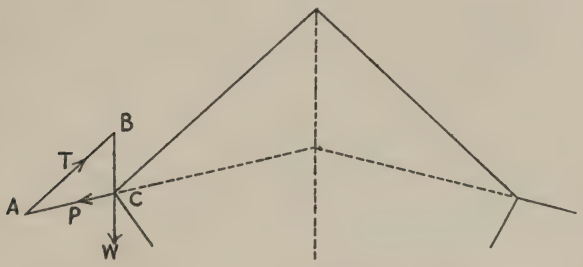
The slings of a boat consist of a span of chain at each end of the boat, one leg of which is shackled to a bolt through the keel and the other leg to a bolt through the stem and the sternpost. The two legs of each span either meet in a ring which carries a hook as above mentioned, or are shackled to a disengaging apparatus. To keep the boat upright when supported by the slings, "steadying lines" or chains are fitted to the slings at their junction, which are hooked or lashed to bolts in the side of the boat.

Slings are differently fitted according as to whether the boat is to be hoisted at davits or by a derrick. The largest steam pinnaces are not fitted with chain slings, but a three-legged wire span is used, of which two legs (fitted with steadying lines) hook direct to bolts through the keel forward and aft, and a centre leg hooks to a short length of chain which goes through the engine-room to a bolt in the centre of the keel. Other boats which are hoisted inboard are fitted with chain slings of which the keel leg is nearly vertical and 40-ft. steam pinnaces have also a centre leg.

But, in boats hoisted at davits, provision has to be made for turning in, and therefore the point of suspension has to be brought further forward and aft to allow the stem and stern to pass under the bow of the davit.

The practice of hoisting a boat whose slings are fitted for davits, by means of a span, is most unsafe. It brings an undue proportion of the weight of the boat on her ends, and not infrequently leads to a collapse of the boat or drawing the bolts in the stem or stern. It is, in fact, an example of the "taut span."

This diagram is a rough representation of the case of a 30-ft. boat fitted with slings for use with davits, suspended by a span of which each leg is 15 ft.



Applying the triangle of forces at each point of suspension,

W is a proportion of the weight.

T is the tension in one leg of the span.

P is the pull on the fore and aft leg of the slings which is counteracted by the strength of the boat

Then, $\frac{P}{W} = \frac{\text{Sin } A\ B\ C}{\text{Sin } B\ A\ C}$ and $P = W \frac{\text{Sin } A\ B\ C}{\text{Sin } B\ A\ C}$

Now if the angles $A\ B\ C$ and $B\ A\ C$ are equal, $P = W$ that is to say, the whole weight of the boat is borne on the end bolts, and as these are higher than the keel there is leverage tending to double up the boat.

But, in the diagram, the angle $A\ B\ C$ is even less than the angle $B\ A\ C$, so that in this case the force tending to double up the boat is actually greater than the boat's weight.

Therefore, when it is necessary to hoist in a davit boat, the safest plan is either to hook the span direct to the keel bolts and extemporise steadying lines, or to lengthen the fore and aft legs so that the keel legs become vertical.

Hoisting and Lowering Boats.—When hoisting or lowering a boat with men in her, care should be taken that they are all between the falls. This is in case one fall should carry away, in which case anyone being between the fall that remained and the end of the boat would be crushed.

Where life-lines are provided, each man should keep one in hand—and, in hoisting, take his weight off the boat with it. The after fall is always unhooked first and the foremost fall hooked on first.

At sea or in a strong tideway a boat rope is highly necessary for the boat to ride by whilst hooking on and until the weight is taken by the falls. In boats not fitted with disengaging gear a boat rope is also needed for unhooking. A boat rope should be led well forward so that the boat shall ride easily on a long scope. Where disengaging gear is fitted the boat rope should be made fast to the lower block of the foremost fall, where it is ready for use on the boat's return. And it is a good plan to have a stern fast on the after fall as well. In boats without disengaging gear, the boat rope should be brought into them over the broad of the bow, and being fitted with a long eye or a bowline should be passed under a thwart and toggled between two thwarts with a stretcher on top.

It cannot be too emphatically stated that a boat rope is no good unless it has a long scope. A boat cannot ride easily on a rope that is approaching the vertical, for as she rises and falls to the waves at each descent a large proportion of her weight is brought upon it and no rope or boat will stand such treatment for long

Gripes.—Boats which are carried turned-out at sea are prevented from swinging by "gripes" made either of sword-matting or a double rope covered with canvas. These are secured to the davit heads, and passing round the boat are lashed to a triangular link which passes under the tongue of a slip. These slips have up-turned tips to prevent their being accidentally freed, and a hammer is kept on a lanyard near each with which to knock off the link. But it is very often difficult to do this, and in such cases a useful "wrinkle" is to hold the tongue of the slip down with one hand and push the link off with the other.

Where no slips are fitted and there is a strong rail, a strop and toggle can be used. A strop is placed round the rail (to which it is seized) and one end passed through the eye of the gripe and back through its own part where it is secured with a greased toggle. Or the strop may be fitted with a thimble and lanyard so that the slack may be taken in.

Life-lines.—Every davit is provided with a life-line of the same size as the fall, and sea boats have in addition a smaller life-line for each thwart hanging from the jackstay between the davits. When a boat is hoisted the life-lines on the davits are used to hang her whilst the falls are being belayed. The way of doing this is to take two turns under the slings and over the davit head, make a half hitch round all between the blocks, dog the end back and hold on to it. When the fall is belayed the life-line is taken off and coiled down in the boat.

When hoisting, the foremost and after life-lines should be crossed to prevent fore and aft swinging and stretchers used for fending off from the ship's side.

Each davit is fitted with a snatch sheave at the bend, over which the fall is placed before being belayed. The fall is unsnatched when hoisting. In belaying a boat's fall, the first turn should be a complete round turn to facilitate lowering. To prevent sea boats swinging when hoisting or lowering, a wire jackstay is fitted from the bend of the davit to the water line, on which a lizard runs. The other end of this lizard should never be made fast, but should form a round turn round the eye of the lower block, and be attended.

Boats should never be allowed to make fast to the ship's side. If absolutely obliged to make fast alongside, a boat should be given a boat rope from well forward, and she should ride by this on her inner bow.

The common practice of passing a boat's painter up to the deck or over the bulwarks of a vessel, or passing a rope's end

the reverse way, is quite wrong in principle, for, in anything but the smoothest water, it brings a succession of heavy jerks on to the rope. Actually, it brings part of the weight of the boat on the rope instead of the force required to prevent her drifting astern.

The reason why, in spite of this, boats can lay in comparative security at the lizards on the lower boom lies in the length of their painters, the weight of the bight of which forms a "catenary."

When the boats at the boom start jerking at the lizards the boom should be lowered so as to increase the catenary.

This is the reason for mooring boats at night on a hawser led through a block hanging from the boom, instead of on the lizards.

Boats should never ride by a Jacob's ladder, for the strain is liable to force the rungs through the sides, or to carry them away.

XI.—LAYING OUT HAWSERS—SECURING TO A BUOY.

It may not be out of place to set down a few words on this simple subject, for the experiences of most seamen will probably include not a few instances of loss of time caused by ignorance of the principles governing the success of the operation.

These principles are—

1. Always take the whole hawser to the distant point first, and haul it back to the ship.

2. Remember that hawsers have weight (150 fathoms of 6-inch wire weighs over 2 tons). The only exception to No. 1 is when the distance is extremely short, as in securing a vessel alongside a wharf or another ship. In all other cases, such as laying out an anchor, making fast to a buoy, or laying out a warp, the whole hawser should be flaked

down in a boat (in a figure-of-eight)*, and sufficient coir hawser to reach the objective similarly flaked down on top of it. The reason for this is that the weight of the hawser will always tend to take it to the bottom and so anchor the boat, making it impossible for her to make any progress. But the coir hawser, being paid out as she goes, will float, and this is used for hauling back the end of the hawser after it is made fast at the distant point. It is far easier to haul a hawser back to the ship, where sufficient power may be presumed, than for a boat's crew to haul it out. The attempt to haul a length of heavy hawser through the water with insufficient power is bound to fail.

When the hawser to be laid out is wire, it is recommended that a hemp hawser of the same size should be used as a hauling line, for coir hawsers are not always to be trusted for the final pull. In the foregoing description, therefore, it is to be understood that the wire should be sent in one boat and (if necessary) the hemp and coir in another.

It may sometimes be necessary, in a strong tide and in the absence of towage facilities, to lay out the coir first and let the boat or boats with the wire and hemp haul out by it. The coir is then used for hauling back the hemp and the hemp for the wire.

Lastly, never trust a heaving line to haul out a long length of wire, but, even for short distances, use a hemp hauling line, not smaller than the wire.

We now come to the particular case of securing to a buoy.

Before securing to a buoy, the anchor, if stockless, must be eased out of the hawse-pipe and hove up to the special fairlead on the bow with the cat-pendant, and then hung by the securing chains provided for the purpose. The cable is unshackled at the after end of the swivel piece, and enough veered out through the hawse-pipe to reach the water.

Reeve a bull-rope, either through a block on the awning

* A figure-of-eight prevents turns coming into the hawser as it is turned alternately with the lay and against it.

stanchion, over a fairlead or down the hawse-pipe, and bend it to the cable with a rolling hitch about half way between the hawse-pipe and the water.

