

## CHAPTER XIV.

## LEAD LINE AND SOUNDING MACHINES.

THE hand lead for ships' use weighs about 14 lbs. A smaller lead weighing about 7 lbs. is supplied for boats' use.

The line is from 20 to 25 fathoms long. The lead is generally hove from small leadsmen's platforms which are fitted close to the navigating bridge. Where no platforms are fitted, the lead can be hove from the sea-boats, or, as in destroyers, from any convenient position along the ship's side from where the soundings called by the leadsmen can be heard.

Leadsmen's aprons are supplied, made of a band of sennit with canvas flap, which are secured at the position from which the lead is to be hove. The leadsmen lean the whole weight of his body against the apron while heaving the lead.

The lead should always be used in pilotage waters. It is usual for special leadsmen (generally petty-officers) to be stationed to heave the lead when entering or leaving harbour, or on any occasion when special accuracy is required, and in order to obtain soundings quickly an extra man should be detailed to assist in hauling in the lead after each cast.

It is to be noted, however, that the hand lead is of little use at speeds over 10 knots, and that if accurate soundings are to be obtained speed must be eased.

## Marks on the Lead Line.

2 fathoms	.	.	A piece of leather with two tails.
3	"	.	A piece of leather with three tails.
5	"	.	A piece of white bunting.
7	"	.	A piece of red bunting.
10	"	.	A piece of leather with a hole in it.
13	"	.	A piece of blue bunting.
15	"	.	A piece of white bunting.
17	"	.	A piece of red bunting.
20	"	.	Two knots.

These marks are stranded into the line. The intermediate depths not marked are called "deeps."

In calling soundings, when the depth corresponds with any mark, the leadsman calls, "By the mark 7 or 10, etc." If the depth corresponds with a deep, he calls, "Deep 9 or 11, etc." If a quarter or half a fathom more than a mark or deep, he calls, "And a quarter 6 or 7, etc.," or "And a half 6 or 7, etc." If a quarter of a fathom less, he calls, "A quarter less 6 or 7, etc."

Owing to the impossibility of seeing the marks on the line at the water's edge at night and also to the difficulty of seeing them even in daylight if the leadsman is at a considerable height above the water, it is not an uncommon practice to commence the marking of the line at a distance from the lead equal to the height of the leadsman's waist above the water. By doing this the depth of water is shown by the mark in the leadsman's hand when the line is vertical.

When special accuracy is required, as in surveying, the lead line is marked in feet.

### Deep Sea Lead Line.

A deep sea line is supplied to ships for use in the event of the sounding machine breaking down. The lead weighs from 28 to 30 lbs.

The line is marked in the same way as the hand line up to 20 fathoms; at 30 fathoms three knots, at 40 fathoms four knots, and so on up to 100 fathoms, at which there is a piece of white bunting. Intermediate 5 fathoms are marked with one knot, and in order to avoid error, at 110 fathoms there is a piece of leather. At 120 fathoms two knots, and so on, the remainder of the second hundred fathoms being marked in the same way as the first hundred.

When sounding with the deep sea lead the ship should be stopped, otherwise the line is almost certain to be cut by the propellers, and in all cases the lead should be dropped on that side of the ship from which she will drift, so as to avoid the line getting under the bottom.

It is convenient when sounding with the deep sea lead to station a number of men along the ship's side with a few coils of the line in their hands; the lead is usually dropped from forward, and as each man feels the line tauten, he drops his coil and calls, "Watch there, watch" to the next man abaft him, unless he feels bottom, in which case he will call out "Bottom," and the quartermaster will take the sounding.

All leads have a recess in the bottom to take a filling of tallow.

This is called "arming the lead," and is done to enable the nature of the bottom to be ascertained. Sand, gravel, shells, etc., will stick to the fallow, and rock will make an indentation in it.

Lead lines should be tested from time to time in their *wet state*, so as to allow for shrinkage. For this purpose it is convenient to mark the various lengths along one of the planks of the upper deck with copper tacks.

### Sounding Machine.

Lord Kelvin's sounding machine is the type used in the Royal Navy, and in fact almost universally.

