OFFSHORE SOUNDINGS — USE OF FLOATING BEACONS.

In the course of coastal hydrographic operations it is often found necessary to extend the soundings outside the limit of visibility of the signals erected on land (terra firma). In order to fix the position of soundings, if the coast is low and it is necessary to examine very irregular depths in the open sea with boats out of sight of the signals, the area to be examined must be covered with a network of beacons, forming a veritable floating triangulation, connected with the land triangulation. This is also necessary, in certain cases, when the signals are invisible due to bad light; or again, when the lines of soundings must be prolonged, by means of the surveying ship itself, to depths of more than 100 metres towards the open sea. entirely out of sight of land.

This method has been in use for some time by various Hydrographic Offices, and practice has led to a considerable modification in the form of the earlier signals, so as to make them more convenient and reliable.

Very little, however, has been published on this subject and, in reviewing the practical information supplied by the French Hydrographic Office, the International Hydrographic Bureau hopes that other correspondents will also be encouraged to send the results of their personal experiences to the Bureau, in order that they may be published in the Hydrographic Review.

GENERAL.

In general, as nothing interferes with the disposition of the network of the floating triangulation, the most favourable form is naturally adopted: that of the equilateral triangle.

The beacons used by the French hydrographic expeditions are visible on an average 5 to 6 miles from the height of a bridge. This distance is naturally reduced when observations are taken in boats.

In consequence, the area to be sounded is covered with a series of regular hexagons, the sides of which have an average length of 6 miles. The form of the hexagons may be slightly modified, however, to suit the radiation of the lines of soundings which it is proposed to follow.

Generally, the positions of the beacons nearest land are fixed in relation to the signals of the land triangulation by taking fixes in the boats, or in the surveying vessel itself, at all the beacons of the net work, in turn, taking advantage of the occasions when they are anchored or weighed. The angles

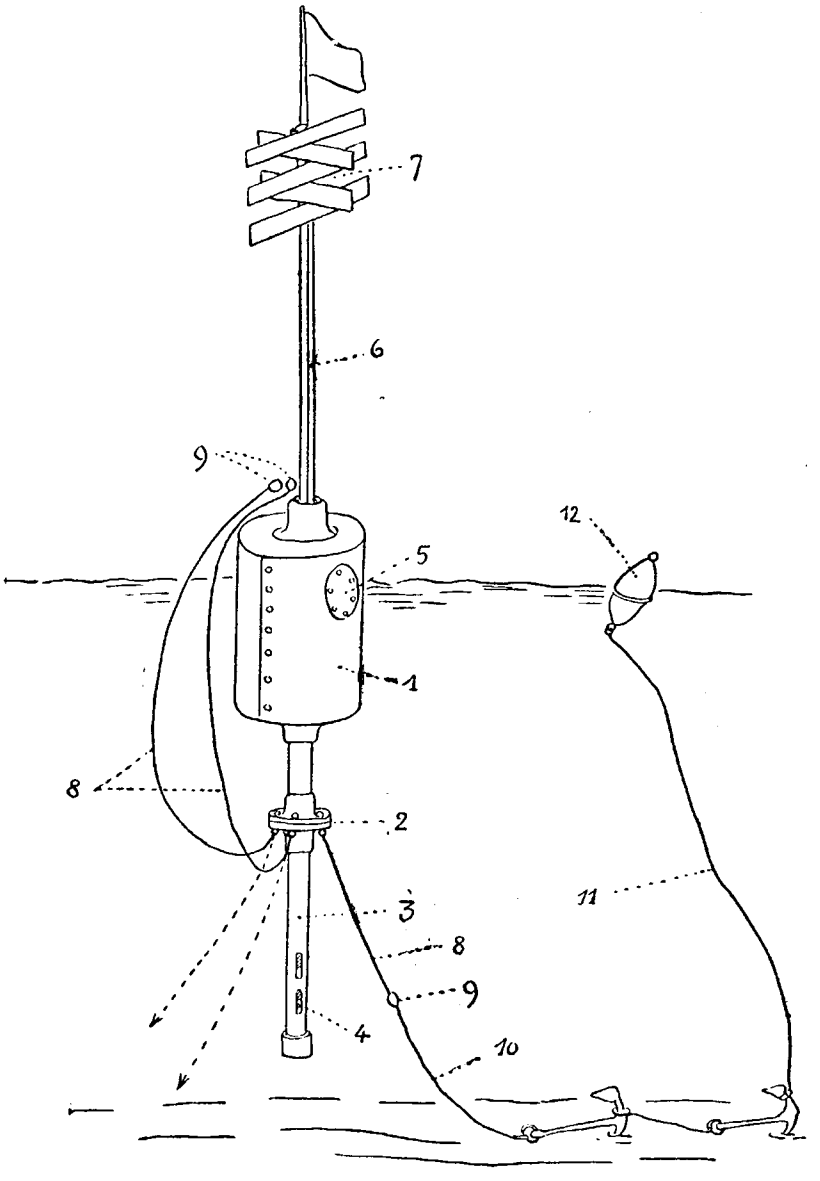

fig. 1

FLOATING BEACON (Fig. 1.)