Bring the bull-rope to the capstan and heave the bight of cable as high as possible, stopper and belay the bull-rope. This is to allow for easing down the cable to the buoy and keeping it under control. Place a strand middled in the end-link of the cable.

Flake the whole of the picking-up rope into one of the sea boats, with the hook in the bows and the bight from it hung outside the boat. (These ropes are generally supplied in a quite unnecessary length of about 60 fathoms. Half this is ample and more convenient, for it ought to be quite certain that the bows can be placed within 180 ft. of the buoy.) Lead a grass hawser through the bow fairlead (or the hawse-pipe if not below the deck) and lead it outside everything to the boat.

Bend it to the upper end of the picking-up rope, take a good length to pay out on top of the wire and stop the bight to the bows of the boat.

As the ship approaches the buoy, lower the boat nearly to the water, and when about half a ship's length from the buoy, slip her and haul her ahead by the boat rope while the crew get their oars out. When the officer in charge judges he can reach the buoy he orders the stop on the bow to be slipped, the boat pulls to the buoy, paying out the grass as she goes. The bowmen jump on the buoy, pass the painter through the ring back into the boat, and hook on the picking-up rope.

The grass line and wire are then hauled back to the ship, the latter brought to the capstan and the buoy hove close to the stem.

The cable is then eased down by the bull-rope and the end link secured to the ring with the strand mentioned before.

The anchor shackle is then placed in the ring, the lugs

lifted till they come in line with the cable and the bolt put through and secured. Then remove the strand, ease down and unbend bull-rope, ease the picking-up rope and unhook it, adjust the amount of cable out and bouse-to.

With heavy cables, and if the buoy is not quite close to the ship, a ring rope may be required to haul the cable to the ring. If this is so, bend it to the first studded link and pass the strand in the end link as before.

This strand should never be omitted, it simplifies the process enormously.

The above will be found the most satisfactory way under all circumstances. To try to tow a length of wire hawser with a boat, or to haul it out with the number of men that can get foothold on a buoy, is to ask for trouble and rarely misses it.

To secure head and stern between two buoys, prepare two boats as above, but omit the grass hawser from the boat with the stern wire. Have this flaked down on the quarter-deck and through the fairlead and bend a heaving line to it.

When the boat is slipped she pulls clear of the wash of the screw and must catch the heaving line on the after grass line, which she then hauls out and bends to her wire. She then pulls to the buoy, the grass being paid out from the ship, and hooks on the stern wire. It is no use hurrying to get the stern wire in before the cable is shackled. When this is once done, the ship is secured and the cable can be veered as much as required.

At Malta, where ships generally secure head-and-stern, pendants are kept on the stern buoys, and then all that is required is a grass hawser to haul them inboard.

XII.—SECURING A VESSEL ALONGSIDE A WHARF OR ANOTHER VESSEL.

Although the operation of securing ships alongside a wharf is generally performed by riggers whose speciality it is, it may sometimes occur that a vessel may have to

secure with her own appliances and without assistance, so that a knowledge of the principles involved is very necessary to every seaman. For the principles which govern the securing of the largest ships apply just as much, in their degree, to the securing of the smallest boat or the homely lighter.

In the case of securing alongside another vessel, outside help cannot be expected and it is in this particular case where knowledge is most essential.

Broadly speaking, the whole principle may be condensed into this formula—secure by springs and not breast-fasts; and the smaller the angle which these springs make with the keel, the better.

The reason for this is that no power yet known will prevent ships from rolling, and if they are bound together or to a wharf by breast ropes at the level of the upper deck these ropes will always try to prevent the distance between the ships from increasing. But, as this is impossible, something has got to give, and either the rope will part or the bollards to which it is secured will be torn out. With springs, there is more play, and as the ship or ships roll the tendency is for the fore-and-aft component of the springs to be brought into play, and there will be slight compensating movement in the fore-and-aft direction.

In the following description, the word "spring" will be used to indicate a hawser leading forward from its point of egress, and "back-spring," a hawser leading aft.

All that is required to secure a ship are springs and back-springs forward and aft.

With a cross wind and in smooth water, it may sometimes be desirable and safe to pass a breast-fast temporarily, but this should be removed as soon as it is no longer necessary.

Before going alongside a wharf without assistance from the shore, it is necessary to land sufficient men to secure the

hawsers, and it is not a bad plan, if there is any doubt about getting the ship close in, to send two short wires, such as picking-up rope and mooring-pendant with hauling lines attached, with them. The ends of these would be placed on two bollards about the length of the ship apart, to be used as foremost spring and after back-spring. But one is no use without the other, for it is by heaving on one against the other that the ship should be placed.

If the ship can steam up to the jetty (or wharf) she should do so stemming the tide and at as small an angle as possible. The first rope to get ashore should be the foremost back-spring, from as near the turning-point of the ship as possible, not forgetting the hauling line on the end. In the case of being forced to come alongside with a following wind or tide, the after back-spring should be got ashore first. This will, given proper handling, gradually reduce the way of the ship and at the same time bring her close to the wharf. As soon as possible after the back-springs are fast, the foremost and after springs should be passed, and by bringing either the springs or back springs to the capstans, while keeping fast or easing their opposites, the ship can be accurately placed in the berth desired. It is recommended that both springs and back-springs should be led out of the bow and quarter pipes or fairleads as there is then no overlapping of the hawsers of the next ship—if any. The after spring and the foremost back-spring should cross one another.

Fig. 90 shows the arrangement of hawsers.

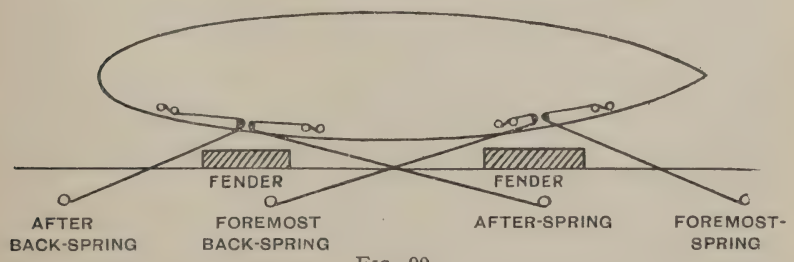


Fig. 90.

The bower cable, if not too heavy to get ashore, makes an excellent back-spring, led out of the hawse-pipe, well aft. Its weight helps to keep the ship to the wharf and keeps the springs taut.

The operation of securing alongside another vessel is performed on precisely the same principles, but as it may not be convenient to have the foremost back spring out of the spring pipe or fairlead, it can be led from the knight-heads or hawse-pipe of the moving ship to the spring-pipe of the other.

This operation is very frequently needed for securing a collier or other vessel alongside a man-of-war. Such vessels are very unlikely to be prepared with a hawser out of the spring-pipe (or "well-deck pipe" as it is generally called) but will have one ready on the forecastle. This should be taken well aft in the stationary ship and a hawser should be got ready beforehand, from the hawse-pipe, to pass in to the collier's well-deck pipe.

In a rough seaway, it will be found a good plan to shackle this hawser to the riding cable with a joggle-shackle and veer the cable till the hawser grows well ahead. Or a hawser can be taken out of the collier's hawse-pipe and shackled to the cable.

Breast ropes should never be employed between two vessels, for there is bound to be some motion, which such ropes will tend to prevent, and as this is impossible, either they or the bollards will carry away. They are obviously of no use to prevent the second vessel drifting astern, and that is the tendency which is to be overcome.

These principles should be far better known than they are, for even in the apparently simple matter of bringing a boat alongside a gangway or a landing place much time can be saved by their application.

XIII.—THE APPLICATION OF THE PARALLELOGRAM OF FORCES TO THE FOREGOING SUBJECT.

(Previously contributed to *The Journal of Commerce.*)

A vessel secured at one end only will always ride head to wind or to tide, or in a direction corresponding to the resultant of these two forces.

If, therefore, it is required to place another vessel alongside such a one and to secure her there, the force to be counteracted is one that will carry her directly astern.

This force would be best met by a contrary one acting in line with the keel to keep her ahead. But as this is not always possible, it is required to find how a force can be applied as nearly as possible parallel to the ideal, it being borne in mind that a rope can only convey a force in the direction of its length.

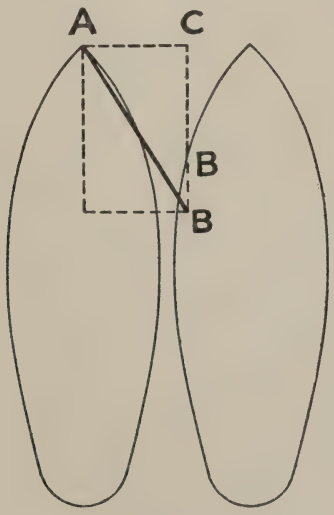


Fig. 1.

To arrive at this result, a rope should be taken from right forward in the stationary vessel to the broad of the bow of the

second so that we obtain the condition indicated in the diagram. By completing the parallelogram we see that the force preventing the second vessel from dropping astern is represented by the line B C, and we see that the further aft the point B is made the greater the ahead component becomes. But this is limited by the distance between the stem and the natural turning point of the vessel. If the point B were taken abaft the turning point, there would be a tendency for her to sheer off and ride broadside on to the wind (or tide as before).

