METHOD AND APPARATUS FOR DRIVING PILING

One of the claims and the object of this invention is to enable the driving of Piles underwater to be carried out in any depth of water. It is customary when driving Piles into the ocean floor that the Pile projects above the water surface because the Pile Driver has to operate in air. As the depth increases the process becomes more undesirable due to the long section of Pile necessary between the ocean bottom and surface of water. This invention will enable Piles to be driven at any depth even to driving the top of the Pile flush with the ocean floor without any rigid projection to the surface if it is so desired.

Another claim of this invention is the power generating and transmission system design that enables only one umbilical cord to be used connecting the Pile Driver with its source of power located aboard the Pile Driver's support vessel, whether it is operating above or below water. Heretofore, Pile Drivers using a fluid medium to transmit the energy developed by a pump to the Pile Driver would require two hoses connecting the power source and the Pile Driver. One hose would carry hydraulic fluid under pressure to the Pile Driver; the other hose would return the fluid to the reservoir near and connected to the pump. This was required because normal hydraulic fluid is an oil based material and environmental considerations prevent its being dumped and also because of its cost, it needs to be reused.

One claim of this invention is: this Pile Driver uses seawater as its hydraulic fluid, and having given up its energy, it is disposed of by returning it to the ocean surrounding the

hammer. Thereby, eliminating the need for two power transmission hoses between the pump and Pile Driver.

To enable this invention to work properly a valve of special design is required.

The special valve is the object of a Patent application sent to Mason, Kolehmainen, Rathburn & Wyss on May 24, 1979 titled Hydraulic Pile Hammer.

Further to enable this Pile Driver to work more efficiently an air environment is maintained within the Pile Driver Casing.

The maintaining of an air atmosphere within the Pile Casing requires special equipment. The use of an air atmosphere and the necessary equipment to supply and maintain it constitutes a claim of this invention.

These claims are best described by referring to drawings Figure I, II, III, and IV and the following description.

Figure I shows the general concept of where and in what manner this invention would be used.

Figure II shows the various major component parts of this invention: The drawing is in approximate true proportion with the Hammer in its lowest position. All Key Nos. refer to same Items on all drawings.

Item (1a) the general overall outside casing of the Pile Driver. (Item 1) Cylinder within which the Piston (7) operates. Item (2) Pipe Cap that sets on top of Pile (90). Item (3) Cushion Material, Item (4) Anvil that transmits the impact force generated by dropping Ram (6) to Cushion Material (3) and Pipe Cap (2). Item (5) Ram Point (integral with and lower portion on

Ram (6). Item (9) Piston Rod connecting Piston (7) object on which lifting force is acted upon and Ram (6) (weight lifted). (7) Piston, (8) Special Valve (claim of previously filed Hydraulic Patent) (10) low friction Ram Guides.

Figure III shows the entire Hammer in about true proportion with the Ram in its top position.

Figures IV & V are schematic versions showing only the essentials of: (1) Cylinder, Special Valve (8), Valve (11) and auxiliaries needed for operation.

A description of a portion of the cycle referring to the lifting energy is as follows: Figure II shows the Hammer setting on the Pile (90) ready to start driving--the Ram Point/Ram (5) (6) setting on the Anvil (4) the Piston Rod/Piston (9) (7) in its lowest position. For detail of Valve operation see Figures IV, V, VI, and V, VII also.

Valve (8) is covered in a previously filed Patent for a Hydraulic Hammer. Its function is repeated here for the sake of continuity regarding the entire hammer function.

Figures VI and VII show Valve (8) in about its true proportions for an underwater hammer. In Figures II, IV, and VI, Valve (8) is in a downward and open to the pump source of power position. A description of Valve (8)'s function is as follows:

Figures II, IV, and VI show the Valve in its lowest position, admitting seawater under pressure into Cavity [A] through Port (50) from water supply line (81) thereby creating an upward force on Piston (7). Special Valve (8) is held in its downward position by water under pressure in Cavity [B] through line (43) via Valve (11)

and Line (70) meanwhile Cavity [C] is open to exhaust its contents into the sea via line (44) Valve (11) and Line (71). See Figure I. The water from pump (91) is transferred to the Pile Driver (1 through hose (81) entering Cavity [A] via Port (50). The force of the water acting upon the underside of the Piston (7) lifts the Piston Rod/ Ram (9) (6). The function and working parts of Control Valve (11) are covered in previously filed Hydraulic Patent Application. The water under pressure in Cavity [A] continues to lift Piston (7) until the Stroke Control (12) mounted on the Slide Bar (13) contacts the Stem (14) of Control Valve (11) and pushes it upward. The upward force on Stem (14) of Valve (11) moves the Spool of Valve (11) thereby reversing the flow of water through Valve (11). This action reverses the pressure on Piston (15) of Valve (8). This takes place in the following sequence.

