Feb. 4, 1947. F. MODUGNO 2,415,106

AUTOMATIC CONTROL OF THE CIRCULATING PUMP OF CONDENSERS NORMALLY WORKING WITH NATURAL WATER CIRCULATION FOR PROPELLING APPARATUS

Filed Feb. 8, 1941 4 Sheets-Sheet 1

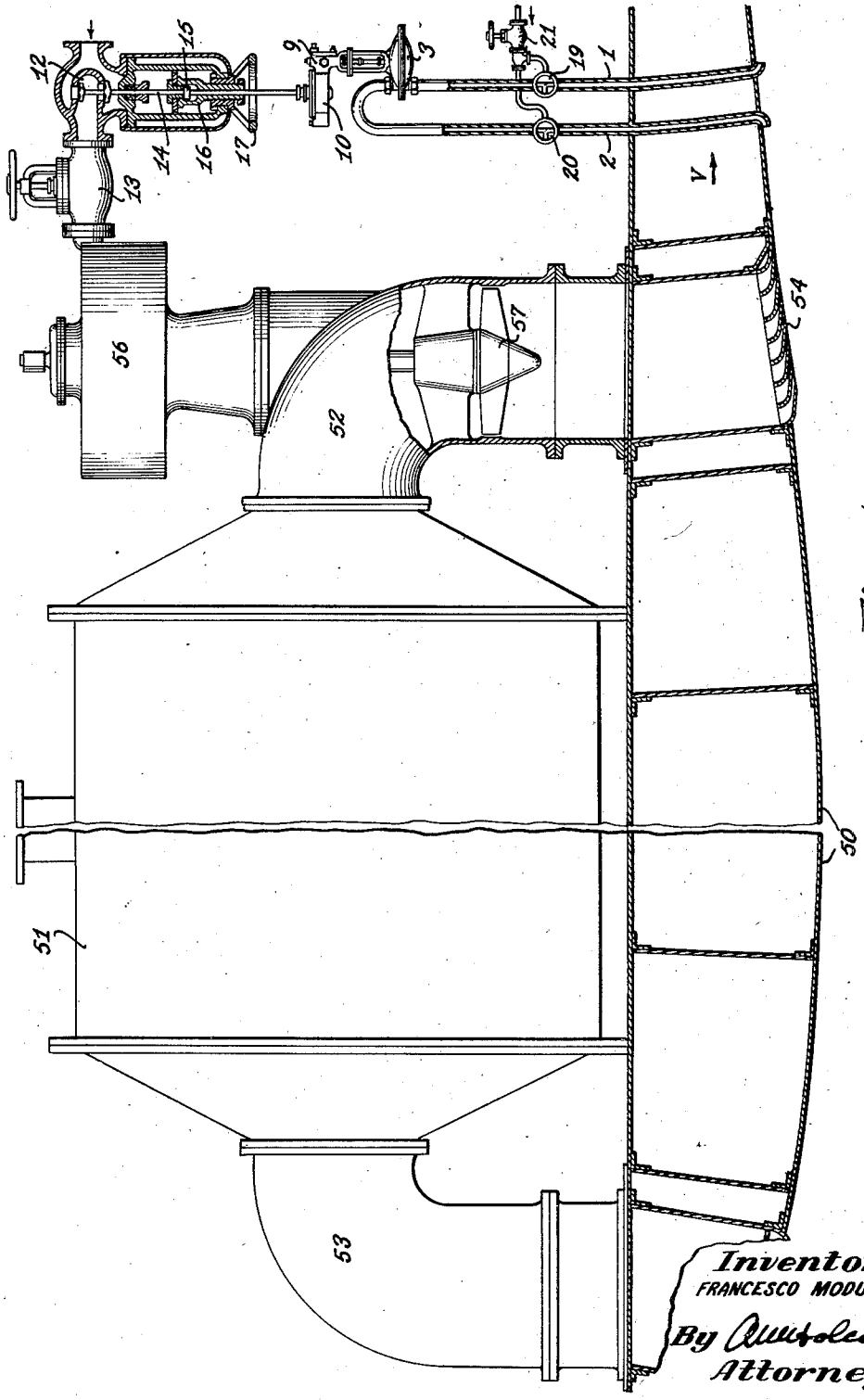


Fig. 1

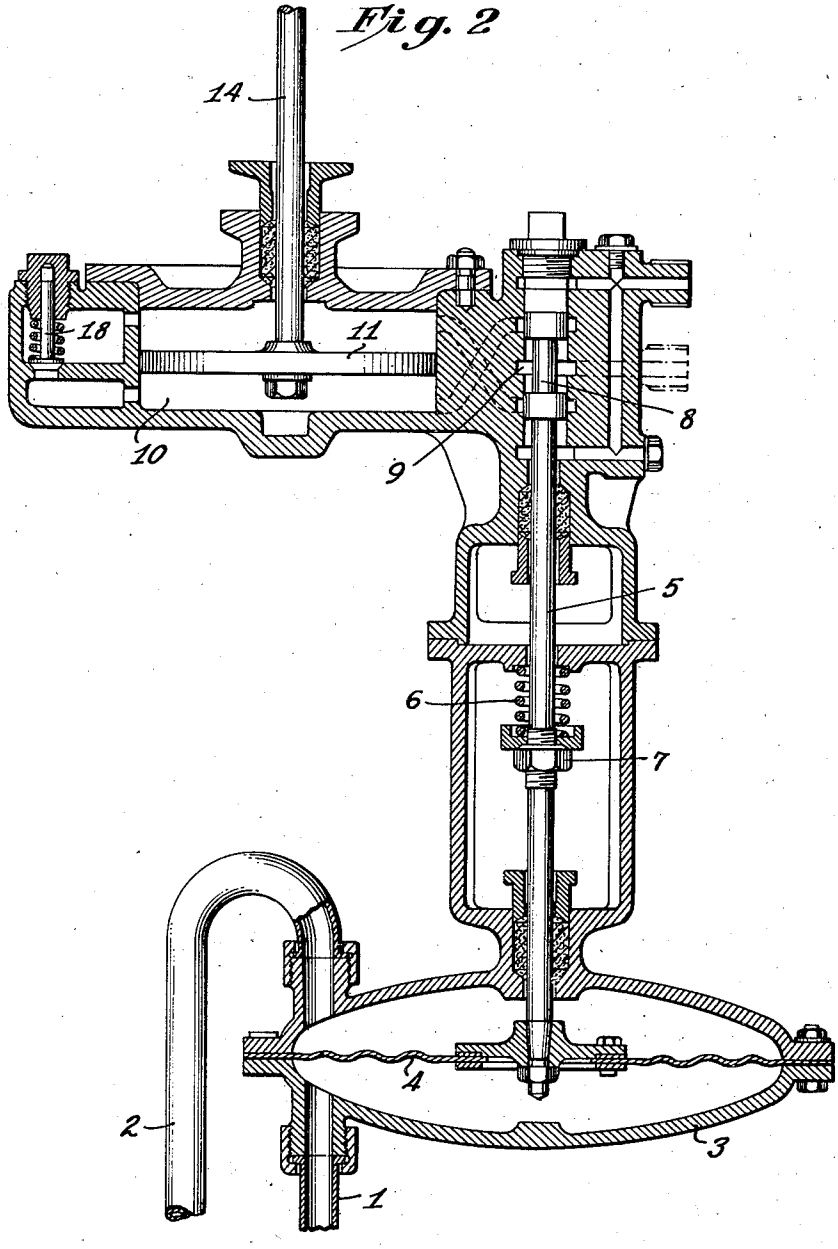
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Filed Feb. 8, 1941 4 Sheets-Sheet 2