If instead of the above an attempt is made to lash the vessels together by athwartship ropes, it must be apparent that until the lashings ceased to form right angles to the line of keel there is no ahead-component at all.

If we now construct another parallelogram indicating this case, and let length of the diagonal represent the breaking strain of the lashing, it will be seen that the tauter is the lashing the more nearly will the athwartship-component approximate to the breaking strain. When, then, there is any tendency in the vessels to roll, this athwartship-component is endeavouring to prevent the distance between their gunwales increasing, and as this is impossible the

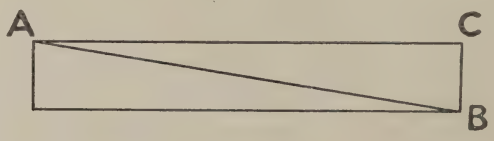


Fig. 2.

result is either to carry away the lashings or tear out the securing places.

Having secured the second vessel from dropping astern, as described above, it is next necessary to prevent her surging ahead and to secure her aft as well, especially if it is desired to rig a gangway or to pass from one to the other.

With regard to the former, the weight of the hawser

between the two ships will always tend, however slightly, to bring the ship ahead. This is prevented by a second hawser from the stem of the second ship to the bow of the stationary one (2). (Fig. 3.)

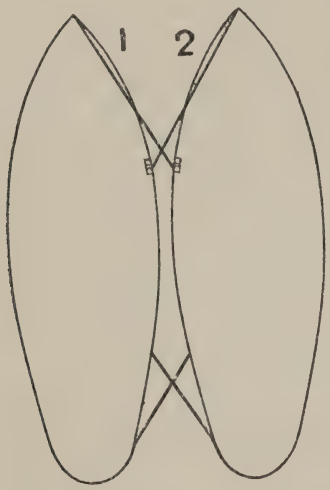


Fig. 3.

Securing aft is done in precisely the same method as forward, with a hawser from the stern of each to the quarter of the other. Breast-fasts or ropes at right angles to the keels are as dangerous aft as they are forward.

The above principles apply to all cases of securing ships or boats alongside other ships or boats, whether stationary or towing, and to wharves. In the latter case, it is recommended that the springs and back-springs, or hawsers led from the stem aft and from the stern forward, should lead from the foremost and after spring-pipes, aft and forward respectively, crossing each other. This is because they are likely, in most ships, to be more nearly on a level with the bollards on the wharf with a corresponding decreased strain on the ropes, bollards and fairleads.

In a steamboat, when going alongside a ship or landing

place with the wind or tide setting off, the best plan is to get a rope from the bow of the boat, fast to the steps (forming a back-spring) and go ahead slowly on this with the helm

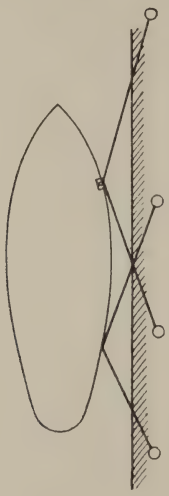


Fig. 4.

towards the steps, which has the same effect as, but more power than, hauling on it, for resolving the tension in the rope again into fore and aft and athwartship components, as the former cannot act, the rope being made fast, the effect will be to haul her to. Ships' boats are rarely fitted with fairleads sufficiently far aft on the bows for this; and another fitting, which few possess, which is of great use, is a cleat or bollard nearly amidships, for an after-spring to be secured to for the same purpose.*

Many people appear to imagine that a boat can ride alongside a ship from a rope thrown down almost vertically over her bow. The fallacy of this can be easily seen by resolving the tension in the rope by the P.F. as before, and it will

*The analogy of the action of an ordinary pair of parallel rulers is a good illustration of this method, the bars representing the springs.

be seen that a boat rope should be as far forward as possible and as low as possible, and let it be stated once again that

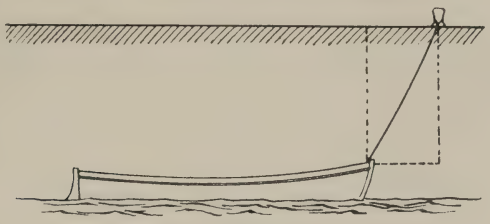


Fig. 5.

the boat should ride with the boat rope on her inner bow and not over the stem.

XIV.—TOWING.

For towing another vessel there is no better arrangement than using the whole length of the best wire hawser shackled to the cable of the ship being towed. And, purely as a safeguard against this carrying away, it is usual to use the next best hawser and the other cable. It is improbable that the weight will be equally divided between the two except momentarily. In securing the hawser in the towing ship, care must be taken that the strain is distributed over as large a part of her structure as possible. Consequently, most of H.M. ships are supplied with towing pendants of the same size as their largest wire hawsers, with which a turn is taken round the after turret—if any—or round two or more bollards. To the after end of these pendants towing slips (Senhouse pattern) are shackled and these should be well forward of the stern fairleads. Tugs have a slip amidships well forward and a horse over which the hawser rides, which facilitates steering, but in ships which are not built for the purpose the use of the stern fairleads, though objectionable, is unavoidable. As the thimbles fitted in the ends of wire hawsers are generally too small to go over the tongue of the towing slip, towing-shackles

are supplied for use with them. These are simply elongated joining-shackles which will take the tongue of the slip easily, and, what is most important, will not jamb when slipping. The vessel to be towed should provide the hawsers, towing-shackles and hauling lines, as, if the towing ship provided these, there would be danger of fouling her propellers when the tow was slipped, but, none the less, it may sometimes be necessary for this to be done.

The method, in fine weather, is as follows:—The ship to be towed shackles the end of her wires to her bower cables (using the swivel-piece if possible) and flakes down the remainder on her forecastle in long bights, securing each bight aft with a good stop to prevent the hawser "taking charge." To the other end of the wires, hemp hawsers, of the same size if possible, are secured with the first two parts of a rolling hitch and the end seized along the wire. The crown of the towing shackle is secured to the hemp with a good seizing. These hemps are similarly flaked down. A grass line is flaked into each sea-boat, the first end to go in being well secured in the bows, and the last end taken forward, clear of everything, in through the foremost fairlead (or hawse-pipe) and bent to the top end of the hemp. The towing ship should provide a boat-rope on each quarter—not from the stern—with heaving lines bent to the ends. Another heaving line each side is required to haul up the ends of the grass lines. When the boats arrive, they ride by the boat ropes, bend the heaving lines to the end of the grass, and when the end is inboard let the remainder go and return to their ship. The hemp hawsers are hauled in by the grass, and then the wires by the hemps. It must be borne in mind that the weight of the hawsers between the two ships will tend to bring them together; it is therefore necessary that the operation of hauling them across and getting them on the slips should be performed as rapidly as possible, and, as soon as the slips are on, the towing ship should start steaming slowly ahead.

The bights of hawsers should never be allowed to leave the water, for, if they do so, a very small extra jerk caused by either ship pitching will not improbably, or almost certainly, part them. This is one reason for using the cables, for their weight causes a sag in the tow and this ensures elasticity.

The ship being towed can, by adjusting the length of cable outside, assist in the synchronisation of the two, that is to say, so that both rise to the waves at the same time.

If the sea is too rough to allow the use of boats as above described, the towing ship should veer a grass hawser astern with two or three buoys or barricoes on the bight and end, and tow this from about the turning point of the ship across the bows of the ship to be towed. The procedure when she has got hold of it is the same as before.

It may be desirable, in the case of insufficient clear space for flaking down the wires to run easily, to control them while they are running out. This can easily be done by means of a chain check stopper (fig. 91) By manning the tackle and veering or hauling as required, the speed can be regulated to a nicety. But the standing part of the stopper must be ready to slip at the last, or the eye of the hawser will jamb.

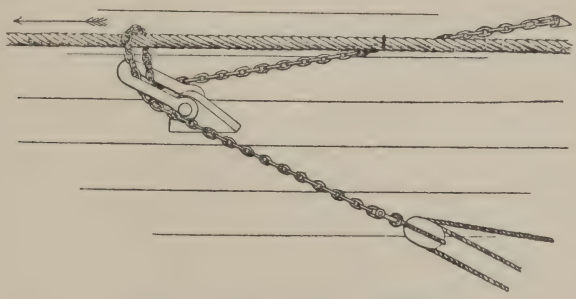


Fig. 91.—Chain Check Stopper.

Towing alongside.—This is an operation which is sometimes necessary in harbours where there is not enough room to tow ahead, or for placing a vessel alongside a berth.

It should never be attempted except in smooth water, for the motion of the ship is liable to cause great damage to both.

