

IV.

DESCRIPTIVE DETAILS OF THE GRAVING DOCK AND ITS EQUIPMENT.

Diagrams are included in this brochure illustrating various sections referred to in the following description of the graving dock :—

Dock.

The length of the dock from head to outer caisson sill (*Diagrams Nos. 1 and 2*) is 1,150 feet, that is, its effectual docking length, but this length can be increased by 41 feet, *i.e.*, to 1,191 feet by placing the caisson in the outer or emergency stop, as is shown in *Diagram No. 1*.

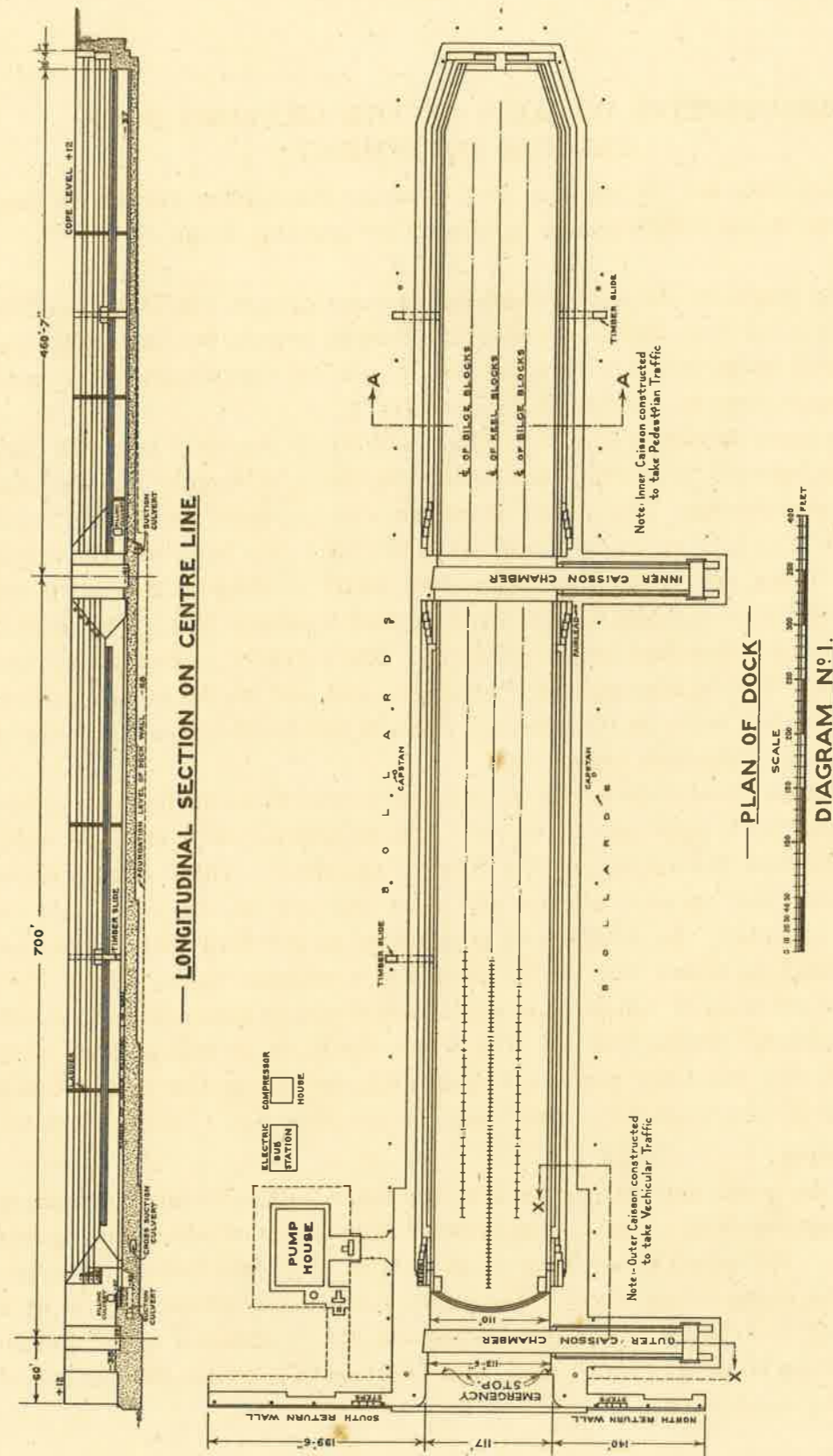
An inner caisson is provided which will divide the dock into two compartments, referred to as inner and outer chambers, of lengths 440 feet and 660 feet respectively. The width at entrance is 110 feet; depth over outer sill at H.W.O.S.T. is 41 feet and at L.W.O.S.T. 35 feet, and the depth over the inner sill is 37 feet below low water. Inside the dock the width at coping is 138 feet 6 inches and at floor level 110 feet. The floor at the outer end is five feet below sill level. The entrance is flanked by two return walls, that on the south side being 200 feet and on the north 140 feet. The depth at low water in the entrance channel will be 36 feet when dredging operations are ultimately completed.