Compare Figures IV and V, continue with Figure V. As the Ram (6) rises it moves Slide Bar (13) upward until Stroke Control (12) pushes upward on Valve Stem (14) which reverses the flow of water through Control Valve (11). Due to the change of the Ports in Valve (11), Cavity [B] is exhausted to the ocean while Cavity [C] is pressurized. This shifts the movable Body (15) of Valve (8) from its downward position to its upward position. With the Movable Body (15) in its upward position Port (50) is closed off preventing any further entrance of water from the Pump (91)/Line (81). As Port (50) is closed by hydraulic pressure (in this case the hydraulic medium is seawater) in Cavity [C], Cavity [B] is opened to exhaust its contents into the sea. The characteristic of Valve (8) i.e., Port (50) closing or opening in reverse of

Port (51) closing or opening is a claim or Patent Disclosure of May 24, 1979, in that Valve (8) is so constructed that at no time is Valve (8) in such a position that both intake and exhaust Ports (50) and (51) are in a closed position simultaneously. Stated in another manner Valve (8) has no "deadspot" when fluid is trapped in Cavity [A] which would cause shock to be transmitted to areas surrounding the trapped fluid. The fluid in Cavity [A] discharges to the sea through Port (51). Port (51) is by design greater in area than the underside (lifting area) of Piston (7) which permits the assembly: Piston (7), Piston Rod (9), Ram (6), and Ram Point (5) to fall with the least resistance of water in Cavity [A] that is possible. As long as the Port (51) is open and Port (50) closed the Ram Assembly will fall due to gravity. As the Ram Assembly drops it carries with it the Slide Bar (13) that has attached to its upper end Control Arm (17). As the Ram Point (5) Figure II strikes the Anvil (4) the Control Arm (17) (see Figures IV and V) is so positioned that it pushes downward on the Upper Stem (16) of Control Valve (11). This reverses the position of Valve (11) to the position it was in Figure VI that changes the position of the Valve Slider (15) in Valve (8). This opens Port (50) closes Port (51) and the Cycle is repeated.

Another claim of this invention is the portion of design that enables the Ram to fall through air and thereby encounter less resistance than one that is falling through water. See Figures II and III. The spaces that are to be maintained in an air atmosphere are [D], [E], [F]. The unique way this is to be accomplished is: Line (82) supplies compressed air to the Hammer

at 10 lbs./sq. in. higher pressure than the water pressure of the depth the Hammer is operating in. Valve (18) is a pressure control Valve that senses the pressure of the water surrounding it and maintains a flowing air pressure through the Valve of 10 lbs. higher pressure. The compressed air is admitted to Cavity [D] through Port (52) from Cavity [D] it passes through Port (53) to Cavity [E]. Cavity [E] is integrally connected to Cavity [F] surrounding the Ram (6), from Cavity [F] it passes out to the sea surrounding the Hammer through Port (54). By means of the above the Ram and Piston is able to fall with a minimum of resistance.

The special claim of the foregoing is that the Ram falls through an air filled Cavity thereby encountering the least resistance possible in its fall while the air contained within Cavities [D], [E], and [F] are maintained at 10 P.S.I. pressure above the outside sea-water whether the hammer is going down (seawater pressure increasing) or coming up to the surface (seawater pressure decreasing). The pressure is automatically matched to its surroundings thereby preventing a situation whereby the interior of the Cavity may be flooded or a sudden release of excess air pressure may occur as an explosive force that could endanger anyone nearby.

Each special feature stated heretofore working together will enable a Pile Driver to operate satisfactorily at any depth under-water which has not been possible before.