Each ship should prepare by taking her best wire out of her foremost spring-pipe, aft, outside everything, to abreast her after spring-pipe. Their next best hawsers should be taken out of the hawse-pipes or foremost fairlead to abreast the foremost spring-pipe. Plenty of fenders should be provided by both, and any portable obstructions on the sides removed. When the towing ship arrives alongside the other they have merely to exchange the ends of their

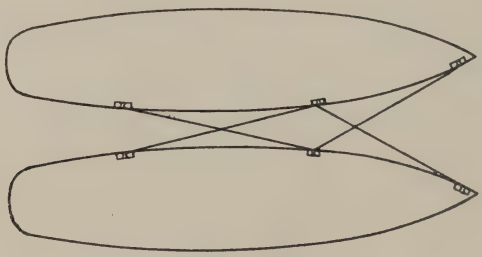


FIG. 92.

hawsers and secure them (fig. 92). The foremost hawsers are simply to reduce yawing and to assist steering, the principal work falling on the longer springs. As has been observed in the last chapter, breast ropes are to be avoided, as the motion of the ships is likely to part them.

If possible, the stern of the towing ship should be abaft the other, so as to clear the propellers and avoid the effect of their wash.

PART II.

ANCHORS AND CABLES.

I.—TYPES OF ANCHORS.

THERE are three types of anchors in common use, namely:—Admiralty pattern anchors, with iron or wooden stocks; swinging fluke anchors; and stockless anchors.

The names of the parts of an anchor are shown in fig. 93.

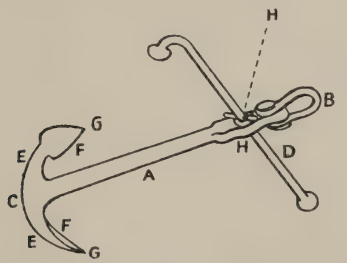


FIG. 93.—Admiralty Pattern Anchor.

A. Shank.	E. Arms.
B. Ring.	F. Palms or flukes.
C. Crown.	G. Bill or pea.
D. Stock.	H. Forelock (Split).

In addition, a "balancing band" is sometimes fitted on the shank in such a position that the anchor, with cable shackled, will hang horizontally when supported by it.

The "Admiralty pattern" anchor has been found superior to all others in holding power, but on account of the superiority of other patterns for stowage it is rarely seen now except as a kedge.

The iron stock is oval in section so that it cannot turn in the shank and is kept in place by a split forelock. The bulb on the end is also oval, but on the opposite axis, so

that, to remove the stock, it is drawn through the shank after removing the forelock, and then turned at right angles.

The action of the stock when the anchor reaches the bottom is to lie flat itself, causing the flukes to bite the ground.

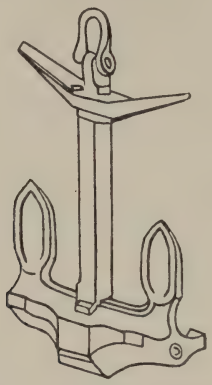


FIG. 94.—Martin's Improved Unchokable Anchor

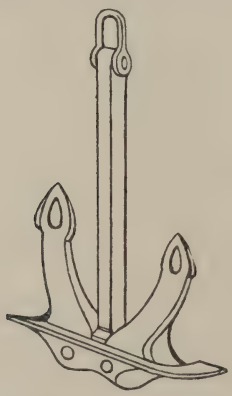


FIG. 95.—Hall's Stockless Anchor.

It should be remembered that it is the weight of the cable lying on the bottom that keeps the anchor from dragging. If a ship is lying in a gale or strong tide with so little cable out that a direct pull is brought on the ring of the anchor, it will inevitably drag, while with plenty of cable out the pull of the ship only lifts the cable off the bottom, to which its weight causes it to return. This is called the "catenary."

The usual type of swinging fluke anchor is shown in fig. 94, and a stockless anchor in fig. 95.

The arms of all these anchors are capable of moving through about 45° on either side of the shank, and to assist the flukes to bite into the ground tripping horns or palms are fitted to the arms which, by pressing on the bottom, cant the flukes downwards. The palms of all these anchors are hollowed or grooved out to give them a better grip.

The usual anchors carried by a ship are:—

2 Bowers (formerly called "best bower" B.B. and "small bower" S.B.)

1 Sheet—or spare anchor—of the same size as the bowers. (This name originated from the fact that the anchor was stowed near the fore-sheet.)

1 Stream anchor—(about $\frac{1}{3}$ the weight of the bower).

2 Kedge anchors (up to 16 cwt.)

Boat's anchors—one for each boat.

II.—CABLES.

Chain cables are made from iron bars which have been twice worked in the forges and mills, free from any admixture of steel, and of a highly fibrous character. The bars are cut into the length required for making one link, the cut being made diagonally to form the "scarf." These pieces are then, whilst red-hot, turned by a machine into shape, the ends welded together and the stud inserted.

Cables are made up into lengths of $12\frac{1}{2}$ fathoms for the Navy and 15 fathoms for the Merchant Service. The links at the two ends of each length are studless and $\frac{2}{16}$ inch larger than the links of which the cable is made. The last studded links are $\frac{1}{16}$ inch larger than the others.

Cable is designated by the diameter of metal of which the links are made and this is measured by callipers.

The sizes vary by sixteenths of an inch.

The length of a link is 6 times the diameter of the metal and the width $3\frac{1}{2}$ times.

Lengths of cable are joined together by joining shackles (fig. 96). The bolts of these are kept in place by, in the Royal Navy, a steel tapered pin which passes through the lug of the shackle and the bolt, and is kept in place by a

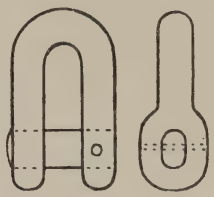


Fig. 96.—Joining Shackle.

leaden pellet which is hammered in and expands into an undercut cavity. In the Merchant Service the place of the steel pin is taken by a wooden plug, which has to be broken to remove the bolt.

For driving out the steel pins, cable-punches are used, shown in fig. 98 ; (*a*) is a starting-punch, (*b*) is a driving-punch.

Shackles are placed in the cables with the lugs aft, as if they were forward they would be likely to catch in running out.

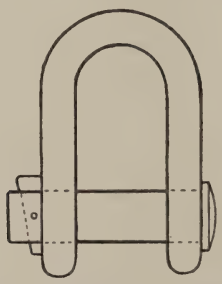


Fig. 97.—Anchor Shackle.

As many as fifteen lengths (or shackles) of cable may be joined together for each bower, but the distribution of the cable supplied between the two bowers and the sheet anchor is at the discretion of the ship's officers.

The cable is joined to the anchor with an anchor shackle. This is made of heavier metal than the joining shackles,

is wider, to take the ring of the anchor, the bolt projects beyond the lugs, and is kept in place by a forelock which passes through it and this is kept in either by a steel pin and leaden pellet or a split ring. Fig. 97 shows the former method.

For stockless anchors, however, the anchor shackle is made similarly to the joining shackles (fig. 98).

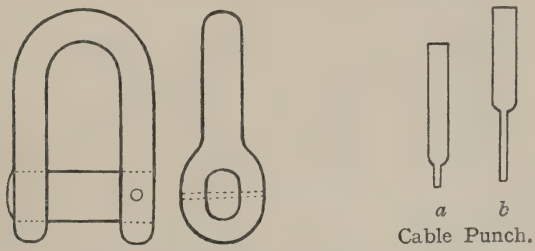


Fig. 98.—Anchor Shackle for Stockless Anchors.

The lengths of cable are numbered consecutively from the anchor, and each is marked by a piece of iron wire twisted round the stud of the link whose number from the studless link corresponds with the number of the adjoining shackle. Thus the sixth length of cable will have a piece of wire on the stud of the sixth link from its after end and on the fifth link from its foremost end.

Fig. 99.—Swivel-Piece.

In order to keep turns out of the cable, a swivel-piece (fig. 99) is introduced into each end. With stockless anchors this is placed between the end of the cable and a "lengthening piece" of about ten links which is shackled to the anchor. In ships without stockless anchors, the first length of cable is sometimes in two halves with the swivel-piece between them.

A swivel-piece should never, if avoidable, be allowed to come on to the sprockets of a capstan or cable holder,

for, being bigger than the cable, it will ride over the sprockets and may cause an accident.

The swivel-piece on the inboard end of the cable is secured to a "Senhouse" slip which is bolted to the bottom of the chain locker. This slip is kept triced up to the top of the chain locker so as to be always accessible in case it is necessary to slip the cable.

Fig. 100.

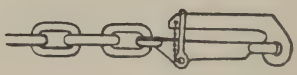


Fig. 101.

In order to hold the cable temporarily, there is fitted on the cable deck a "Blake" slip (fig. 101) which goes over one link.

The difference between a Blake and a Senhouse slip is that, in the former the tumbler link is horseshoe-shaped and pivotted on the slip, and in the latter the tumbler is a complete link which slides along the slip.

Ships with stockless anchors are fitted with a second Blake slip, mounted with a bottle-screw, just abaft the hawse-pipe. This holds the cable, ready for letting-go, and the bottle-screw is for heaving the anchor home into the hawse-pipe. Before letting-go, this screw is eased right back, so as to have something to heave in with, and doing so also discloses any tendency of the anchor to hang.

The "navel-pipes" (fig. 102) (in merchant ships, called the "spurlingates,") are the openings in the cable deck through which the cables pass to the lockers.

