Heaving in is accomplished by means of a hemp “ swifter ” or driving belt, which conveys the motion of the drum of a donkey engine to the drum carrying the wire of the sounding machine. It being impracticable to regulate the speed of the engine by hand according to the heave of the ship, in order to obviate the sudden and excessive strains on the wire so caused, an ingenious mechanical arrangement has been fitted by which frictional disks, geared by cog-wheels and capable of adjustment are interposed on the axle connecting the grooved wheel actuated by the hemp swifter and the revolving drum carrying the wire. By this arrangement the latter can be controlled as desired, both in speed and direction of motion, by means of a lever regulating the strap on the frictional disks, which may be set by experiment to act at any given tension of the wire. As the tension approaches this limit, the velocity of revolution of the drum is automatically checked; and if the tension further increases, the motion of the drum is actually reversed, thus causing the wire to run out, until the tension is relieved sufficiently to allow the frictional disks again to act in the direction of heaving in. The drum may be stopped instantly by moving the lever in the proper direction to throw the apparatus out of gear.

Galvanized-steel wire of 20-gauge and 21-gauge is supplied on drums in lengths of 5000 fathoms. The 2o-gauge wire when new has a breaking strain of 240 lb, and the smaller wire 190 lb. The large machines will hold sufficient quantity of the larger wire for the deepest soundings; there is therefore no longer any necessity for the smaller wire, and its use is not recommended. The zinc wears off to a considerable extent with constant use ; it is necessary *to* pass the wire through an oily wad whenever soundings are suspended for a time, and the surface layers on the drum should be kept well coated with oil and covered over with oily waste. A fortnight’s continuous use is about the limit to the trustworthiness of any piece of wire ; no amount of care will prevent it from becoming brittle; and directly it can be snapped by twisting in the hand, it should be condemned and passed on to the boats’ machines. A magnifying glass will assist in examining its condition. Taut and even winding on the reel from the drum is most important ; otherwise, when heaving up after a sounding, the strain forces each layer as it comes in to sink down amongst the previous layers loosely reeled on, with the result that at the next sounding slack turns will suddenly develop on running out, to the great risk of the wire. The wire is liable to cut grooves in the interior of the swivelling frame; a file must constantly be applied to smooth these down, or they will rip the splices. A roller\* of hard steel, underneath which wire passes, and which placed in rear of the swivelling frame, obviates this to a great extent.

Splices are made about 5 ft. in length, one wire being laid round the other in a long spiral of about one turn per inch. A seizing of fine wire is laid over each end and for 2 or 3 in. up the splice, no end being allowed to project, and solder is then applied the whole length of the splice. Three more seizings should be placed at intervals. Splices are the weakest parts of the wire, and their multiplication is to be avoided. They should be frequently examined and their position noted, so that in heaving in they may be eased round the wheel with the guider nearly in the centre, to avoid tearing.

Under 1000 fathoms a lead of 30 to 40 lb weight can be recovered, and no detaching rod is necessary. At a little risk to the wire, when sounding from astern up to that depth, the ship may go ahead directly bottom is struck, increasing speed as the wire comes in; the great saving in time thus effected will often justify the increased risk of parting the wire. For greater depths the “ Driver rod” is the best detaching apparatus for slipping the sinkers; its construction is easier than that of the “ Baillie rod,” and with a piece of gas piping cut to the proper length the ship’s blacksmith can make one in a day. Both rods are fitted with tubes to bring up a specimen of the bottom, and the same sinkers fit them both.