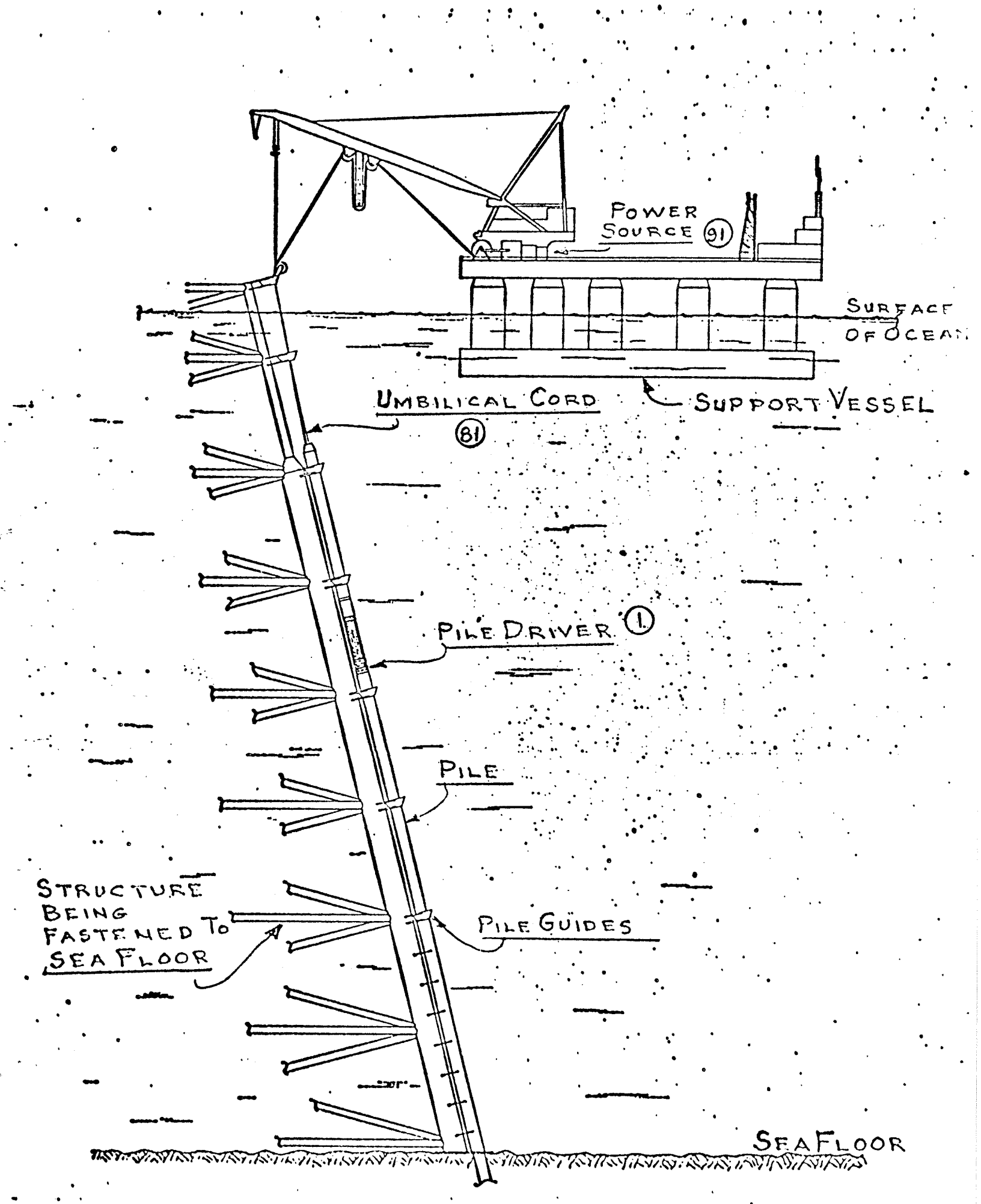
POWER SOURCE (91)
SURFACE OF OCEAN
UMBILICAL CORD (81)
SUPPORT VESSEL
PILE DRIVER (1)
PILE
STRUCTURE BEING FASTENED TO SEA FLOOR
PILE GUIDES
SEA FLOOR