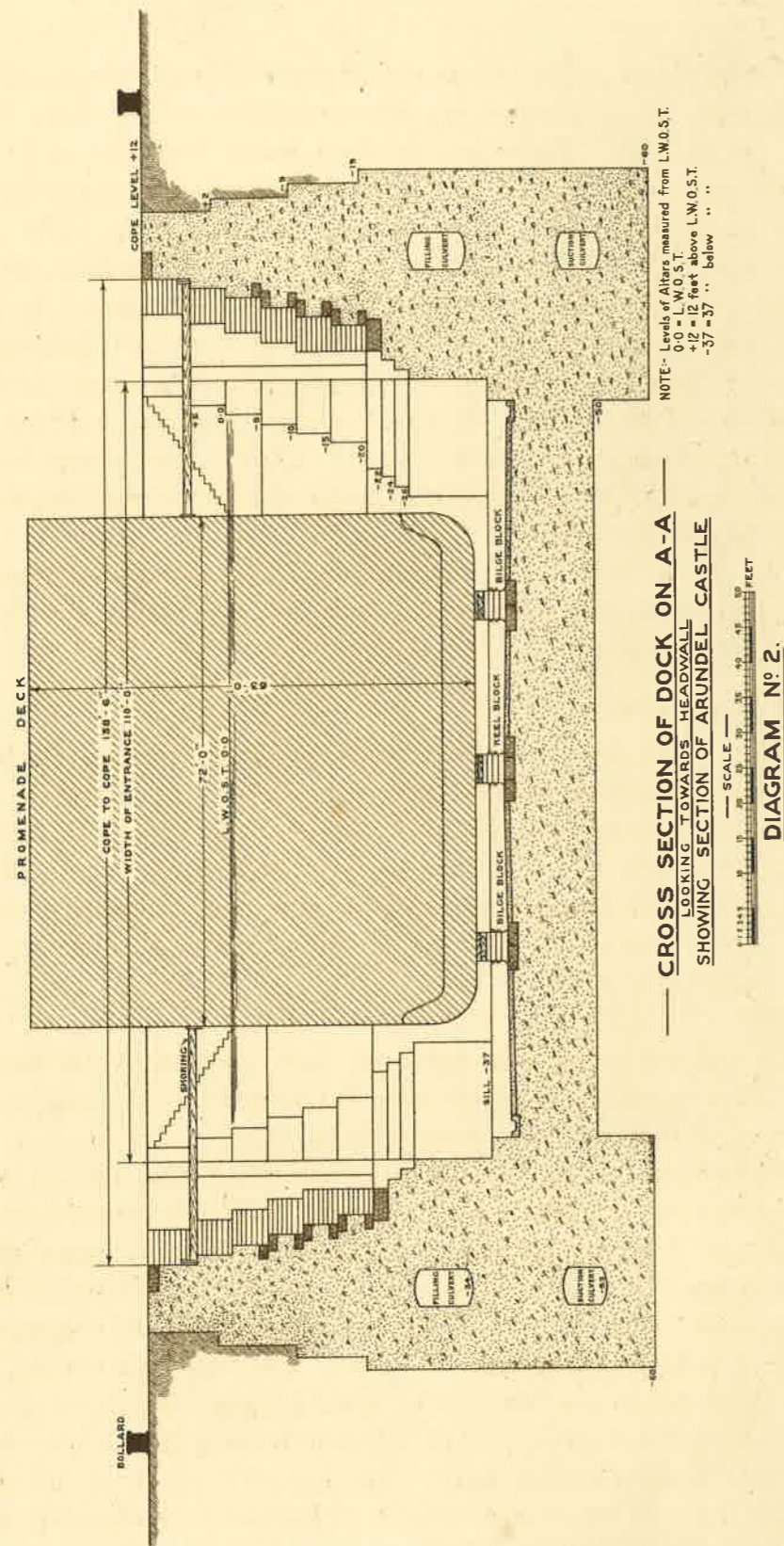
Four flights of steps in the outer chamber and three in the inner chamber, together with eight sets of vertical iron ladders recessed into the walls, give access from the coping to the floor of the dock. Three timber slides are provided, one on each side for the inner and one on the south side for the outer chamber. In addition to keel blocks on the floor, bilge blocks are also provided on either side. The floor has a uniform falling grade from the head of entrance of 1 in 660 and a fall from centre to either side of 1 in 60.