The “ Driver rod ” is shown in fig. 2. ABC is a tube about 2 ft. in length, fitted at the top with a flap valve D, working on a hinge at E. The lower part of the tube C screws on and off, and contains a double flap valve to retain the bottom specimen. The sinkers WW, each 25 lb in weight, conical in form, and pierced with a cylindrical hole through which the Driver rod passes loosely, are slung by wire or cod line secured to a flat ring or grummet shown at L and passing over the stud G. A stud K on each side of the tube fits loosely into the slot H in the lower part of the slipping lever MH. The weight of the apparatus being taken by the sounding wire, the sinkers remain suspended; but on striking the bottom, the wire slackens, and the weight of the sinkers drags the slip­ping lever down till the stud K bears against the upper part of the slot H. By this action the point M of the slipping lever is brought to bear against the upper end of the standard EF, being thereby forced outward sufficiently to ensure that the weight acting at the point G will tilt the slipping lever right over, and thus disengage the sling. The tube being then drawn up, the sinkers are left behind. In descending, the valves at top and bottom, opening upwards, allow the water to pass through freely; but on drawing up they are closed, thus retaining the plug of mud with which the tube is filled. For water under 2000 fathoms two conical weights are sufficient. In deeper water a third cylindrical weight of 20 lb should be put between them. It is important to interpose a piece of hemp line, some 10 fathoms long, between the end of the wire (into which a thimble is seized) and the lead or rod. This tends to prevent the wire from kinking on the lead striking the bottom. A piece of sheet lead, about 2 lb in weight, wrapped round the hemp just below the junction, keeps the wire taut while the hemp slacks. Small brass screw stoppers, fitted with a hempen tail to secure to a cleat, hold the wire during the sounding if necessary to repair splices or clear slack turns. In heaving in the springs are replaced with a spring balance, by which the amount of strain is seen and the deck engine worked accordingly. A system of signals is required by day and by night, by which the officer superintending the sounding can control the helm, main engines and deck engine.

*Method of Sounding.—*The machine is placed on a projecting platform on the forecastle. An endless hemp swifter, led through blocks with large sheaves, connects the sounding machine and deck engine, and when heaving in is kept taut by a snatch block set up with a jigger. As the wire runs out, the regulating screw of the brake must be gradually screwed up, so as to increase the power of the brake in proportion to the amount of wire out. The regulating screw is marked for each 500 fathoms. In fairly smooth water the brake will at once act when the weight strikes the bottom and the reel stops. Under 3000 fathoms one spring only is sufficient, but beyond that depth two springs are required. If the ship is pitching heavily, the automatic brake must be assisted by the screw brake to ensure the reel not overrunning. The marks on the regulating screw are only intended as a guide; the real test is that the brake is just on the balance, so as to act when the strain lessens, which may be known by the swivelling frame being just lifted off the stop. As the wire weighs 7⅛ lb for each 500 fathoms, the 500- fathoms mark on the screw should be at the position in which the screw has to be to sustain a weight of 7½ lb; the 1000-fathoms mark, 15 lb; and so on. This can be tested and the marks verified.

*Handling the Ship.—*Sounding from forward enables the ship to be handled with greater ease to keep the wire up and down, and especially so in a tide-way; but in very heavy weather soundings may be obtained from a machine mounted over the stern, when it would be quite impossible to work on the forecastle. The spanker must be set with the sheet to windward, unless a strong weather tide renders it undesirable ; the ship’s head must be kept in a direction which is the resultant of the direction and force of the wind and current ; and this is arrived at by altering the course while sounding, point by point, until the wire can be kept up and down by moving the engines slowly ahead as necessary. It should seldom, or never, be necessary to move the engines astern.

The temperature of the water is usually taken at intervals of 100 fathoms down to a depth of 1000 fathoms, and at closer intervals in the first 100 fathoms. If a second wire machine is available; the observations may be made from aft whilst the sounding is being taken forward. A 30-lb sinker is attached to the end of the wire, and the registering thermometers are secured to the wire by the metal clips at the back of the cases, at the required intervals. To avoid heavy loss, not more than four thermometers should be on the wire at one time. When sounding a thermometer is usually attached to the line a short distance above the lead.

The primary object of the machine called the “ submarine sentry ” is to supply an automatic warning of the approach of a ship to shallow water: it has been instrumental in discovering many unsuspected banks in imperfectly surveyed waters. By means of a