#### *Description of the Original Type of Sounding Machine and its Use.\**

In this machine the depth is ascertained by means of a chemical tube at the end of a sounding wire.

The wire is coiled on a V-shaped ring. This ring can revolve independently of the spindle, or it may be clamped to the spindle by means of the plate. When a cast is to be taken, the handles should be shipped and fixed by tightening up the thumb-screw. The arm should then be turned round till it is behind the upright of the frame, and the catch turned over to prevent the arm turning. To put on the brake, turn the handle in the direction for winding in the wire; to take off the brake and allow the wire to run out, turn the handle in the direction for paying out the wire. Half a turn, or at most one turn, of the handle in the direction for paying out is sufficient to release the wire drum and allow the wire to run out with the weight of the sinker hanging on the wire. While the wire is running out, the handle should be held fixed in the hand, and as soon as the sinker touches the bottom, which is ascertained by keeping a brass finger-pin pressed gently against the wire so as to feel when it slackens, the handle should be turned in the direction for winding in, so as to put on the brake and prevent any more wire running out. When the brake has been put on and the egress of the wire stopped, turn over the catch to release the arm and wind in the wire. It will be observed that the arm is held in the fixed position during the whole time except when the wire is being wound in. While the wire is coming in the arm is allowed to turn round with the drum and spindle. The

\* The principle of the original type is similar to that of the 1906 machine, illustrated and described in the following pages; the arm referred to corresponds to the brake cheek D.

counter must be watched, and if bottom has not been reached when the index is at 250, apply the brake gradually so as to stop the wire running out before 300 is reached.

The chemical tubes are placed in a brass guard tube which is lashed to the rope between the wire and the lead about 3 feet from the end of the wire. Before taking a cast, a glass tube is placed with the open end down in the guard tube and the cap put on. When the guard tube is brought up close to the fair-lead pulley it should be lifted on board, care being taken to keep it right side up. If it is turned on its side or upside down, the water will run up the glass tube and produce a bad mark. The glass tube is then taken out and applied to the scale with the closed end against the brass plate at the top of the scale. The number of fathoms is shown on it abreast the lowest part of the red coating. This without correction will be the depth accurately enough if the barometer be at anything from  $28\frac{3}{4}$  to  $29\frac{1}{2}$  inches.

If the barometer stand at  $29\frac{3}{4}$  add one fathom in 40.

"	"	30	"	"	30.
"	"	$30\frac{1}{2}$	"	"	20.
"	"	31	"	"	15.

When navigating out of sight of land in less than 100 fathoms, if there is any doubt as to the ship's position, the sounding machine should be kept going. Two men suffice to work it whatever be the speed of the ship. It takes from a few seconds to a minute for the lead to reach the bottom from the time it is let go, and from a quarter of a minute to four minutes for two men to heave it in, if the depth is from 10 fathoms to 100 fathoms. Thus it is easy to take frequent soundings, with an extra hand or two to relieve. One man should guide the wire, to make it lie evenly on the drum, with a piece of canvas.

The position of a ship can generally be obtained with considerable accuracy by running a line of soundings and fitting the line into the right position on the chart; care must however be taken to reduce the soundings obtained to the level of the soundings on the chart, viz., low water ordinary springs. The reading on the counter shows approximately the number of fathoms of wire run out. This may be something more than twice the depth for speeds under 11 knots, or it may be almost as much as three and a half times the depth if the speed be 15 or 16 knots. The proportion of wire to depth differs not only with the speed of the ship, but also with the roughness of the sea and with the depth itself.

*Cautions and Explanations.*

The wire will break at a kink under a very moderate pull ; 30 lbs. steady force, or a very slight jerk, will break it at a kink. Without a kink, and with proper care, the wire can scarcely be broken in practice with the machine. No wire should ever be lost in service, unless by some extremely rare accident, not foreseen, and therefore not provided against.