A general perspective of the whole dock, as it will appear when completed, and buildings connected therewith, including the power house contemplated, is reproduced on the cover (*see also plate No. 1*) of the brochure.

Pump house.

At the south side at the back of the main wall is situated the pump house (*Diagrams Nos. 3 and 4*), the internal dimensions of which are 70 feet by 45 feet. The pump house floor is at a level of 33 feet below low water. Beneath the pump house floor is the pump house well, whose floor is at a depth of 58 feet below low water. *Diagram No. 3* shows a cross section through pump house and south wall, and *Diagram No. 4* the arrangement of the pumping machinery.





Pumps.

On the pump well floor are placed three 48 inch twin parallel "Invincible" pumps, direct coupled to electric motors of 760 h.p., 6,600 volts, 3 phase, 50 periods. These pumps draw water from the main sump and deliver through sluice valves and reflux valves into the main discharge culvert and thence through the return wall into the Bay. The dimensions of this culvert, which is controlled by a single-faced sluice door, are 10 feet by 10 feet and the invert is at level 34 feet, below low water. In addition to the three main pumps on the well floor there is a 12 inch leakage pump as well as a 2 inch house pump, a vacuum charging pump and hydraulic pump, all electrically driven by direct coupled motors, together with the necessary transformers and switch board. (The entire pump house equipment was supplied by the General Electric Co., in conjunction with Messrs. Gwynnes Engineers, Ltd.)

The pump well is surmounted by a brick superstructure, 75 feet long by 50 feet wide, and carries the runway for an overhead electric travelling crane of 5 tons capacity.

Caisson chambers.

On the north side are the two chambers for the caissons (*Diagram No. 5*). Each of these chambers, in itself, represents a dock in miniature into which the caisson is drawn to allow a ship to pass in or out. The type of caisson is known as the rolling box type, and the selection of this type, which necessitates the building of chambers to accommodate them, is amply justified by the ease and safety with which they can be moved under all weather conditions.

Caissons.

The caissons, weighing 875 tons each without water ballast, were made by Messrs. Sir. W. G. Armstrong Whitworth & Co., Ltd., and temporarily erected at their works at Newcastle-on-Tyne.