FIG I

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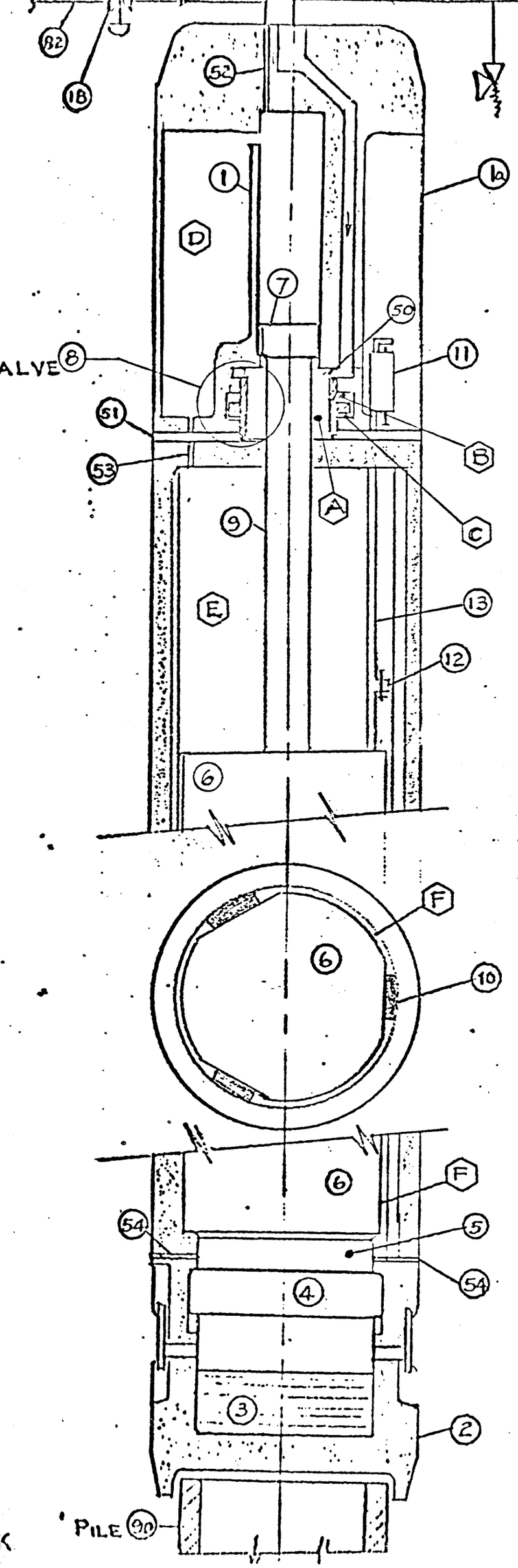