Fig. 2



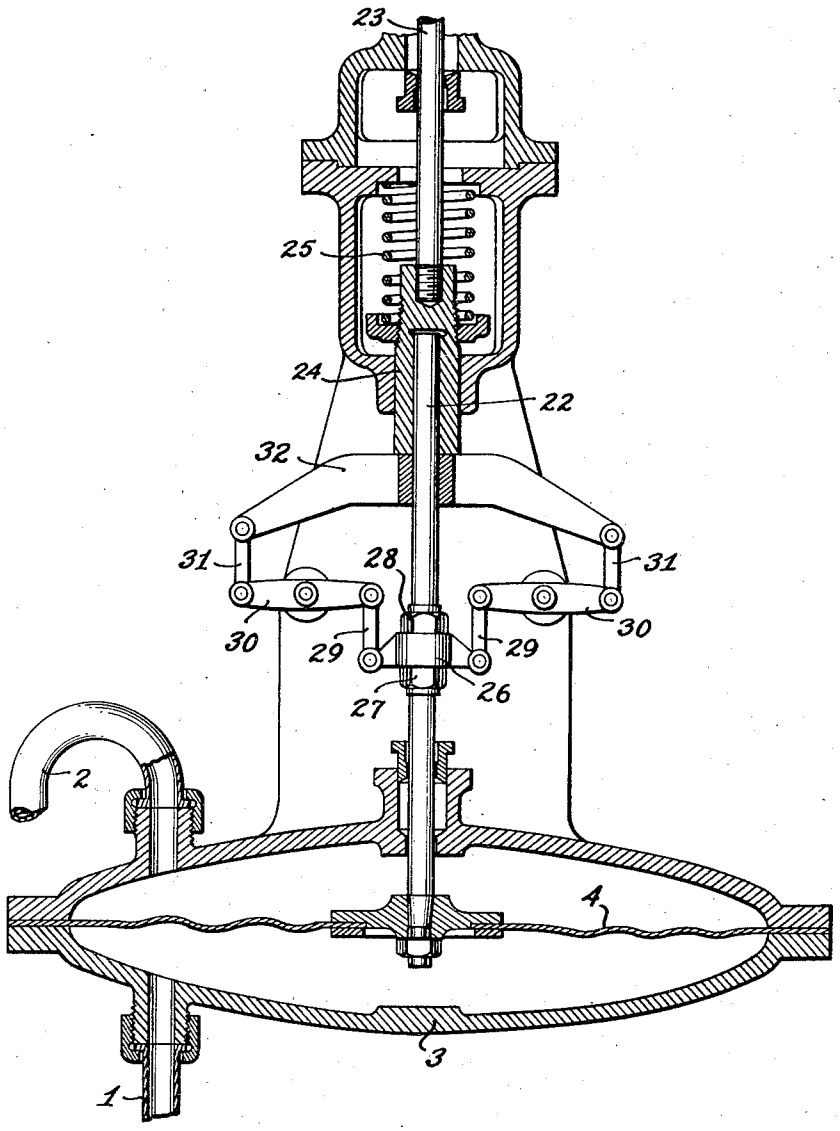
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Filed Feb. 8, 1941 4 Sheets-Sheet 3

Fig. 3



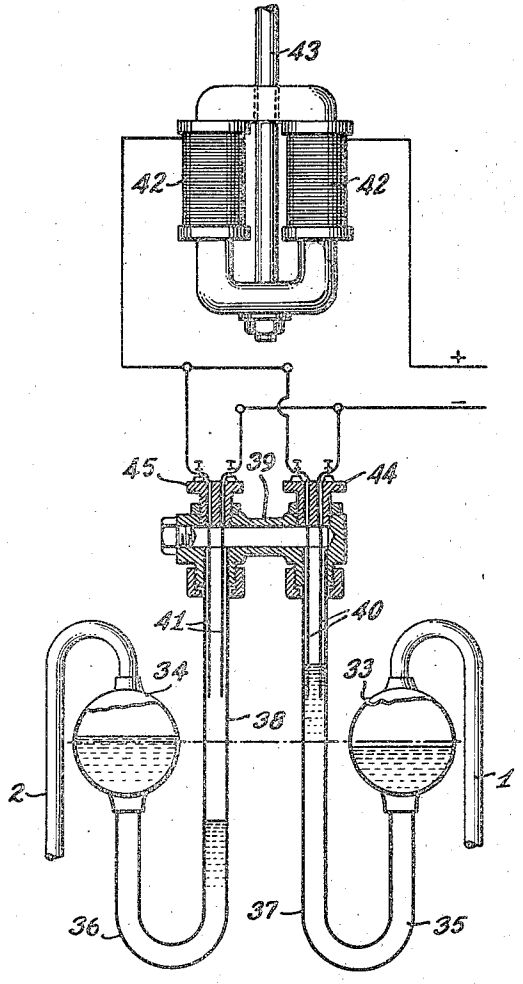
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Fig. 4