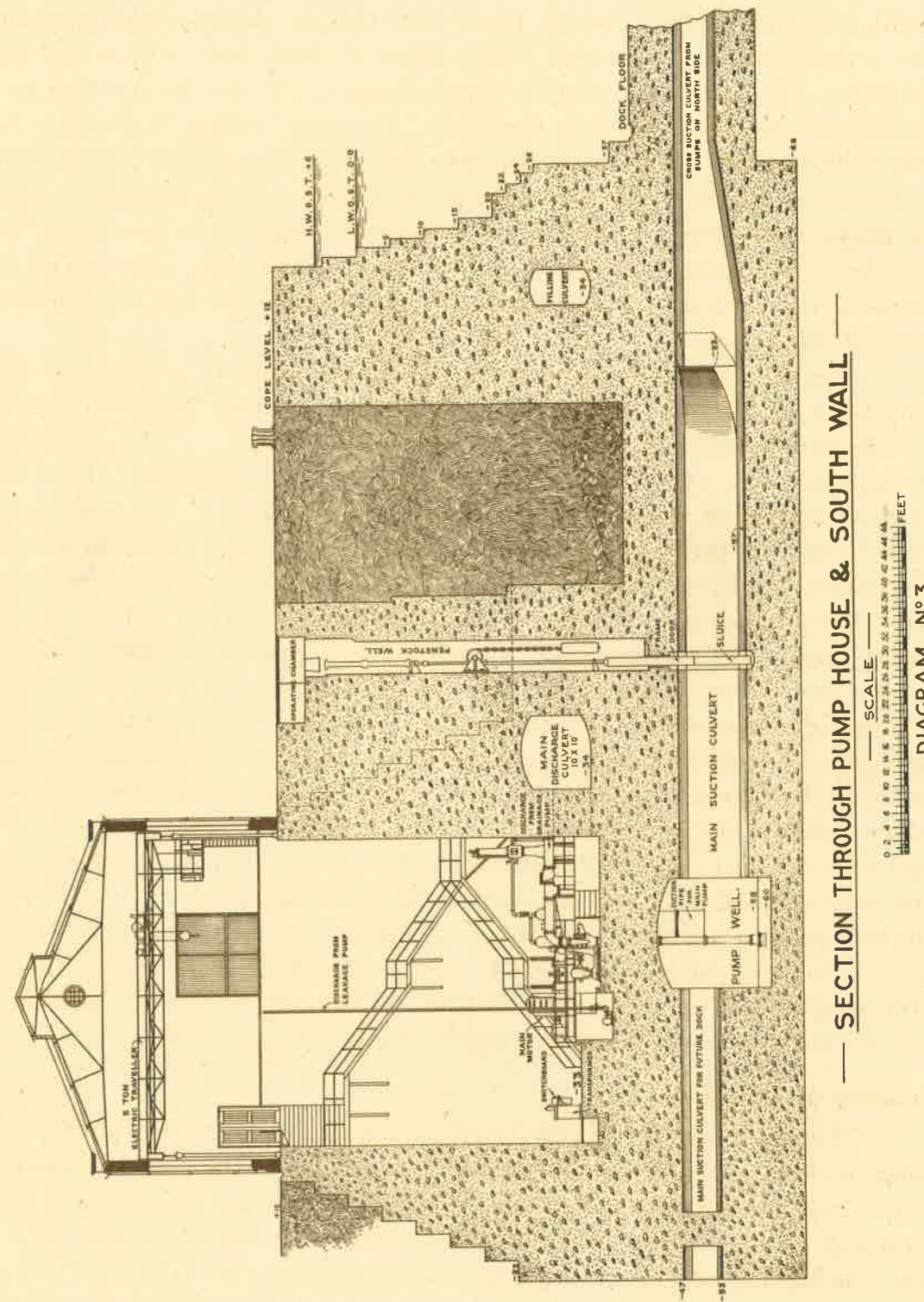
The caissons are at present in course of erection on the floor of the dock (*see plates Nos. 13 and 22.*) Both inner and outer caissons are similar in general design, but the following description will apply more particularly to the outer one. There are five decks (lettered A to E) E being the bottom deck (*Diagrams Nos. 6 and 7*). B and E are open decks, E being partly plated to take the permanent ballast. C and D are watertight decks, the space between them forming a watertight compartment which is divided into three chambers, the centre one of 88 feet length being the air chamber and the two end ones forming scuttle tanks. The sizes of these three chambers are so arranged as to give together a reserve of buoyancy represented by six feet