1. Barrel
2. Flange
3. Ballast tube
4. Ballast
5. Manhole
6 Mast
7. Mark.
8. Pendants
9. Eyes
10. Mooring
11. Buoy-rope
12. Mark-buoy

to be taken are distributed between the observers, so that they are taken simultaneously, at the same moment as the elements for the reduction to the centre are measured.

If the first line of beacons has been anchored at the extreme limit of visibility of the coast, it is advantageous to make some fixes at sea, with the surveying vessel, conveniently situated and made some miles nearer land. The most accurate method, however, consists in fixing, whenever it is possible, the same buoy simultaneously from two signals of the land triangulation.

Naturally during sounding operations, angles taken between points of such small dimensions, and from distances such as 10,000 or 11,000 metres, ought to be carefully prepared in advance, and observed in the circle some moments before the fix. It is generally impossible for an observer to take more than one angle, and three observers are not too many to carry out such work satisfactorily.

It is advantageous to reduce the lateral displacements of the beacons as much as possible by appropriate mooring methods, which will be rapidly reviewed, after a short description has been given of the material used by the French expeditions.

FLOATING BEACONS.

The beacons should be very buoyant, absolutely water-tight, and capable of resisting a rough sea during several consecutive months of immersion. For this purpose, galvanised steel-plated cylindrical barrels, carefully riveted, have been chosen for preference.

DESCRIPTION :

A floating beacon is composed of three dismountable parts: *the barrel, the ballast tube,* and *the top mark* (Fig. 1).

The barrel is of galvanised steel plate, about 2 metres high and 1 metre in diameter. A tube 15 centimetres in diameter, fitted with a collar on its lower end, passes through the barrel.

The ballast-tube is fitted to the collar by 4 bolts carrying shackles on the under part. In the base of this tube, discs of 2 kilos are placed in sufficient number to assure the stability without compromising the buoyancy of the whole.

The top mark is composed of an 8 metre wooden mast, which is fitted, at the head, with intercrossed pieces of wood, arranged in 2 rectangular planes, and secured at their periphery by steel wire. The mast is driven about 3 metres into the tube, passing through the barrel. Above the top mark, a calico flag can be fixed on a spar nailed to the mast. The whole is coloured black, the wood with paint and the iron with coaltar.

MOUNTING.

The top mark is constructed apart; a strap is fitted to the head (sometimes a cleat is fixed at 3 m. 50 from the head to facilitate the reduction to the centre). The ballast tube is bolted to the collar; the discs are stowed in the

bottom of the tube; three galvanised steel wire pendants, about 4 centimetres in circumference are secured to the shackles, by means of special galvanised thimbles; the pendants, terminated at their other extremity with an eye, are made fast around the upper neck of the barrel with spun-yarn.

Further, the barrel is provided with a strong strap for raising and lowering it.

The barrel being thus equipped, its strap is secured by means of a slip toggle to the end of a purchase; then it is suspended from a yard or spar, and kept outboard.

The top mark is held by its strap, and its extremity is inserted and driven down into the tube; then, if it is necessary, it is wedged so that it cannot turn.

The draught of water is 9.50 m. A smaller model, which is used in shallow water, has a draught of 6.50 m. The barrel emerges about 0.50 m., the top mark rises 8 metres above the water line.

Generally, steel wire stays are fitted to secure the mast of the top mark to the circumference of the barrel; this arrangement contributes only a very little to the solidity of the whole, but it has the advantage of preventing the complete loss of the top mark should it be broken by the sea.

MOORING :

Originally, the beacons were moored with four grapnels; this method of mooring was evidently the best, to restrict, as much as possible, the displacement of the signals; but it took a long time, necessitated the lowering of a boat and, in consequence, could only be done in relatively calm conditions, which are not always found.

Experience proves that for the ordinary scales of Hydrographic Surveys, a beacon moored with 4 grapnels, the cables of which are sufficiently taut, is equal, graphically speaking, to a fixed signal.

Sometimes the beacons were moored from the ship itself with two grapnels each provided with a backing anchor and anchor buoy. Experience has shown that, by sufficiently tautening the cables, the displacements were reduced within acceptable limits. At first chains were used instead of steel wire cables; but the links were too frequently broken. Even steel wire cables are quickly attacked in warm seas, and often strands are broken by rubbing against the coral on the sea bottom.

The beacons are more generally moored with three backed grapnels.

Each mooring is fitted, in addition to the wire pendant, with a small galvanised steel wire cable about 4 centimetres in circumference and at least 5 times the depth of water in length; a 40 kilog. grapnel, a second small cable and a second grapnel of the same dimensions as the first; on the flukes of the second grapnel is secured a steel wire buoy rope of sufficient length, secured to a strong iron buoy. Hence the usual moorings consist of 6 grapnels, 3 buoys and about 500 metres of steel wire.