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AUTOMATIC CONTROL OF THE CIRCULATING PUMP OF CONDENSERS NORMALLY WORKING WITH NATURAL WATER CIRCULATION FOR PROPELLING APPARATUS

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7 Claims. (Cl. 257—26)

1

In some propelling apparatus of fast ships the circulation of sea-water through the condensers is obtained by means of an inlet and outlet arrangement which is open to the sea, the forward movement of the ship through the water being utilized to circulate sea-water through the condensers with the desired speed and volume.

Upon diminution of the ship's speed the circulation thus obtained diminishes, but may nevertheless be sufficient if the quantity of steam to be condensed decreases concurrently in a considerable degree. However, when it is desired to maintain greater circulation of sea-water through the condenser at low ship speeds, it is necessary to provide for keeping the circulating pump in motion.

It may be necessary in any case to keep the circulation pump in operation when the ship is backed up, and at times when the natural circulation is completely lacking and at the same time the quantity of steam being discharged into the condenser may be great and have a heat content which is increased by the low efficiency of the turbines.

Should abrupt reversing manoeuvres have to be executed during navigation, the engine attendants or watch may easily neglect to immediately put the circulating pump in motion and this may cause trouble.

The object of the present invention is a controlling device automatically furnishing the driving machine of the circulating pump with steam when the natural circulation is lacking or is insufficient, and cutting off the steam when the natural circulation is restored to the desired degree.

According to the invention there is incorporated in the piping leading steam to the driving engine of the pump, a valve responsive to an operating device actuated by flexible calibrated means constantly tending to open the valve, said means being simultaneously subjected to the difference in the hydrodynamic pressures generated within two piezometric tubes whose lower ends open forwardly and rearwardly, respectively, into the water surrounding the ship.

The operation of the control valve for the steam admission to the motor of the pump may take place by means of a direct mechanical connection or through a fluid as for instance the lubricating oil or also electrically by means of an electromagnet.

In the accompanying drawings some preferred forms of realisation of the invention are illustrated by way of example.

2

Figure 1 is a general schematic view of an arrangement according to the present invention, portions thereof being broken away to disclose internal structure; Figure 2 is a transverse section on an enlarged scale of the valve mechanism of Figure 1; Figure 3 is a similar section through another form of valve mechanism; and Figure 4 is schematic view of a further form of valve mechanism wherein the operating means is electromagnetic.

Referring more particularly to the drawings the numeral 50 indicates the curved bottom of a ship. A condenser 51, having inlet and outlet conduits 52 and 53, is disposed within the ship, said conduits penetrating the ship bottom at spaced points. Inlet conduit 52 is provided with scoop 54. Intake conduit 52 also has associated therewith a motor 56 and pump 57 whereby sea-water may be conveyed at certain times through inlet conduit 52, condenser 51 and outlet conduit 53.

According to the example illustrated in the Figures 1 and 2 a casing 3 is subdivided by the corrugated diaphragm 4, into two chambers, the lower one communicating with the sea by means of piezometric tube 1, whose open lower end is directed toward the bow of the ship, and the upper chamber communicating with the sea by means of piezometric tube 2, whose open lower end is directed toward the stern of the ship. The diaphragm upon deformation transmits the movement to the piston 8 of distributor 9 by means of the rod 5 on which the spring 6, the compression of which is regulated by nut 7, also operates.

As oil under pressure derived from the lubrication piping is sent into the cylinder 10 above or beneath the piston 11 by the distributor 9, the oil on the opposite side is discharged through the same distributor.

The piston 11 opens or closes valve 12 of an equilibrated type, which admits the steam into the motor of the circulating pump through regulating valve 13.