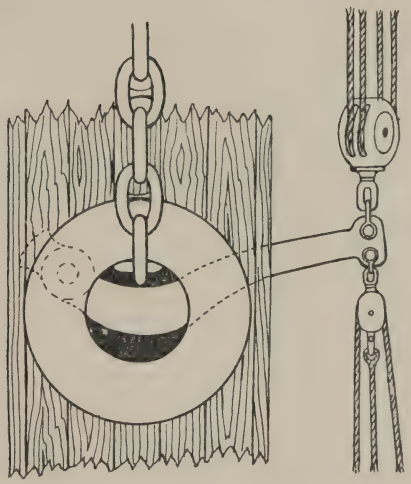


Fig. 102.—Navel-Pipe and Compressor.

The "compressor" (fig. 102) (which is not fitted in the latest ships) consists of a curved bar or a ring of steel pivotted beside the navel-pipe, and below the deck. It is used for holding the cable by nipping it against the lower edge of the navel-pipe called "bowsing to." A "good nip" is obtained by engaging both sides of a link. If the link is upright, it is a "bad nip." Ring compressors are fitted when it is necessary to bowse to either on the fore or after side of the pipe. When the cable holder is used, the nip is on the after side, but when using the capstan it is on the fore side.

"Riding bitts" (fig. 103) are vertical, cylindrical hollow castings placed between the navel-pipes and the hawse-pipes for controlling the cable when running out and to assist the compressor in holding it when at anchor. They are not used in conjunction with cable holders, as these

perform the same duties. To keep the two parts of the cable separate, a flat-ended bar of steel called a "battledore" is passed through the bitts and kept in place by two forelocks. Sometimes two battledores are fitted so that the cable can

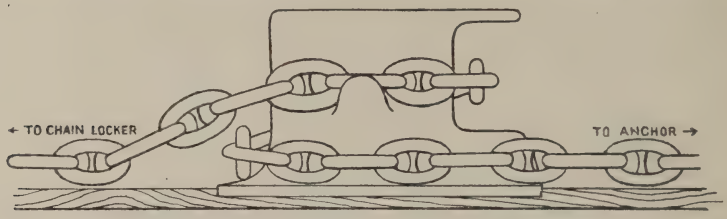


FIG. 103.—Riding Bitt, with Cable Bitted.

be double-bitted when at anchor in very deep water. To keep the cable from slipping over the top of the bitts, bitt pins are fitted which are round bars passing through the bitts in a fore-and-aft direction.

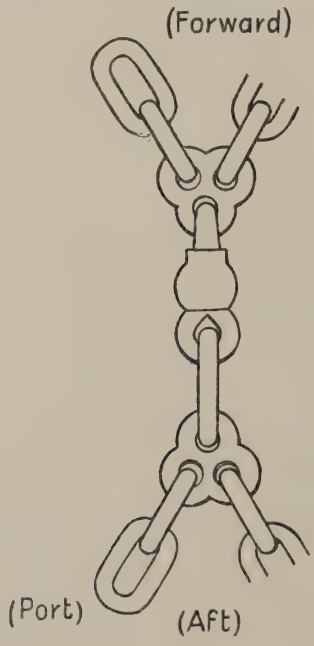


FIG. 104.

A "mooring swivel" (fig. 104) consists of a swivel and a link between two three-way links. In the other eyes in these links there are fitted, on one side, two studless links, and, on the other, one. The odd-numbered links are for the starboard cable and the even-numbered for the port. The swivel is put on with the cup of the swivel aft, so that it will be uppermost when out and can thus be lubricated.

A "clear hawse slip" (fig. 105) is a Blake slip fitted with a "roller shackle." The bolt of this shackle is secured in the same manner as that of a joining shackle, but as the bolt is circular in section there is a stud under the head which fits into a recess in the lug to bring the holes for the pin into line. It is used for holding the cable below the turns in clearing hawse.

FIG. 105.—Clear Hawse Slip.

A "joggle shackle" (fig. 106) is a long curved shackle used for holding a bight of cable or for securing two bights together. The bolt is fitted with feathers which pass through

feather-ways in the lugs so that half a turn will hold it in place.

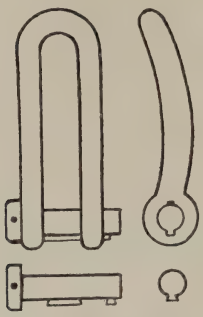


Fig. 106.—Joggle Shackle.

Strength and Weight of Cables.—The proof strength of cable is given by the formula:—

$$\text{Size}^2 \times 18$$

The breaking strain is size^2 $\times 27$ and the weight in tons per length (or shackle) of $12\frac{1}{2}$ fathoms size^2 $\times .3$. Cables should be re-tested every three years.

Surveying Cables.—Every six months cables should be surveyed. The best time for this is when in dry dock, for the cables can then be veered down and ranged on the bottom. Otherwise they have to be got up and ranged on deck. All shackles are taken out, the bolts and pins cleaned and lubricated and the lead from the old pellets reamed out of the lugs. Every link is sounded by an experienced blacksmith, and if a defective one, or one whose smallest diameter is one-eighth of an inch less than the original size, the length containing it is returned to the dockyard at the first opportunity for repair. Any loose studs are re-caulked, or if broken, replaced. Every ship carries a supply of spare studs, which are put in when red-hot. Swivels are cleaned and lubricated with tallow. The cable lockers are cleaned, dried and painted. All slips and spare shackles, rigging screws and wire hawsers are examined and cleaned at the same time.

The arms of all swinging fluke anchors should be worked and lubricated at least once a month as otherwise they are likely to be found set up when wanted. The capstan and cables holders should be worked every week. The latter, when of the friction-plate type, are liable to become seized, and a case has been known of the cable failing to run, when the anchor was let go, from this cause.

Anchor buoys, for indicating the position of an anchor, are either small barricoes filled with cork, or plain chocks of wood. They are attached to the crown of the anchor by a hemp buoy rope, but to prevent this being cut on the bottom a short length of chain is generally fitted. This has a running eye which goes over one arm, and a half-hitch is made over the other. In the case of small anchors, such as kedges, the buoy rope is supposed to be capable of weighing the anchor, and with a stream anchor the buoy rope is double, through a clump block on the crown of the anchor, for this purpose.

When anchoring a boat over a rocky bottom, the grapnel (as the hemp rope used with the anchor is called) should be made fast to the crown and stopped to the ring. When weighing, this stop can be carried away and the anchor comes up by the crown.

III.—STOWAGE OF ANCHORS.

Stockless anchors are hove close into the hawse pipes, the final heave being got with the screw stopper as previously mentioned, then secured for sea by short lengths of chain passing through the ring and secured by ships.

Admiralty pattern anchors are stowed with the inner fluke resting on an inclined plane called a billboard, and the lower end of the stock resting on a chock on the ship's side. They are hung, either by a chain through the ring called a cat stopper, and another round the lower part of the shank called a shank painter, both of which are connected to tumblers, or by two shank painters.

Swinging fluke anchors stow either on an inclined anchor bed as illustrated in fig. 107 or vertically against the ship's side as in fig. 108.

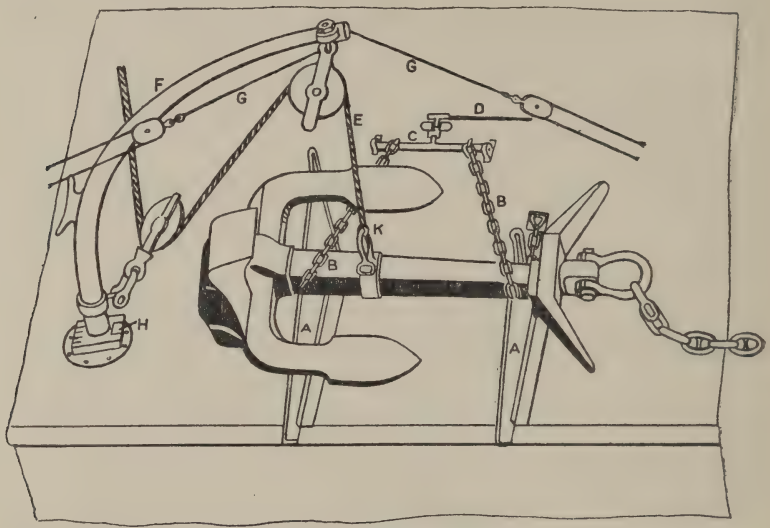


Fig. 107.—Stowage of Swinging Fluked Anchor on an Anchor Bed.

A. Anchor chocks.
B. Shank painters.
C. Tumbler.
D. Lever for working tumbler.
E. Cat pendant.
F. Cat davit.
G. Guys.
H. Hinge for lowering davit.
K. Cat hook.

The operation of lifting the anchor into its stowing position is called catting.

IV.—CABLE HOLDERS AND CAPSTANS.

The cable holders, one for each bower cable, and the capstan are worked by an engine, and by means of clutches can be geared to work independently, together, or in contrary directions.

The capstan is generally fitted with sprockets for use with the sheet cable, or in case of the cable holders being out of action. But in some ships where the cable deck is below, the capstan is geared to work the cable holders.

The capstan either has a barrel, fitted with steel strips called whelps, above the sprocket wheel, or portable whelps are supplied for covering the sprockets for working a hawser.