Security against kinks would be had if the wire could be prevented from slacking. It does slacken somewhat the moment the lead touches the bottom, but not to a dangerous degree if the ship is going at anything more than 5 knots, and if the brake is instantly applied when, by the wire yielding to the brass pin, the commencement of slacking is shown. The brake should be instantly applied, so as to slow the motion of the wheel, but not with force enough to stop the wheel suddenly. There is much more danger of losing the wire through a kink in taking an up-and-down cast than in a flying cast with the ship running at 12 or 14 knots. Whenever a cast is taken at any speed less than 5 knots, it is advisable to manage the brake so as to moderate the speed of egress according to judgment, letting the wheel run round at something like three turns per second.

In fixing the machine the fair-lead should first be screwed to the taffrail in a position carefully chosen to be as convenient as possible. The machine, with its feet screwed to its deck plates, should next be placed on the deck in a convenient position, at about twelve feet from the fair-lead, and set so that, with its length exactly fore and aft, the middle of the wire drum shall be exactly in the fore-and-aft line from the middle of the fair-lead pulley. The places of the deck plates should then be marked on the deck, and the plates should be securely screwed to the deck by brass wood-screws in these positions. A proper place should be made in the neighbourhood of the fair-lead for permanently keeping the sheath and lead, with guards to prevent them from rolling about.

Owing to the great length of modern ships and the desirability of ensuring that the officer of the watch shall be made acquainted with the soundings with the least possible delay, it has been a common practice of late years to fix the sounding machine close to the navigating bridge, in such a position that the officer of the watch can practically superintend each cast. Where this is done it is necessary to make provision for keeping the wire clear of the ship's side and propellers, and for this purpose the wire is led

through a small snatch block secured to the end of a boom of the necessary length. The snatch block may be of wood or metal, but the sheave should be of metal, and it is important that the pin of the sheave shall be kept well lubricated.

In order to meet these requirements Lord Kelvin has devised a special machine with boom and fittings for use from under the fore bridge, which has now been adopted by the Admiralty.

This machine, of which a general view and section are shown in Fig. 355, has been designed with the further object of enabling the depth of water at each sounding to be ascertained from the dial showing the amount of wire line which is run out at each cast, taken in conjunction with the speed of the ship.

For this purpose tables are supplied giving the depth corresponding to the amount of wire run out at various speeds. This method should not, however, be relied upon exclusively, as the chemical tubes are more accurate, although the dial indications can be obtained more quickly. When running a line of soundings, therefore, an occasional tube should be used, the intermediate depths being ascertained from the dial.

*Description of Lord Kelvin's 1906 Sounding Machine. (Fig. 355.)*

The sounding wire is wound on a drum which is free to revolve on a lignum vitæ bearing on the axle. As it revolves it rotates a worm which is also free on the axle, and is geared to a pointer on the top of the instrument, thus indicating the amount of wire run out.

To enable the drum to be stopped when bottom is reached and the wire to be wound up, a clamping or brake arrangement is fitted between the drum and the axle. On one side of the drum a cheek plate is fixed to the axle and is fitted with a wooden disc, which just clears the drum when it is running freely. On the other side of the drum a similar cheek plate and wooden disc engages with a screw on the axle, and has slots on its periphery into which a pin can be inserted to prevent it turning.

When this pin is inserted and the handle is moved in the running-out direction the cheek plate is moved away from the drum by means of the screw on the axle, and the drum can revolve freely. When the handle is turned gently in the winding-in direction the cheek blocks rub on the side of the drum and bring it gradually to rest. As soon, however, as any pressure is put on the handle in the winding-in direction the cheek plate is forced against the drum and clamps it securely against the fixed cheek plate; the pin can then

be taken out and the wire be wound in by the handles on the axle.

A spring washer is inserted between the drum and the fixed cheek plate to prevent their rubbing together when the handle is eased back for running out.