When the boat reaches the position where the beacon is to be moored, the beacon is lowered into the water, after making certain that the bolts of the inspection hole are well screwed up.

One of the cables is then run out by the boat, and the first grapnel is let go, then the backing is run out, the second grapnel is let go, and the anchor buoy is thrown into the water.

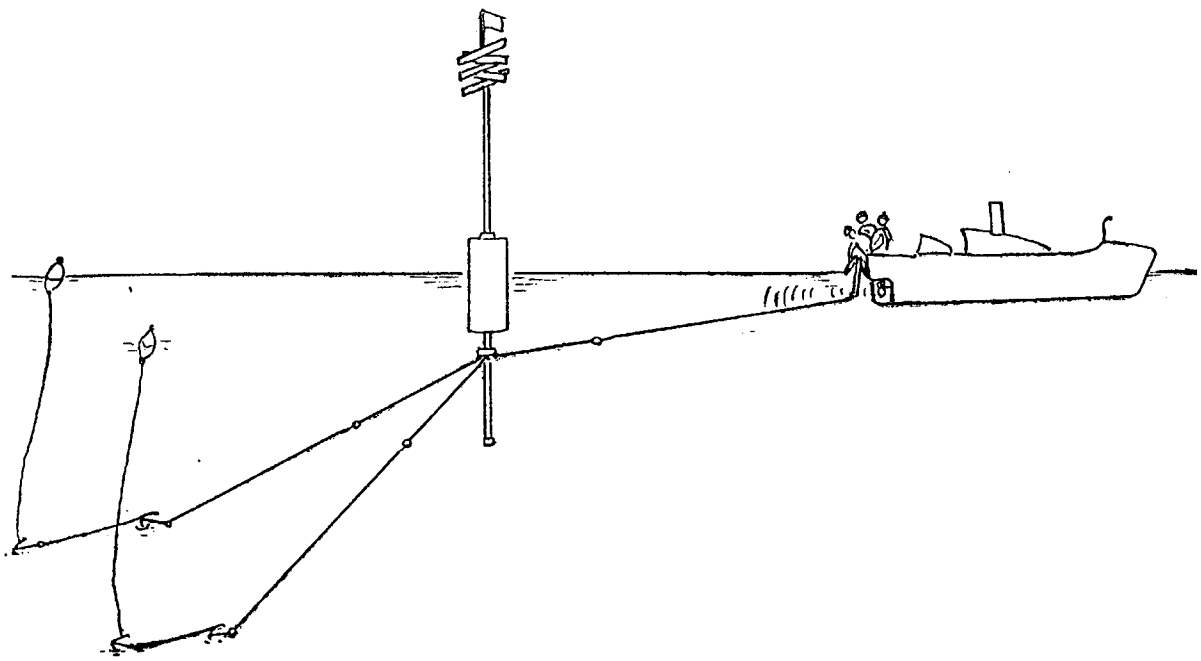

Fig. 2

The two other backed grapnels having been placed in a steam pinnace, the beacon is brought alongside, the cable is secured to the second pendant, and the second backed grapnel is run out and let go on a line 120° from the first. After having secured the third cable to the third pendant, it is run out on a line 120° from the other two, and the steam pinnace goes ahead to tauten up all cables. The grapnel is held by three men against the stern (fig. 2) and when all the slack is taken up, is is let go. Its backing grapnel is let go in a similar way. The proportion of cable of 5 times the depth of water is allowed in order to leave an elasticity to the cables, both on account of tides and, above all, to prevent the grapnels from being subjected to too vertical a strain, which might make them drag in a big swell or squall. Experience has shown that this proportion is far from excessive. Backing the grapnels by means of pig iron, tried with a view to reducing the length of the cables, has not given satisfactory results, and it has been rejected so that the operations may not be needlessly complicated.

In ordinary times the beacons, to the number of twenty, are stowed away, dismounted, on chocks, in the hold of the surveying vessel. When they are to be used, they are mounted on the deck, and hung by their barrel from the end of a yard ready for letting go. The top mark is put on at the last moment.

4 to 6 beacons can be moored in a day, depending on the state of the sea.

More detailed information on the mooring of beacons will be found in the *Annales Hydrographiques* - 1906, pages 194 and following.

WEIGHING.

A steam pinnace is used for weighing the moorings and the anchor buoys are always hoisted up first. If one anchor buoy is adrift, after having weighed all the other moorings, an attempt is made to pass a rope's end round the wire pendant by which means the first grapnel could be lifted. In case of failure, the second grapnel must be found by sweeping.

The barrel thus freed, is taken in tow and brought alongside. (The depth of water must always exceed 10 metres). A hook is then passed through the strap of the barrel, and it is hoisted inboard, after the top mark has been removed.

The barrel is carefully cleaned, tested for water-tightness, and then painted with coal tar ; all the tackle and accessories are overhauled.