The upper part of the capstan is fitted with recesses for the insertion of bars when working by hand. And the lowest part is fitted with pawls which engage in a pawl bed

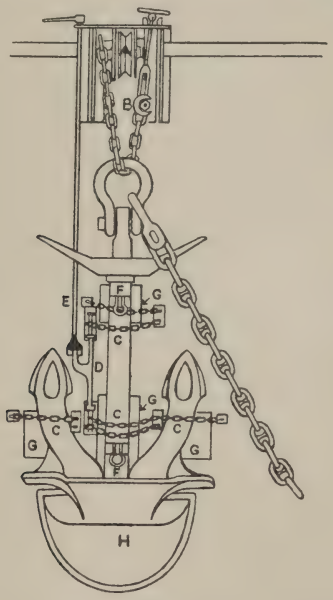


FIG. 108.—Anchor Stowed Vertically.

A. Sheave for cat pendant.
B. Guide roller for cat pendant.
C. Securing chains.
D. Tumbler.
E. Rod for releasing tumbler.
F. Bands for flamming tackles.
G. Ports for securing anchor.
H. Anchor chock.

fitted in the deck to prevent the capstan revolving in the wrong direction under these conditions. The pawls are fitted to engage either way, and when not required, as when working by power, they are held up by pawl rests.

When using a capstan for heaving in cable, rollers are required, round which the cable is hauled off. Four sockets

are fitted for these, and two are used, on the side opposite the cable. Hauling off is done by men sitting on the deck, using chain hooks. To prevent the cable going right round the capstan, a strong bent arm is bolted through the deck on the fore side to throw it off the sprockets.

When using the barrel of the capstan for a hawser, not less than four round turns should be taken. The part next to the weight will always seek the smallest diameter, that is, the middle, and if the whelps are not kept clean and smooth this will lead to a series of jerks which are most dangerous. This is particularly the case in veering, and to prevent riding turns arising from this cause the hauling off part must be guided into place with a handspike or a crowbar.

The capstan bars are held in place by a pin through each, and to distribute the strain their outer ends are connected by a rope called a swifter. This is fitted with a cut splice in the centre, which is placed over the notch in one bar, and then each end is taken to successive bars—in the notch and under, up inside, in the notch and over, in the notch and on to the next bar. One end is fitted with an eye and thimble, through which the other eye reeves when they meet and finished off with round turns over the nearest bar and the end frapped round the turns.

V.—ANCHORING.

To get an anchor ready for letting go, remove the sea securing chains, ease back the friction gear (or in some patterns disconnect the clutches) of the cable holders, see the compressors back, the cable lockers uncovered and all loose impediments clear of the cables. With stockless anchors, if the navel-pipes are very far from the hawse-pipes, it may be necessary to range a few links—ten or a dozen—before the holder. But if the screw Blake slip is eased down as already described any tendency of the anchor to hang up will be disclosed.

Just before the anchor is let go, the anchor buoy (if used)

is "streamed." The length of the buoy rope must be adjusted to little more than the depth of water, by a sheepshank if it is too long.

In ships without cable holders, the cable must be bitted before letting go.

The amount of cable by which to ride should be not less than five times the depth of water, but if there is plenty of swinging room the more cable there is out the more easily and safely will the ship ride.

The cable should not be snubbed when the required amount has run out, but allowed to run until the ship has lost her way. Even then, in deep water, the weight of cable outside the hawse-pipe may cause it to run on, and with frictional cable holders it can be checked gradually.

As each shackle goes out of the hawse-pipe the fact is signalled to the bridge, either by numeral flags, flash lamp, whistle or bell.

When sufficient cable is out, the ship is said to have "got her cable," and the compressor is bowsed to.

Some types of cable holders are designed to hold the cable without the assistance of the compressor, and in some ships a compressor is not even fitted. The advantage of this is that there is a certain amount of "give" in friction gear which is not the case with a compressor.

Weighing Anchors.—1. With stockless anchors—uncover cable lockers, connect cable holder, back compressor, rig hoses for washing cable and heave in until the anchor enters the hawse-pipe. Then put on the screw slip and heave it home. Pick up and haul in buoy rope, heave in the slack of the cable with the cable holder, put on securing chains, bowse to, disconnect cable holder and cover lockers.

2. With stocked anchors.—"Anchor gear" must first be rove. The cat davit, if down, must be raised and turned outboard. A purchase is shackled to the after guy,* hauled taut and belayed. The cat pendant is rove through

* For the sheet anchor the purchase is used on the fore guy.

the block at the foot of the davit, up, before the davit (for bower anchor) through the block at the head of the davit, and the end taken forward over the hawse pipe. The cat hook is shackled on and hung by its "back." Two tackles and strops—or wire pendants fitted with running eyes—are required for placing the anchor. Hoses are rigged as before. If the cable is bitted, on slip, back compressor, unbitt, and bring to on the capstan by hauling a bight of the cable round, then put in two rollers on the reverse side.

With cable holders—connect the same and heave in until the balancing band is above water. A man is then slung over the bows and guides the cathook into the shackle on the balancing band. On slip, disconnect cable holder, and bring cat pendant to the capstan with not less than four complete turns and back it up well. Heave taut the cat and when the anchor begins to move aft, "surge," by knocking the slip off. As the anchor rises, the after guy should be eased so that the anchor just clears the edge of the anchor bed and then eased so as to land the anchor on the bed quietly. Some people keep the after guy on its slip until the anchor is high enough in case the purchase should carry away when "surging." This is a mistake, because, if it should do so more damage will be caused when the anchor is clear of the water than if it is still in the water, and it is possible to forget that slip, and if it has the weight it is difficult to knock off, and then the purchase may carry away. When the anchor is placed the shank painters are passed under it and over the tumblers, sea securing chains put on, buoy rope hauled in and anchor gear unrove. Slack cable outside is hove in and the bight placed under thumb cleats generally placed on the ship's side to prevent it swinging about.

In very shallow water it may be unsafe to surge the cable on account of the possibility of the anchor catching the bottom again; and in this case the cable must be veered by the cable holder while catting. But if this is done it must be

remembered that the capstan being of larger diameter than the cable holder, the cat pendant will be hove in faster than the cable can be veered.

There is, abreast the cat davit, another leading block, or a place for one. This is for catting the sheet anchor by steam or the bower anchor by hand, because in the former case the cat pendant is rove abaft the davit and goes forward to the capstan, and in the latter case, it is rove before the davit and goes aft to the cat purchase.

Mooring.—A ship is said to be moored when she has two anchors down. Mooring enables a ship to swing in a small circle and is used when there is not room to swing at single anchor. A mooring swivel can be used to keep turns out of the cables.

When mooring, the anchors should be laid in line with the prevailing wind, or the stream if in a river or tidal estuary. Otherwise, if the ship is lying with an anchor on either bow, she is in effect lying by a taut span (*see* Chap. III.).

As the ship will ride by each anchor in turn, as much cable must be allowed on each as if the ship were at single anchor.

To moor and put on the swivel.—To prepare, reeve the mooring pendant out of one hawse pipe, in through the other and stop it out of the way of the cables.

The number of shackles to run out on the first cable before letting go the second anchor is double the number required on each, less the depth of water.

This can be algebraically expressed as follows:—If N be the number of shackles required on each, and D the depth of water.

Then if the second anchor is let go at 2 N—D, there will be 2 N—D on one and D on the other. Then, by adding N—D to one side and subtracting the same amount from the other, the result is N on each.

Then, having middled with, say, the sixth shackle abreast the slip each side, put on both slips before the shackles.

Unshackle the riding cable and shackle the two ends to the proper links of the swivel, heave taut and off slip.

Shackle the end of the mooring pendant to the inboard end (bridle) of the lee cable, bring the other end to the capstan and heave the bridle round the bows, veering it by its cable holder. Remembering that as the capstan heaves faster than the holder veers, the wire must be surged as required. Shackle the bridle to the vacant after link of the swivel and then heave the swivel round the stem with the lee bridle, veering by the riding bridle. When round, shackle the outboard end of the lee cable to the remaining link of the swivel, heave taut, off-slip and veer with the lee bridle until the cup of the swivel is just well above the water.

Another method.—Having middled, put the slip on the lee cable, unshackle, and shackle the two ends to the proper links of the mooring swivel. Shackle the end of the mooring pendant on the bight of the riding cable abaft the sixth shackle, using a joggle shackle or towing shackle. Bring-to the mooring pendant on the lee side and heave the bight of the riding cable round the stem, veering the bridle with the cable holder. When round, put the slip on before the shackle, unshackle, and shackle the two ends to the mooring swivel.

The mooring pendant is shackled abaft the sixth shackle so that when it comes round there will be enough to reach the after end of the swivel.

The reason for heaving the riding cable round instead of the lee is that, to haul the bight of the lee cable round would cause a sharp nip round the stem, the two parts would become twisted up, and if the moor was very taut it could not be done.

The practice which was at one time in vogue (one hopes that it is so no longer) of getting a spare shackle round the bows beforehand to gain a little time had nothing to recommend it, as it was bound to result in a very slack moor, and threw out the numbering of the shackles.

Unmooring.—The lee anchor is always weighed first and the swivel is taken off on the side of the riding cable. It is often necessary to change anchors to avoid getting a cross in the cables.

Having hove in the swivel on the side of the riding anchor, put the slip on the outboard part of the lee cable, lash the bridle, unshackle the two ends from the swivel, shackle them together, off lashing and off-slip.* Then put the slip on the outboard part of the riding cable, unshackle from the swivel, shackle the two ends together and off-slip. Then heave in the lee cable and weigh that anchor.