An important feature of the 1906 machine is the "Automatic Brake," consisting of a cord passing over a "V"-shaped groove on

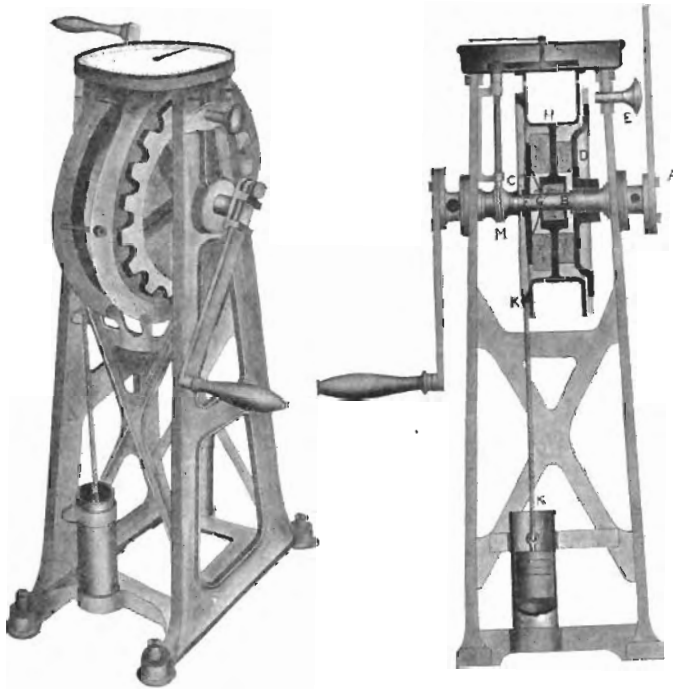


Fig. 355—Lord Kelvin's 1906 Sounding Machine.

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|--|--|
| A. Winding handle.                               | E. Pin for securing movable brake check. |
| B. Spindle with screw.                           | F. Spring washer.                        |
| C. Brake check with wood blocks, fixed to shaft. | G. Lignum vite bearing.                  |
| D. Movable brake check with wood blocks.         | H. Drum for sounding wire.               |
|  | K. Constant tension brake.               |
|  | M. Worm working pointer of dial.         |

the side of the drum. The cord is attached to weights working in tubes and is adjusted as follows:—

“Attach the cord to the heavy weight (6 lbs.), pass it over the groove and secure it to the 1 lb. weight, so that when the heavy weight is resting on the bottom of the tube at the back of the machine, the 1 lb. weight hangs about 1 to 2½ inches from the bottom of the tube at the front of the machine.”

The cord may be wet or dry without making any difference to the working of the brake ; it may be kept oiled with advantage to prevent it rotting. In renewing this cord, care must be taken to use the same quality and diameter as the original. The groove also should be kept free from rust.

A 6 lb. weight will answer up to all speeds of 13 knots ; at higher speeds, if it shows a tendency to jump out of its tube, the 10 lb. weight should be substituted. Four 1 lb. weights are supplied to be added to the 6 lb. weight if found necessary.

Once adjusted the automatic brake requires no attention.

It prevents the wire reel overrunning and ensures that the velocity of the wire, when running out, is always constant for a given speed of the ship, provided that the following points are attended to :—

- (a) That when releasing the main brake at the order "let go" it is given one complete turn in the contrary direction to "heaving in," on the handles ; this must be done smartly.
- (b) That sinkers of the same shape and exactly of the same weight are always used.
- (c) That the same length and size of stray line are always used and that the swivels are identical, and that the guard tube is seized on in the same place.
- (d) That the same brake weight is in use, because at a given speed 10 lb. weight would not permit the wire to run with as much velocity as the 6 lb. weight.

This property of constant velocity for a given speed is a most valuable feature of the 1906 pattern machine. It enables a far more accurate indication of the vertical depth to be given when not using tubes, or only using them occasionally, than was possible with other machines. When soundings are being taken continuously and the ship is steaming at a constant speed a change of depth is at once indicated by a less or greater amount of wire run out.

#### *Instructions for Lord Kelvin's 1906 Sounding Machine.*

To take soundings from forward, the machine should be fixed on the deck in the vicinity of the fore bridge so that the working of the machine is under the general supervision of the officers on the bridge. If space admits it may be placed on the bridge itself, and this is advisable if the deck is low and liable to be swept by the sea.

The wire is kept clear of the ship's side by a spar which should be from 30 to 40 feet long, according to the size of the



ship. In a long ship a long spar is desirable in order to keep the sounding wire clear of the propellers during moderate alterations of course. Fig. 356 shows the sounding machine and spar in position.