Supposing the forward speed of the ship, indicated in the figure by arrow V, to be such as to produce a sufficient natural circulation of the cooling water in the condenser, the pressure within the lower chamber of casing 3 will be greater than that in the upper chamber owing to the direction of the openings of tubes 1 and 2. As a result the corrugated diaphragm will be deflected upwardly, thereby compressing the spring 6 and causing the small piston of the oil distributor to be lifted. The oil under pressure will enter into the lower part of cylinder 10; while the

upper part will be put in communication with the discharge piping, and piston 11 will rise and close valve 12, and thereby obstruct the passage of steam to the circulating pump motor.

Should the ship run ahead or astern at a low speed as is often the case during manoeuvres, the difference of pressure between the two chambers of casing 3 is small and the rod of the oil distributor under the overwhelming action of spring 6, is displaced downwardly, thereby producing the opening of valve 12.

By screwing the nut 7 up more or less, the compression of spring 6 may be varied to determine at what forward or rearward speed of the ship the change from natural to forced circulation of the condenser cooling water will take place.

Rod 14 connecting piston 11 with the obturator of valve 12 has a projection 15 running within sleeve 16. This sleeve, as illustrated, may be displaced upwardly and downwardly by means of handwheel 17. When this sleeve is at the end of its downward stroke it causes the immobilisation of the valve 12 in the open position by means of the projection 15. When it is at the end of the upward stroke the valve is left free so that the valve can respond to actuation as above described.

When valve 12 is immobilised in the open position the steam admission into the circulating pump may be regulated by hand by means of valve 13, not only to permit adjustment of the automatic operation, but to enable manual operation of the valve in the event of failure of the automatic operation through failure of the oil pressure.

Of course in order to open valve 12 by means of the handwheel 17 the passage of the oil from the bottom to the upper part o fthe cylinder 10 must be permitted; this is accomplished by spring valve 18 which opens when the pressure under the piston rises above a determined value.

In the event tubes 1 and 2 become obstructed owing to the introduction of foreign bodies through their sea communication ports, the obstruction may be removed by turning the two three-way cocks 19, 20 at right angles and supplying fresh steam by means of the valve 21. In this position of the valves 19 and 20 communication of the piezometric tubes 1 and 2 with the casing 3 is cut off in order to avoid steam pressure damage to the corrugated diaphragm 4 which is easily deformed.

The described system for the automatic control of the circulating pump allows, in its practical realisation, changes which do not alter its fundamental principle. The casing 3 may for instance be replaced by a cylinder having its piston connected with the small piston of the oil distributor, the two tubes 1 and 2 being connected with the bottom and upper part of the cylinder respectively.

The described device contemplates the normal case that, even through the discharge outlet of the circulating conduit may be directed towards the stern of the ship, the speed of the ship in backing up may never be great enough to reverse the circulation sufficiently to impede the action of the pump, which is not reversible.

There are however special ships designed to travel in both directions, wherein it may be convenient to have a natural circulation for both directions of travel.

In that case it is then necessary to cut off the steam from the motor of the pump when the water naturally circulates through the condenser in either direction.

This result may be obtained in different ways. For example, two solutions may be mentioned, one with a mechanical, the other with an electrical device.

The first solution is illustrated in Fig. 3 of the drawings, wherein 22 actioned by diaphragm 4 is not directly connected to the small piston of the oil distributor, but transmits movement to the latter by means of the rod 23. To the latter sleeve 24, provided with a hole wherein the upper end of the rod 22 slides, is screwed. When the pressure within piezometric tube 1 is greater than that within piezometric tube 2, diaphragm 4 is deformed upwardly and causes rod 22 to be lifted. The upper end of this rod strikes on the bottom of the hole of sleeve 24 and overcoming the resistance of spring 25, causes rod 23 and the small piston of the oil distributor to be also lifted upwardly.

With the rod 22 there is rigidly connected the cross-bar 26 whose position is regulated by means of nuts 27 and 28. The connecting rods 29 have one end connected to the cross bar and their other ends articulated to the inner ends of the swinging levers 30. Connecting rods 31 connect the outer ends of the levers 30 with the cross bar 32 which slides along the rod 22.