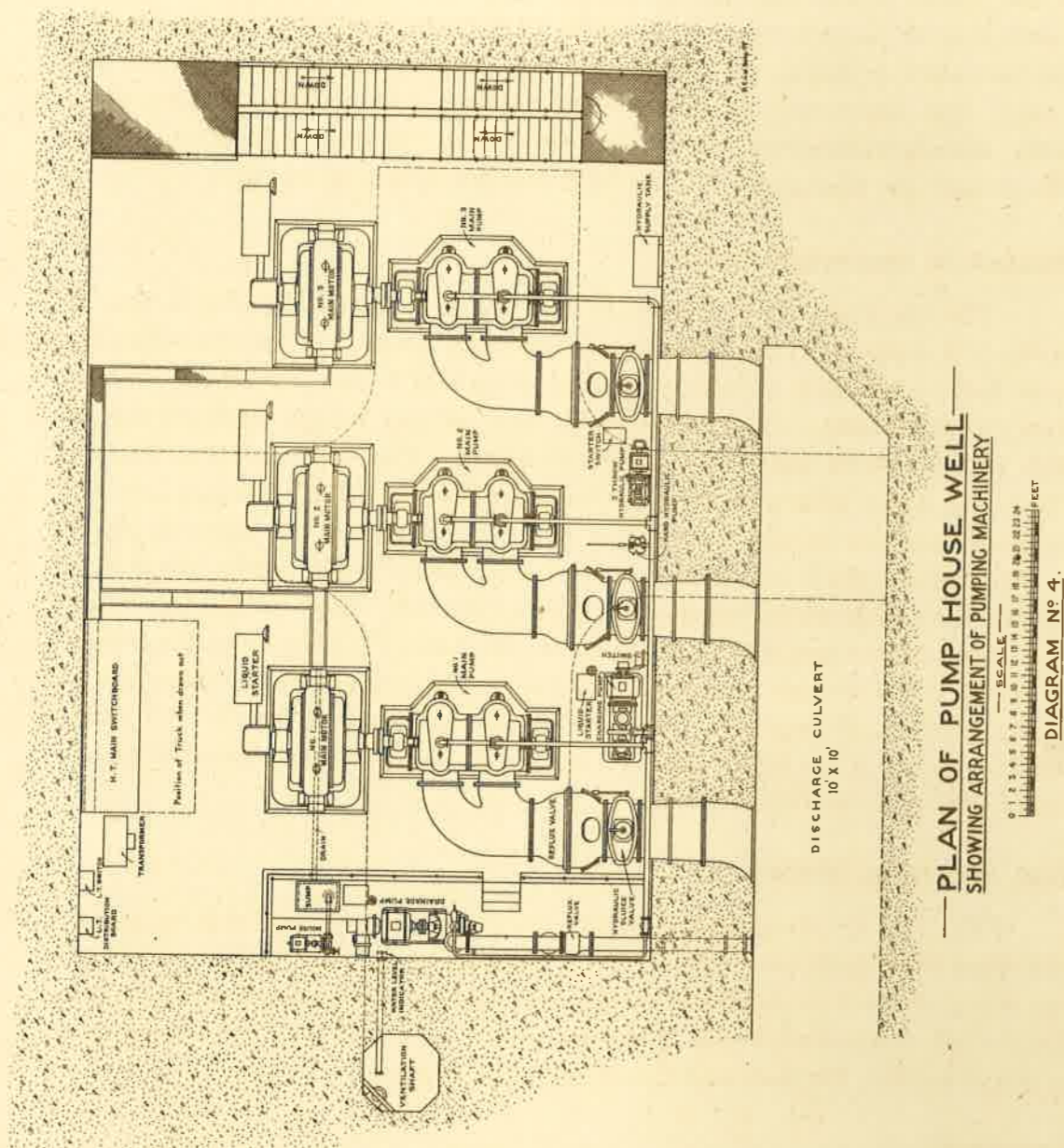
of free board below deck C. The size of scuttle tanks is sufficient to give a negative buoyancy after the reserve buoyancy has been taken up. Eight inch valves with gearing taken into the air chamber are provided and a complete suction system is also fitted to drain both scuttle and air chambers. A small hand pump is supplied situated in the air chamber and discharging overboard through the shell. The outer caisson is arranged to take vehicular traffic and, for this purpose, is fitted with a patent folding deck mounted on a system of two sets of shafts and balanced levers arranged to give the deck a total drop of 2 feet 6 inches. This will enable it to pass under the chamber cover when the caisson is drawn into its chamber. The action of dropping this deck is automatic and simultaneous with the first 6 feet movement of the caisson.