FIG. II

SEE ALSO FIG. IV AND VI

FIG. II

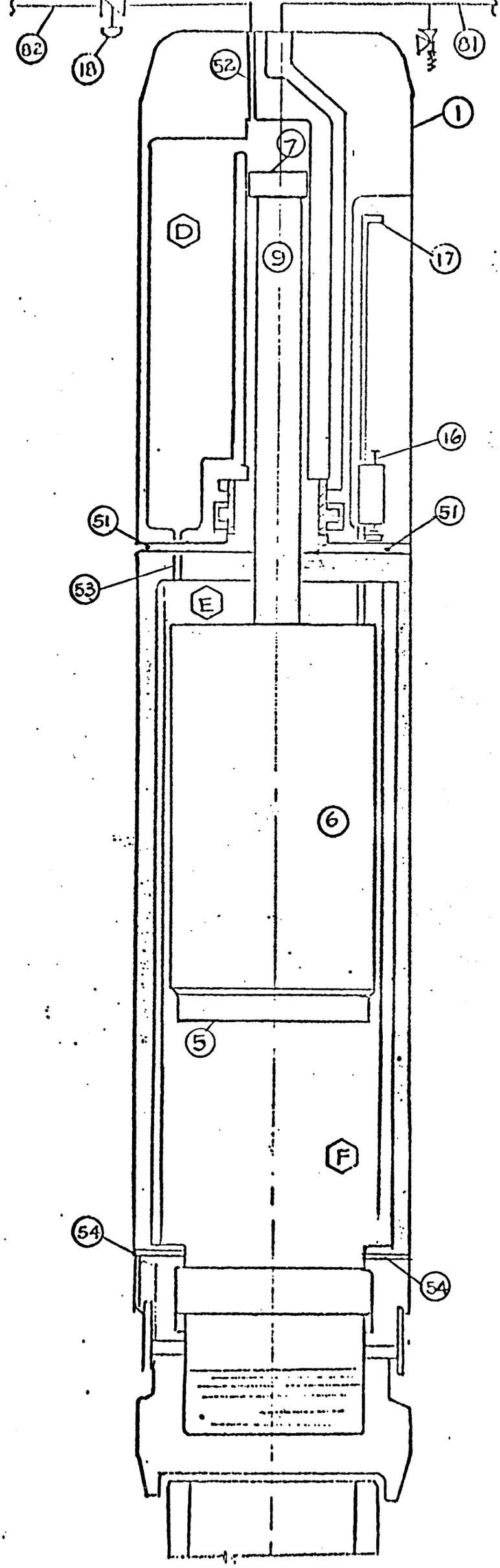

FIG. III

SEE ALSO FIG'S. V & VII

FIG. III