When the forward travel of the ship is reversed, the pressure within tube 2 becomes greater than that within tube 1 and diaphragm 4 is deformed downwardly. The diaphragm, by transmitting the motion through the described members, lifts crossbar 32 until it strikes against the lower end of the sleeve 24 whereby the rise of the small piston of the oil distributor is limited as was the case when the diaphragm was deformed upwardly.

The consequence is that when the ship has a sufficient-high speed, in either direction of travel, the small piston of the oil distributor is always displaced upwardly so as to cause the closure of valve 12 shown in Fig. 1.

When the ship is stationary or moves at a low speed, the difference of pressure between tubes 1 and 2 is so small as to be insufficient to compress the spring 25, so that this spring pushes the rod 23 downwardly and the oil under pressure, by operating on the upper part of the piston 11, Fig. 2, causes valve 12, Fig. 1, to be opened so that steam is introduced into the motor of the circulating pump.

As already mentioned the position of crossbar 26 is regulated by means of nuts 27 and 28; this regulation must be made in such a way, that when the diaphragm is neither deformed upwardly, nor downwardly, the play between the end of rod 22 and the bottom of the hole in sleeve 24 is equal to that between crossbar 32 and the lower end of the same sleeve. The weights of rod 22, of crossbar 26, of nuts 27, 28, of connecting bars 29, 31 and of crossbar 32 is to be regulated so that the resulting total weight, which, through rod 22, acts on the diaphragm, is approximately balanced by the normal hydrostatic pressure.

The second solution illustrated in Fig. 4, involving electrical operation, comprising the piezometric tubes 1—2 ending with their lower ends opening in the upper part of the two containers 33 and 34. To these there are joined branches 35—36 of the two U-tubes while the branches 37 and 38 are in communication by means of the crossbar 39. The two U-tubes are filled with

mercury as far as half the height of the two containers; above the mercury, the two branches 37 and 38 and the crossbar 39 are filled with oil.

In the tube branch 37 two small iron rods 40 insulated from each other and fixed to the crossbar depend to within a small distance from the mercury level. Furthermore, in the tube branch 38 the two similar small rods 41 are fixed.

The small rods are electrically connected to the relay 42 as shown in the Figure 4, and the nucleus of the relay transmits the movement to rod 43 of the small piston of the oil distributor.

The operation is as follows.

If the ship moves so as to increase the pressure within tube 1 and to diminish that within tube 2, the mercury level in the container 33 is slightly lowered and is raised slightly in container 34, while within the branches 37, 38 the difference is more substantial. If the speed of the ship is sufficiently high, the mercury in branch 37 achieves contact with the ends of the small iron rods 40 which are in the same branch, and thereby closes the electric circuit. Thus energized the relay pushes the rod 43 upwardly and consequently the small piston of the oil distributor and this, as already explained above, produces closing of the steam valve.

If the ship moves in the opposite direction, the mercury rises within tube 38 and closes the circuit by means of two small iron rods 41 which are in the same tube and closing of the steam valve is thereby produced.

If the ship is stationary or has an insufficient speed, the circuit is not closed and the small piston of the oil distributor, under the action of a spring similar to spring 25 in Fig. 3, remains depressed and keeps valve 12, Fig. 1, open.

The speed of the ship below which steam is supplied to the circulating pump, is regulated by regulating the up screwing of plugs 44, 45 to which the small iron rods are fixed, so that the distance between these and the mercury level, when the pressure is the same in the tubes 1 and 2, may be varied.

The two containers 33 and 34 have been designed with object of obtaining with respect to the tubes 1 and 2, a greater excursion of the mercury level in the branches of tubes 37 and 38.