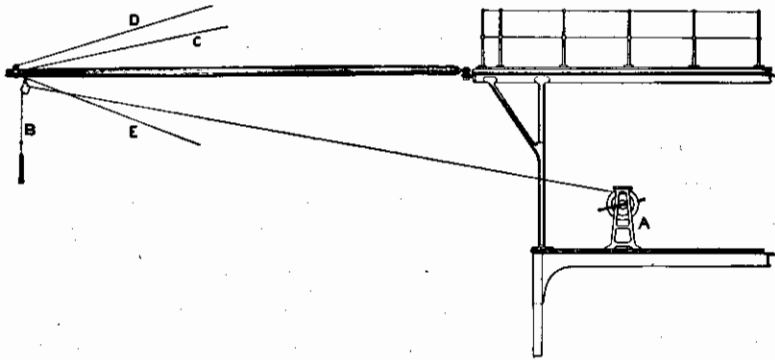


Fig. 356.—Arrangement of Spar for sounding from Forward.

A. Sounding machine.  
B. The lead.

E. Guys.

C. Outhaul.  
D. Topping lift.

The spar should not be over  $5\frac{1}{2}$  inches in diameter and should taper slightly to both ends.

The heel is fitted with a gooseneck and clamp to an awning stanchion or bridge stanchion, or with a swivel bolt to the ship's bridge or rail. For convenience in shipping and unshipping the heel fitting must admit of its being guyed forward or aft, and also of its being topped up or lowered down.

The other end of the spar should be fitted with a band and three lugs. A topping lift to support the spar in a horizontal position is secured to the lug at the upper part of the band, and a fore guy and after guy to lugs on the fore side and after side of the band. When in use the spar is held in a horizontal position at right angles to the fore-and-aft line of the ship by the topping lift and guys.

A small sheave is fixed in a mortice at the outer end of the spar just within the band previously mentioned. A line is rove through the sheave hole to serve as an out-haul for the block through which the sounding wire leads. The sounding wire itself serves as an in-haul.

If possible the heel of the spar should be secured at such a height above the deck as to be 3 or 4 inches above the top of the wire reel of the machine, which should be placed so that the spindle is at right angles to the longitudinal axis of the spar.

Care must be used to see that the wire will run out without chafing against the side of the spar, or any deck fittings, or the sides of its own reel, before the socket plates of the machine are finally screwed down. The wire must run out as nearly as possible parallel to the spar.

The spar should be always in position at sea.

The stray line between the lead and the wire should not be less than nine feet long. The brass guard tube should be seized on to it, three feet above the shank of the lead.

The connection between the hemp and the wire should be a swivel to prevent turns passing into the wire when the lead is struck by the top of a wave and set spinning, as sometimes happens.

When in pilotage water, entering or leaving harbour, etc., at speeds which render it difficult or impossible to get bottom with the hand lead and line, the machine should be kept constantly going as a check on the hand lead and for information as to change of depth. Steaming in 20 fathoms of water at a speed of 10 knots, soundings can be easily obtained continuously once a minute, and in 10 fathoms once every half-minute.

It is important that the number of fathoms of wire run out should be noted at the instant the wire slacks and not after the brake has been applied, as a few fathoms of wire may run out during the operation of applying the brake.

A reel and fittings for attaching it to the machine are supplied, so that the wire can be conveniently wound off for occasional examination or oiling.

To make ready for a cast, have the lead and the stray line attached to the swivel in the usual manner. Ship the handles and let the wire off gently so that the block through which the wire leads may be run out to the end of the spar by the out-haul. Now let the lead down until it is almost touching the water. Push home the brake catch, and set the pointer on the dial to zero. To let go, turn the handle one turn in the direction in which the wire runs out. Press the feeler pin gently on the wire. Immediately the wire slackens, showing that the lead has touched the bottom, call out the number of fathoms on the counter, instantly turning the handle one turn in the winding-in direction, withdraw the brake catch and wind in until the lead is again clear of the water. Then push home the brake catch and set the pointer to zero.