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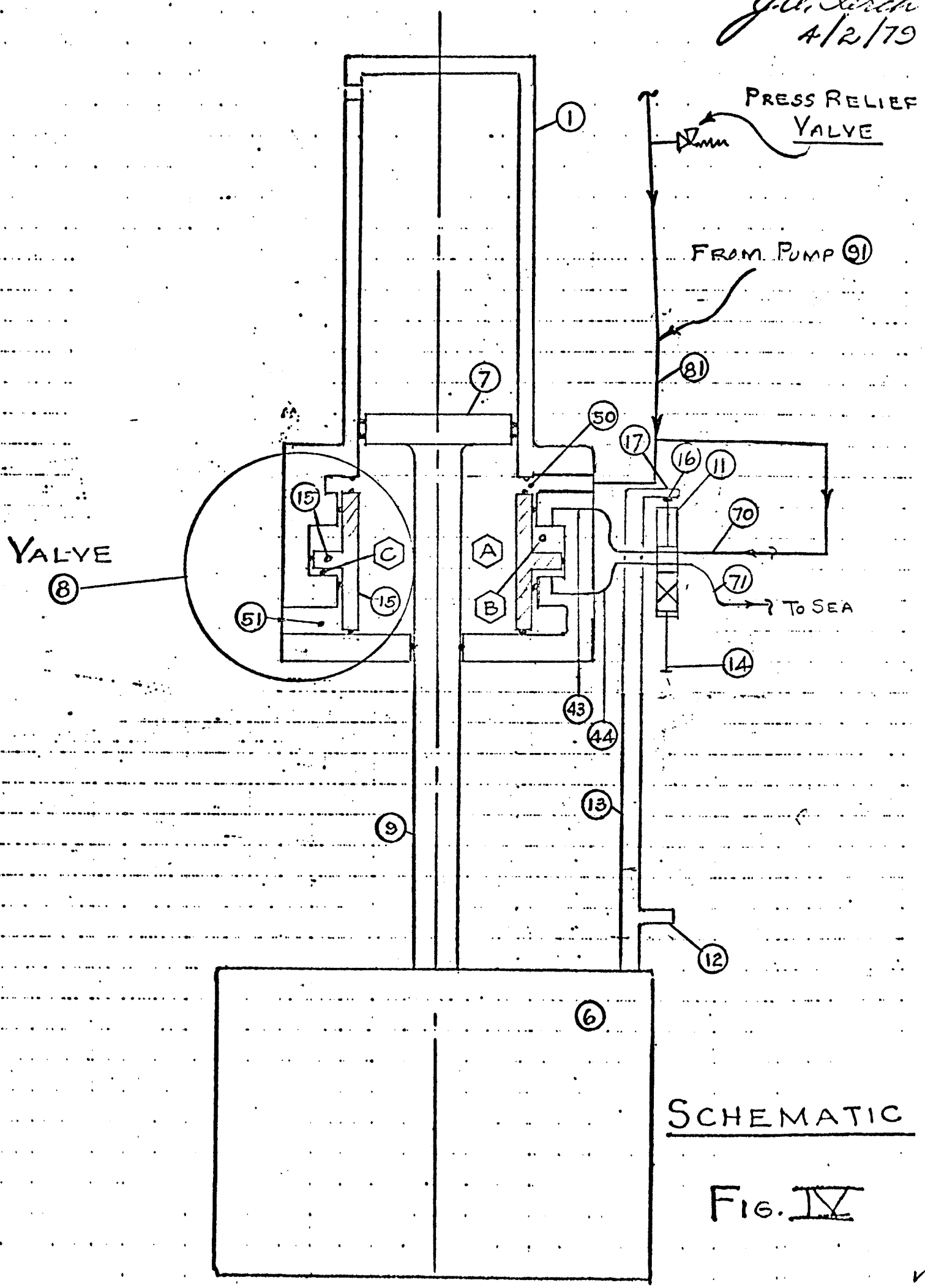
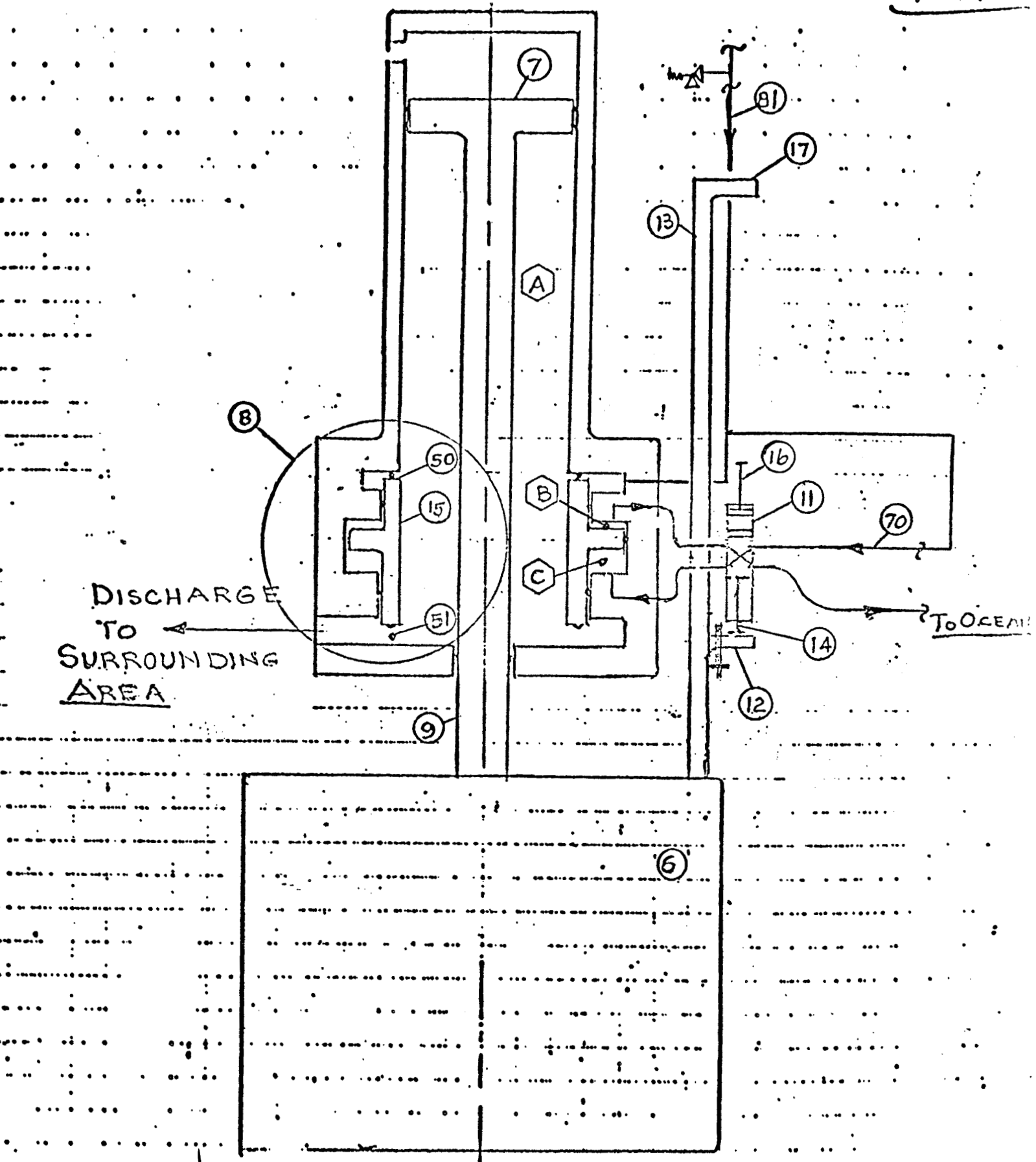