VI.—MOORING HEAD AND STERN.

It is occasionally necessary for ships to moor head and stern, as, for example, in a river or narrow anchorage where swinging room is limited.

The cable of the bower anchor, by which the stern of the ship is to be secured, is unshackled at the second shackle, and the end led out through its own hawse-pipe, where it is shackled to one end of the largest wire hawser in the ship. (The anchor, if stockless, must first be eased down.) The bight of the cable leading from the anchor is secured just inside the hawse-pipe with a stout hemp stop, and the remainder of the two shackles is slung from the bows outside the hawse-pipe by more hemp stops.

The wire hawser is led aft along the ship's side and in through the stern fairlead on to the quarterdeck, where it is flaked down, each flake being secured with a hemp strand to prevent the wire taking charge, and the end belayed to a bollard. The bight of the hawser along the ship's side

* It having been found that, with heavy cables, the practice of letting go the bight from the slip resulted in loosening or breaking studs in the cable, the practice in the Royal Navy now is to ease this bight out. This is done by putting a joggle-shackle on one part and easing it out with a slip-rope. The joggle-shackle is taken off as soon as it comes in through the hawse-pipe.

must be hung at intervals with hemp stops, care being taken to see that it hangs clear of all obstructions.

Let it be assumed that the ship is to be moored with five shackles on each anchor. Four shackles of cable belonging to the anchor which is to secure the ship's stern are got up and led aft along the upper deck ready to be shackled on to the two shackles already on the anchor; a Blake slip stopper will also be required for holding the cable while being shackled and secured.

When the bows of the ship arrive at the spot where the stern anchor is to lie, the anchor attached to the wire hawser is let go. The hemp stops by which the cable is hung carry away in succession as the strain is brought on them; the cable is thus laid in the right direction and is prevented from falling in a heap on top of the anchor.

As the ship passes on, the stops along the side by which the wire hawser is hung carry away in succession until the hawser grows astern, when each flake is cut adrift in turn.

In ships whose propellers project beyond the side, the wire hawser should be guyed out by a spar on the quarter, with a strop and toggle to slip it by at the right moment, and the propeller on that side should be stopped so as to avoid any possibility of cutting the hawser with it, opposite helm being given to counteract the turning effect of the other propeller.

When the ship's bows arrive at the spot where the foremost anchor is to lie, the second bower anchor is let go, and as soon as all way is off the ship the wire hawser is brought to the stern capstan and hove in while cable is veered on the bower.

When the end of the second shackle on the anchor comes inboard, on-slip, remove the wire hawser, and shackle on the end of the four shackles of cable on the quarterdeck. The wire hawser in the meantime is shackled to the inboard end and brought to the foremost capstan ready for veering.

As soon as this has been done heave in the bower cable

and veer the stern cable until the fifth shackle of the latter is awash, then on-slip on the stern cable and secure it to the stern bollards, knocking the slip off again when fast.

As the drum of the capstan is of larger diameter than the sprocket of the cable holders, the stern cable will have been veered at a greater rate than the bow cable has been hove in, so that as soon as the stern cable is fast the bower cable must be hove in until the ship lies fairly between her two anchors.

To Unmoor.—Let it be assumed that the bower anchor is to be weighed first.

Put the slip on the stern cable, cast it off from the bollards to which it is secured, shackle a wire to the end of it and bring the wire to the after capstan. Heave in, off-slip, and veer until the end of the cable is just inside the slip; then on-slip and remove the veering wire.

Lead the largest wire hawser in the ship out of the bower hawse-pipe, along the ship's side and inboard through the same fairlead as the stern cable leads in.

Shackle this wire to the end link of the cable on the quarterdeck, bring the wire to the capstan on the forecastle, and off-slip, aft.

Veer on the wire hawser and heave in on the bower cable until the bower anchor is aweigh, then heave in the wire hawser on the capstan until the cable comes into the hawse-pipe.

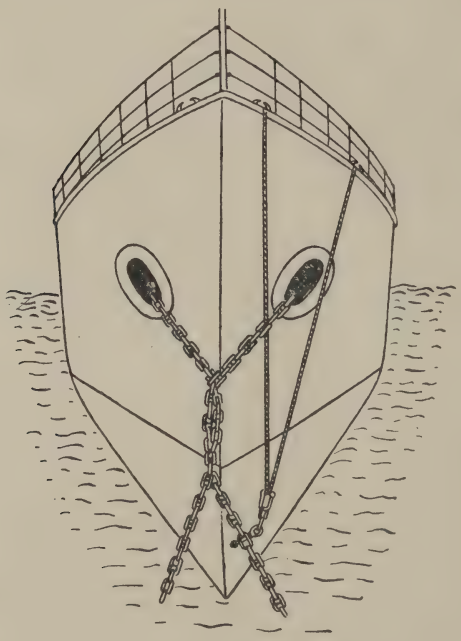
When the end of the cable is abaft the slip, on-slip, remove the wire and shackle the two ends of the cable together again. The bower anchor can then be stowed, after which the remaining anchor can be weighed in the usual manner.

VII.—CLEARING HAWSE.

It sometimes happens that, in spite of a well-greased swivel, turns will be found below it when unmooring. This is very likely to happen with a slack moor in tideless waters. It can generally be cleared by going astern with the engines

and tautening the span, but even this fails sometimes, and after the swivel is off it may occasionally be found, on starting to weigh the lee anchor, that the cables are foul of one another.

When the cables lead directly across one another a cross is said to exist, and this cannot be cleared except by changing over the anchors. The only thing to do if it is undesirable to change over the anchors is to weigh the anchor whose



[Fig. 110.—Use of the Clear Hawse Slip.

cable is underneath, or if this is undesirable, as, for example, in bad weather in a crowded anchorage with the riding cable underneath, the non-riding cable must be unshackled and dipped, otherwise the anchor, on being weighed, would hook the riding cable.

When the cables are foul of each other, and both lead off from the foul in their own direction, an "elbow" is said to exist if the cables cross each other once, as in fig. 110, and

a "round turn" if they cross each other twice. If they are foul of each other, and lead off from the foul in a contrary direction, an "elbow and a cross" is said to exist.

If the foul is under water, heave in on the riding cable and this will bring the turns clear of the water. As they are liable to slip they should always be lashed. The clear hawse slip or joggle shackle is put on the non-riding cable below the turns, as shown in fig. 110, and the hauling part of the wire hove taut with the capstan. The wire is then secured by a carpenter's stopper. Pass the end of a hawser out through the hawse-pipe, round the cable in the contrary direction to the turns, and back through the hawse-pipe to secure to the end of the cable when unshackled. Put the slip on the riding cable just before a shackle, unshackle, reeve a good slip rope through the end link, haul this taut and belay it before knocking off the slip. Then off-slip and ease out on the slip rope and heave in the hawser with the capstan. When the slip rope is of no further use, let go the end. If this operation is attempted without a slip rope, the end of the cable, falling anyhow over the foul, will probably make matters worse.

Not more than an elbow should be taken out at a time, or time will be lost.

VIII.—LAYING OUT ANCHORS.

A KEDGE anchor is slung from the stern of a cutter, generally with the shank vertical. A lashing or a special wire strop fitted with a slip is passed round the shank below the stock and through the ring of the after slings of the boat. Care must be taken that the stock does not rest upon the transom of the boat.

A hemp hawser is generally used, which is flaked down in a figure-of-eight in the stern sheets of the boat. The end is bent to the ring of the anchor with a fisherman's bend or a round-turn and half hitch with the end seized down. Take care that the other end of the hawser is secured.

A buoy-rope, good enough to weigh the anchor, is bent to the crown of the anchor.

Before letting go, stream the buoy, take a cast of the lead, and pay out enough hawser to reach the bottom, taking care to keep it clear of the anchor, then cut or cast off the lashing, or off-slip if using the wire strop, and bring the end of the hawser back to the ship.

To weigh the anchor, the buoy-rope is brought over the fairlead in the stern of the boat, and, if necessary, a luff or luff-upon-luff clapped on to it.

A stream anchor, if of the swinging fluke pattern, is generally hung from the stern of a pinnace in a similar manner to a kedge. But if an "Admiralty pattern" stocked anchor, it is generally placed with the arms vertical over the stern of the boat, the shank horizontal and fore-and-aft, and the stock resting on two capstan bars which have their after ends on the transom of the boat and their foremost ends on a third capstan bar placed across the gunwales. The ring is lashed to the after sling-bolt in the boat, and the shank to the ring-bolt in the stern.

A wire hawser is generally used and this is hoisted out on its reel and placed well forward in the boat to counterbalance the anchor. The reel must be well lashed in place.

A double buoy-rope, rove through a clump block on the crown of the anchor, is used to obtain extra purchase for weighing.

Before letting go, stream the buoy, take a sounding and pay out enough hawser to reach the bottom, with the same precautions as with a kedge, set up the brake on the reel and let go. The boat must be towed or hauled back to the ship. If a reel is not used, the hawser is flaked on top of the thwarts in a figure-of-eight and the boat's crew must take cover under the thwarts before letting go.