The sill against which the caisson bears is formed in granite and the watertight medium between the steel of the caisson and the granite sill is greenheart timber $15\frac{3}{4}$ inches deep by 12 inches thick. The caissons, throughout their travel, are carried on two rows of rollers mounted in brackets fixed on bottom of runway and directly under each keel. The spacing of these rollers is 7 feet 2 inches centre to centre. Movement of the caisson is effected by electrically driven winches housed at the inner end of the chamber. The winches are placed on the first floor at a level of 15 feet above the coping level. The motive power is one 90 h.p. Crompton reversible motor, driving the hauling drums through a treble reduction. A travelling beam is arranged transversely across the chamber having at each end the connections for in-haul and out-haul cables. This beam is connected at its centre to the caisson by a draw bar and at each end by $4\frac{1}{2}$ inch steel flexible cables through the connections just mentioned to the winches. The in-haul wire is direct connected and the out-haul passes over a return sheave. The hauling speed is 25 feet per minute, the operation of opening or closing this occupying $4\frac{1}{2}$ minutes. The chamber cover is of steel troughing filled with concrete to coping level and designed to carry, in case of the outer caisson, a lorry weighing 10 tons including its load. The inner caisson is provided with a fixed top deck and is only intended for pedestrian traffic.

Process of filling dock.

The process of filling the dock, which holds 38,118,750 gallons of water, is effected by a system of culverts. These have their entrance or intake at the junction of the main and return walls and pass up the length of the main wall to a point just inside the outer caisson chamber where they bifurcate, one branch entering the outer chamber at this point and the other going further up the length of the main wall to a point just inside the inner caisson





and entering the inner chamber at that point. These culverts are 8 feet by 5 feet 3 inches and each branch is separately controlled by its own sluice. The invert is at a level of 34 feet below low water. In the case of the filling culvert on the north side it was necessary to introduce inverted syphons at the points where the culvert passes under the caisson runways for the reason that these runways are at levels 37 feet and 39 feet below low water. The operation of filling the whole dock by means of these two culverts will occupy, it is estimated, a period of 47 minutes. In addition to the sluice doors, already mentioned, controlling the filling culvert, there is, at the intake of each, an emergency sluice which is of the single-faced type.

Process of emptying dock.

The emptying of the dock is effected in a period of four hours by means of a separate system of culverts 6 feet by 5 feet 3 inches placed in the main walls with their inverts at a level of 53 feet below low water. Water from the dock enters these culverts by way of four sumps situated one on each side for both inner and outer chambers. The four culverts through which the water passes from these sumps all eventually converge into the main suction culvert which is 10 feet by 11 feet 6 inches. A sluice is placed in this culvert which terminates in the main sump under pump house floor whence the pumps draw water as already explained. Each of the four 6 feet by 5 feet 3 inches culverts, referred to, is controlled by a separate sluice door. All sluice doors are operated by electrical machinery placed in chambers at coping level or, if required, they can be manipulated by hand. All sluice doors in the dock are being supplied by Messrs. Glenfield and Kennedy, Ltd., from their works at Kilmarnock.

Keel and bilge blocks.

The keel blocks and bilge blocks are of similar type and rest on granite laid flush with dock floor. Each block is made up of four cast iron sections, two being tapered to facilitate withdrawal and capped by hard wood timber, the overall dimensions being 4 feet by 4 feet by 15 inches. The spacing is at 4 feet centres for keel and 8 feet for bilge blocks.

Capstans.

For warping a vessel into the dock six 15-ton electric capstans are provided. Three are placed on either side of the dock, two of them being at the entrance, and, by means of fairleads, are able to control a ship in any position during the process of docking.