SCHEMATIC

FIG. IV

5K



SCHEMATIC

FIG. V

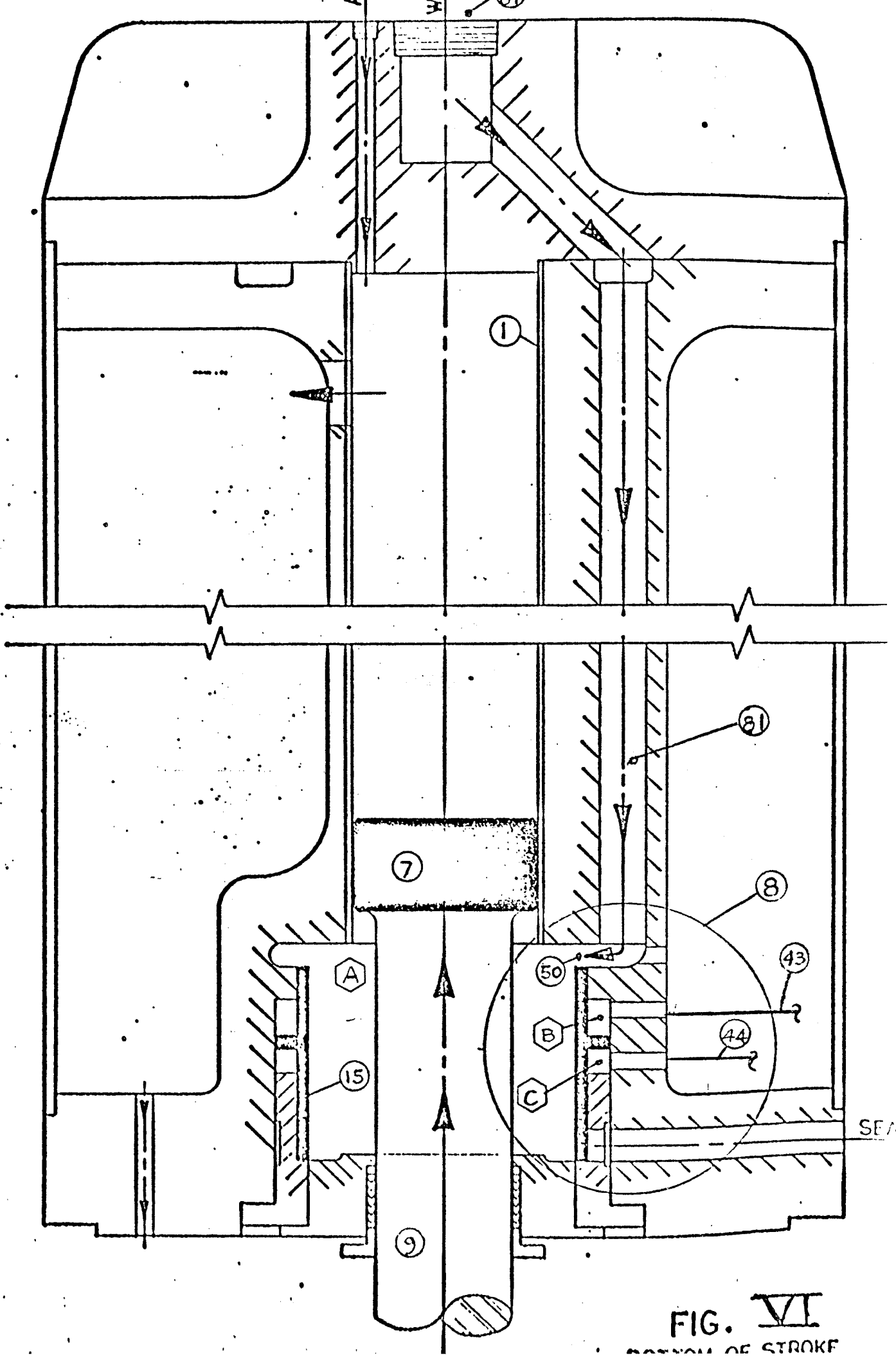