What I claim is:

1. The combination with a ship condenser having scoop means for circulating cooling water therethrough from the water surrounding the ship, and an auxiliary pump driven by a fluid motor for causing circulation of the water through the condenser, the motor having a source of fluid under pressure with a shut-off valve therein; of operating means for said valve comprising a flexible diaphragm, a casing supportably enclosing the diaphragm and providing spaces at the opposite sides of the diaphragm, piezometric tubes having their upper ends connected with the corresponding spaces and having their lower ends immersed in the water surrounding the ship and opening toward the bow and toward the stern, respectively, of the ship, a rod connected to said diaphragm, spring means balancing the rod and the diaphragm, a fluid pressure distributor having a source of fluid pressure and a chamber to which the source is connected, a distributor head working in said chamber, and operatively connected to said rod, a cylinder, a piston working in the cylinder and having a piston rod operatively connected to said shut-off valve, and conduits connecting said cylinder at opposite sides of the piston with ports opening into said chamber at effectively spaced points with respect to the operative movement of said distributor head, whereby when the speed of the ship is sufficient to pass a predetermined amount of water through the scoop and through the condenser, the diaphragm is sufficiently displaced by pressure of water in the corresponding piezometric tube to cause said distributor head to uncover a corresponding one of the ports while occluding the other so as to permit the piston to be moved by fluid pressure in a direction to close said shut-off valve and stop the flow of fluid pressure to the pump motor.

2. The combination according to claim 1 wherein said operating means comprises a movably supported element connected to said distributor head, a yoke mounted for movement relative to said element and relative to said rod, articulated linkage operatively connecting said rod and said yoke, said linkage being arranged to move said yoke away from said element in one direction of movement of said rod and to move the yoke toward and into engagement with said element and push said element in shut-off valve closing direction when said rod is moved in the opposite direction, whereby a rise in water pressure in the piezometric tubes corresponding to an increase in either forward or astern speed of the ship causes closing of said shut-off valve.

3. The combination with a ship condenser having scoop means for circulating cooling water therethrough from the water surrounding the ship and having an auxiliary pump driven by a fluid motor having a source of fluid pressure with a normally open shut-off valve therein; of operating means for the shut-off valve comprising a pair of piezometric tubes having their lower ends immersed in the water surrounding the ship and directed in forward and aft directions, respectively, a pair of mercury filled U-tubes having the upper ends of one of their legs connected to the upper ends of the piezometric tubes, a pair of insulated electrodes depending within the upper ends of the remaining legs of the U-tubes, a relay and a source of current therefor, said relay comprising a coil connected with said pairs of electrodes and with said source of current so as to be energized whenever either pair of electrodes is bridged, operating means operatively connecting said armature to said cut-off valve so as to close said cut-off valve and cause said auxiliary pump to stop whenever a substantial increase in either forward or astern speed of the ship produces a corresponding reduction in water pressure in one of the piezometric tubes while sufficiently increasing the water pressure in the remaining piezometric tube to elevate the mercury in the corresponding U-tube to bridge the electrodes therein.

4. The combination with a ship condenser having scoop means for circulating cooling water therethrough from the water surrounding the ship and an auxiliary pump driven by a fluid motor to cause the circulation of the water through the condenser while the ship is moving at less than normal speed, and a source of fluid pressure for the motor having a normally opened cut-off valve incorporated therein; of operating means for said cut-off valve, said operating means being responsive to an increase in speed of the ship to close said cut-off valve and place the auxiliary pump out of operation.

5. The combination recited by claim 4 wherein said operating means comprises deformable means, a forwardly directed piezometric tube and

a rearwardly directed piezometric tube for conveying to said deformable means water pressures corresponding to the direction and speed of movement of the ship, whereby a substantial increase in speed in either the forward or astern travel of the ship in the water will effect closing of the cut-off valve resulting in stopping the operation of the auxiliary pump.

6. The combination recited by claim 4 wherein said operating means comprises deformable means, a forwardly directed piezometric tube and a rearwardly directed piezometric tube for conveying to said deformable means water pressures corresponding to the direction and speed of movement of the ship, whereby a substantial increase in speed in either the forward or astern travel of the ship in the water will effect closing of the cut-off valve resulting in stopping the operation of the auxiliary pump, and means for adjusting the deformability of said deformable means.

7. In a device for supplying circulating water to a ship's condenser, the combination of a circulating pump to supply sea water to the condenser when the ship is at rest or moving at less than a predetermined speed; means for supplying sea water to the condenser, when the ship has attained said speed, independently of the pump; and means for cutting off said circulating pump when said speed is attained by the ship, said cut-off means being automatically operative when the ship has attained the predetermined speed.

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