To weigh the anchor, both ends of the buoy-rope are unbent from the buoy and brought over the stern of a boat, one end is made fast, and the double block of a luff brought to the other. The single block of the luff is hooked to the ring-bolt in the stern, and the fall led through a leading

block hooked to the foremost slings. Two luffs should be provided so that one can be used whilst the other is being overhauled, or the second can be clapped on the fall of the first to break out the anchor from the bottom.

Laying out a Bower or Sheet Anchor.—The method most generally adopted consists in slinging the anchor by its balancing band under the largest pulling boat carried by the ship; in large ships the launch.

For this purpose a wire sling is supplied to ships, consisting of three legs joined together by a ring. Two of the legs forming a span are brought up from under the boat over a wooden spreader or strongback, and are joined together on top of the spreader by a slip.

The third leg is made sufficiently long to reach from the ring under the keel of the boat to the water's edge or a little above it, so as to admit of the end being shackled to the balancing band of the anchor.

To get the anchor out, anchor gear is rove as usual (except for a stockless anchor) and burtons put on the anchor for easing it off the billboard. When lifting the anchor, as the weight comes on the cathead, the after guy is eased until the cathead nearly plumbs it, but a little outboard, so that the anchor will just clear the ship's side as it is lowered.

The outboard part of the ganger or first shackle of cable is hung by long lines, at intervals of two or three fathoms, for easing it down, and short rope hangers are put on close to these for hanging the cable to the gunwale of the boat.

The inboard end of the ganger is unshackled and a wire hook rope attached to it, and as the anchor is lowered to the water's edge the cable is lowered also by the lowering lines and wire hook rope.

The boat keeps astern of the anchor until it is at the water's edge, when she hauls up alongside it. The sling is then shackled on to the balancing band and the bights of the cable are hung to the thwarts, working along towards the

bow of the boat. When shackled on, the anchor is eased down, while at the same time the sling round the boat is hauled central, so that when the boat has the weight she will float on an even keel. The cat pendant can then be unrove and passed into the boat or, instead of passing the whole cat pendant into the boat, it is sometimes made in two parts, so that the shorter end on the anchor can be unshackled from the inboard or longer end, the shorter part only being sent away.

When the anchor is hanging under the boat, the remainder of the cable is slung round her, by bearing off the stern and taking it round the stem, where it is hung to the opposite bow so as to keep the boat upright. The end is taken into the boat ready for shackling on the wire hawser, and the anchor buoy and buoy-rope are placed in the stern sheets.

A wire ganger, the same size as the largest wire hawser in the ship, is often used instead of taking away cable. This is shackled to the anchor before lifting off the billboard and eased down into the boat, where it is hung round the stern.

It is very necessary to provide a good boat rope for the launch, from as far forward and as low as possible. In the case of a stockless anchor, the boat rope should be taken to the anchor buoy, if in a suitable direction, otherwise it might even be advisable to lay out the kedge ahead of the ship for the purpose.

In the meantime the pinnace or next largest boat to that which carries the anchor has been placed under the most convenient position for embarking the wire hawser. The largest wire hawser carried by the ship is used. It is hauled off its reel and flaked down in the boat round the inside of the gunwale on top of the thwarts, in a figure-of-eight, each flake being stopped to one of the foremost thwarts to prevent them taking charge. The last flake is stopped up round the outside of the gunwale and enough end left for passing into the boat which carries the anchor. A hemp

hawser for hauling in the wire should also be flaked in the boat.

Two cutters or a steamboat take the boat with the anchor in tow, the boat with the hawser being astern of her. It is usual to send a kedge anchor away so that, if necessary, the boats with the anchor and hawser may be hauled out to their position. The kedge is carried by a cutter and is dropped ahead of the position where the bower anchor is required.

The hawser of the kedge is either bent to the ring or rove through a block shackled to the ring. In the former case the launch's crew haul both boats out to the position where the anchor is to be let go, or in the latter case, one end of the hawser is secured to the bows of the launch, the other end is manned on board the ship.

If a powerful steamboat is available for towing, the cutter with kedge anchor is not required.

To let go, the buoy-rope having been streamed and a sounding taken, the shackle of cable hung round the launch is eased down, the stops being cut in succession, and enough wire is paid out of the pinnace to allow the cable to reach the bottom.

Everything being clear, the slip of the anchor sling is knocked off, and the anchor drops to the bottom.

The pinnace is then hauled back to the ship, paying out the wire hawser as she goes.

The operation of laying out a stockless anchor is similar to that just described, except that the anchor is lowered to the water's edge by its own cable, and when the boat has taken the weight of it, the first length of cable is eased out and slung round the gunwale.

Or, if space on the cable deck permits, the wire ganger is inserted between the swivel-piece or lengthening-piece and the end of the cable and lowered from the cable holder.

Kedging.—"Kedging" is the operation of shifting a ship from one berth to another by hauling her up to it with

kedge anchors laid out successively in the required direction. It is obviously an operation which can only be attempted in fine weather.

A kedge is first laid out and the bower anchor tripped. By manning the hawser attached to the kedge, the ship is hauled up to it, and while this is being done the second kedge is laid out ahead of the first, so that as soon as the first kedge breaks ground the hawser of the second can be manned and the ship kept moving.

When the first kedge is clear of the water, it is once more slung over the stern of its cutter and laid out ahead of the second, and so on until the new berth is reached, when the bower anchor is let go again.

APPENDIX.

APPENDIX.

DIRECTIONS FOR RESTORING THE APPARENTLY DROWNED.

Send immediately for hot bottles, medical assistance, blankets, and dry clothing, but proceed to treat the patient *instantly* on the spot.

The points to be aimed at are—first and *immediately*, the *Restoration of Breathing*: and secondly, the *Promotion of Warmth and Circulation.*

The efforts to *restore Breathing* must be commenced immediately the patient is removed from the water and persevered in energetically for five or six hours or until a medical man has pronounced life to be extinct. Efforts to promote *Warmth and Circulation* must be postponed until after the first appearance of natural breathing, unless other assistance is available (*see* below).

Treatment.

Do not waste time in removing or loosening clothing.

Immediately after removal from the water, lay the patient in a completely flat position face downwards with the arms extended. Turn the face to the side. Kneel or squat astride or on one side of the patient (fig. 1 A, B).

Place the hands on the small of the patient's back, one on each side, with the thumbs parallel and nearly touching (fig. 1).

Bend forward with the arms straight so as to allow the weight of the operator to bear on his wrists and thus make a steady, firm, downward pressure on the lower part of the patient's back (the loins and lowest ribs), as shown in fig. 2. (This part of the operation should occupy the time necessary to count—slowly—*one, two, three.*)

Immediately after making this downward pressure, the operator should swing backwards so as to relax the pressure, but without lifting his hands from the patient's body (fig. 1). (This part of the operation should occupy the time necessary to count—slowly—*four, five.*) There should be no alteration in the interval between each count.

Repeat the forward and backward movements (that is, the pressure and the relaxation of pressure) without any marked pause between the movements. The downward pressure forces the air out of the lungs and the relaxation of pressure causes the air to be drawn in again.

Continue the movements at the rate of about 12 to 15 per minute until natural breathing has recommenced.

When natural breathing is fairly begun, cease the movements. Watch the patient closely, and, if natural breathing ceases, repeat the movements as before.

When natural breathing has commenced, the patient should be allowed to lie in a natural position on one side, and treatment for the promotion of warmth

Fig. 1.

and circulation may be continued or proceeded with, the patient being kept covered as much as possible.

The movements of artificial breathing are of the first consequence. If the operator is single-handed, he must attend to these alone until natural breathing is restored. If other assistance is at hand, one person should at

once be sent for medical assistance, as described in the first paragraph, and others should be directed to promote warmth and circulation, taking care not to interfere with the person who is restoring respiration. After that a dry and warm covering may be placed over the patient and warm wrung-out flannels, hot bottles, etc., may be applied between the thighs, to the palms of the hands, arm-pits and feet; but the movements of artificial breathing must

Fig. 2.

not be interfered with. Care must be taken that the hot bottles are covered with flannel or other material before applying them to the naked body.

After natural breathing is restored, the wet clothing may be removed and a dry covering substituted. This must be done without disturbing the patient, who should be allowed to lie quiet, and watched, for at least an hour, and encouraged to sleep.

TREATMENT *after* NATURAL BREATHING HAS BEEN RESTORED.

The above treatment should be persevered in for five or six hours, as it is an erroneous opinion that persons are irrecoverable because life does not soon make its appearance.

On the restoration of life, when the power of swallowing has fully returned, small quantities of warm coffee, or tea, or milk, or broth, or other light warm nourishment, should be administered. The patient should be kept in bed, and a disposition to sleep encouraged.

To promote Warmth and Circulation.—Commence rubbing the limbs upwards, with firm grasping pressure and energy, using handkerchiefs, flannels, etc. (*by this measure the blood is propelled along the veins towards the heart*).

Appearances which generally accompany Death.—Breathing and the heart's action cease entirely; the eyelids are generally half-closed; the pupils dilated; the jaws not clenched; the fingers semi-contracted; the tongue approaches to the under edges of the lips, and these, as well as the nostrils, are covered with a frothy mucus. Coldness and pallor of surface increase.

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