FIG. VI

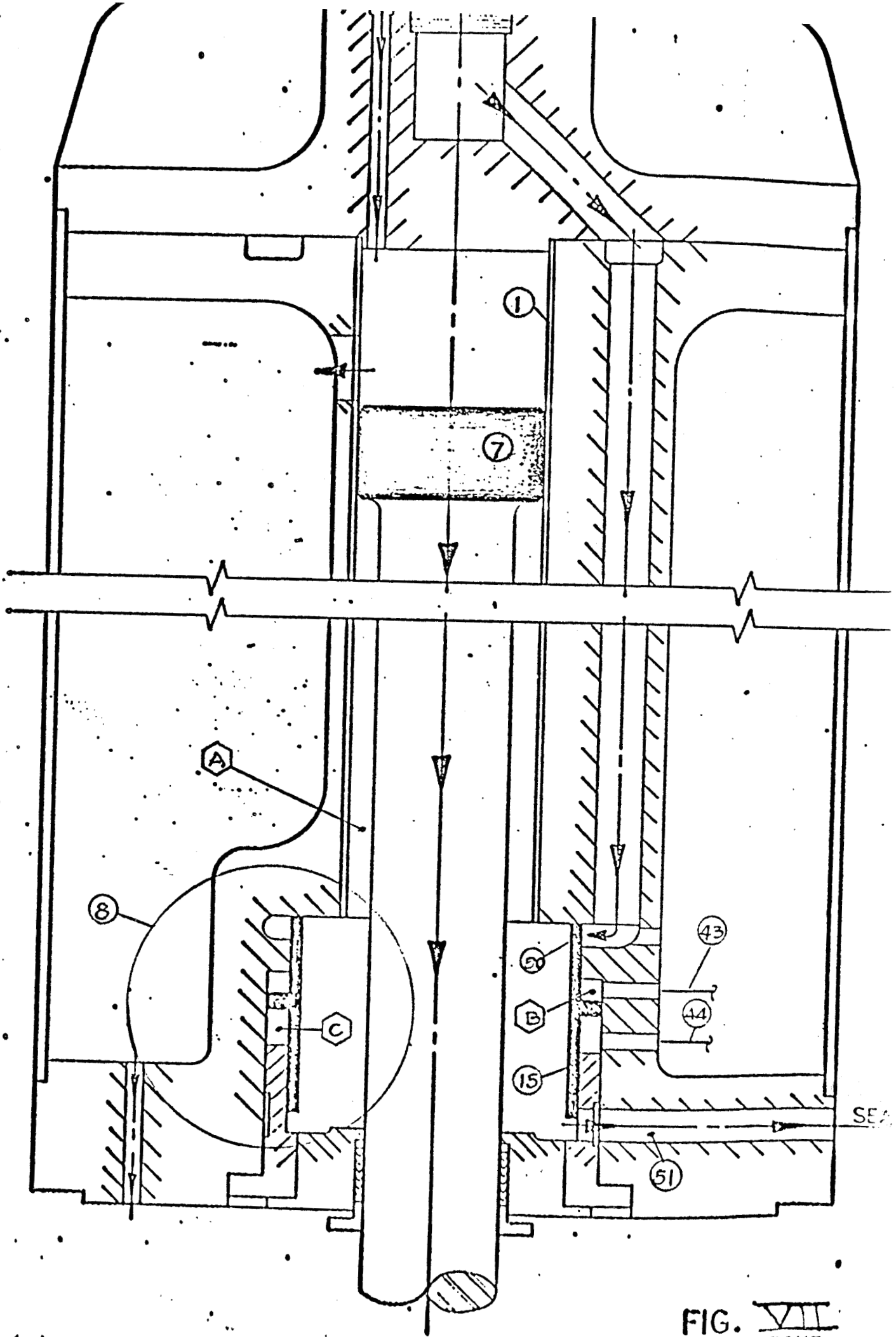


FIG. VII