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

Filed Feb. 8, 1941

Serial No. 378,096

4 Sheets-Sheet 1

Fig. 1

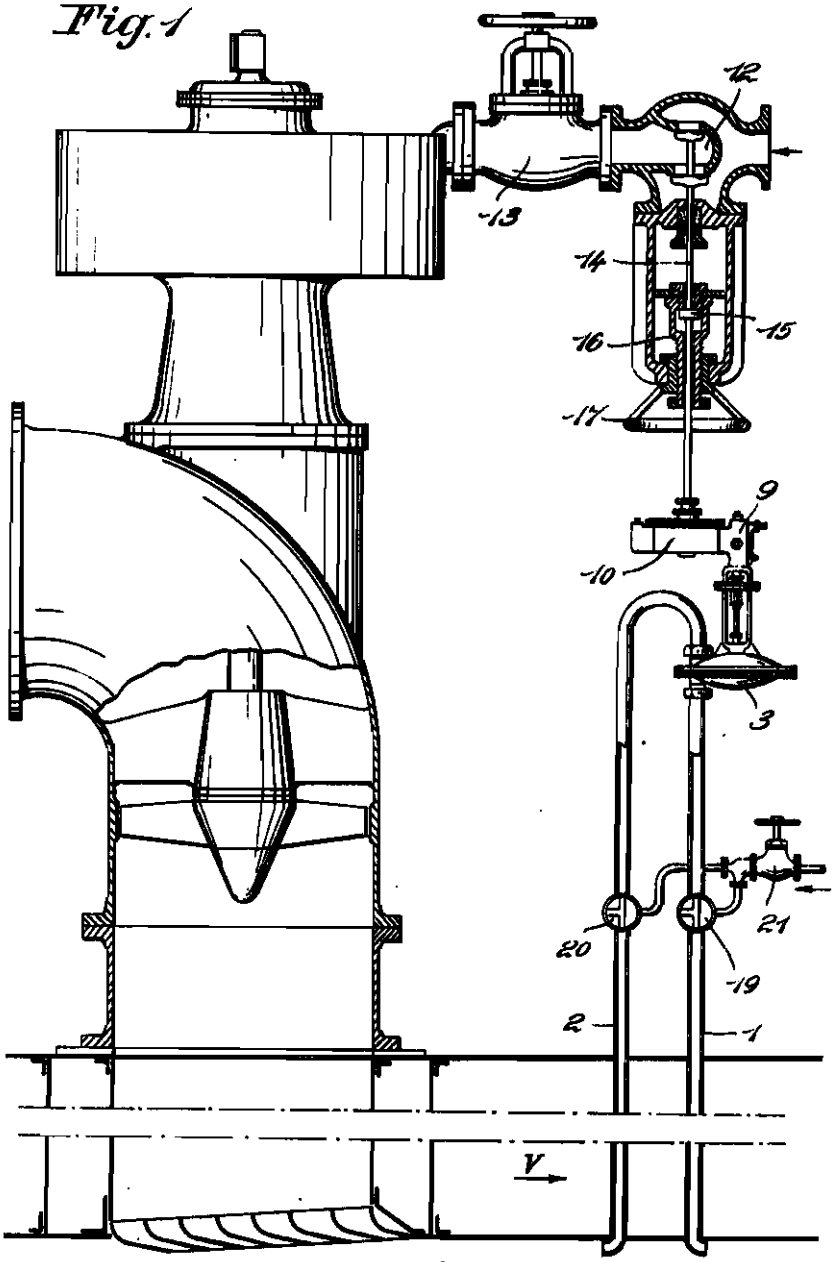


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Fig. 2

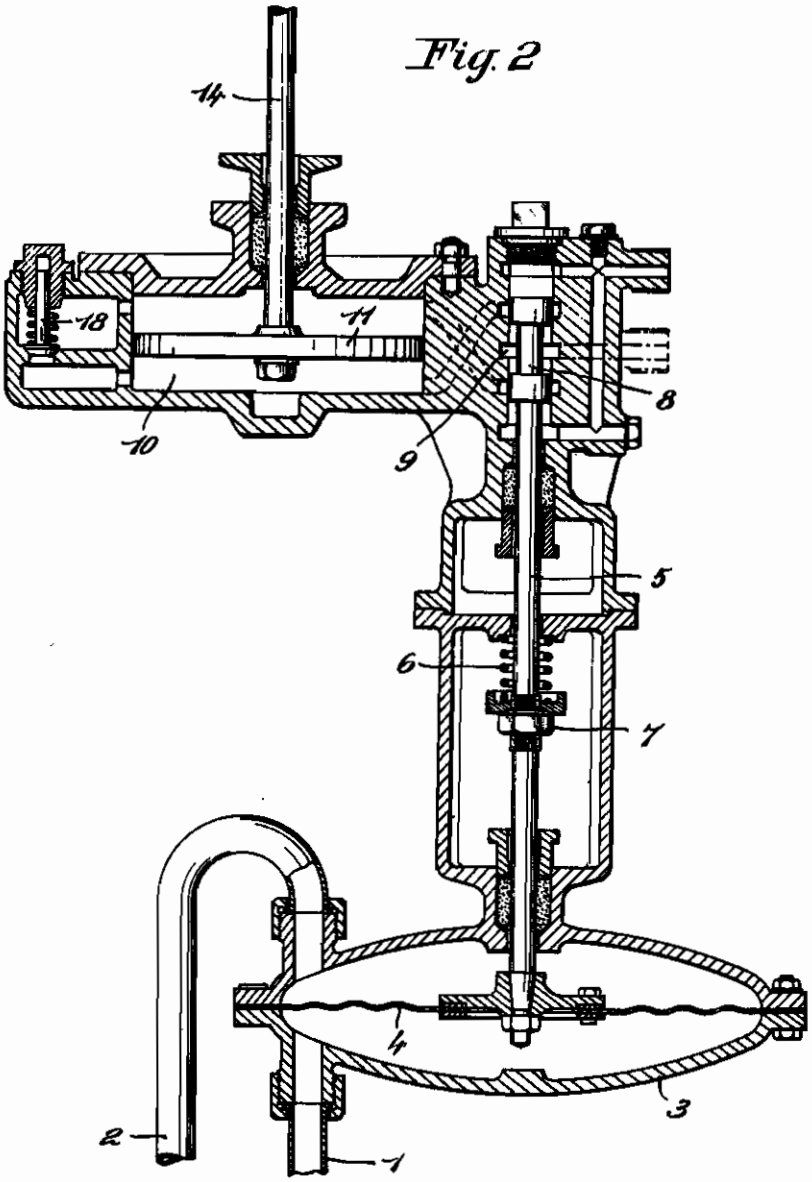


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*Fig. 3*

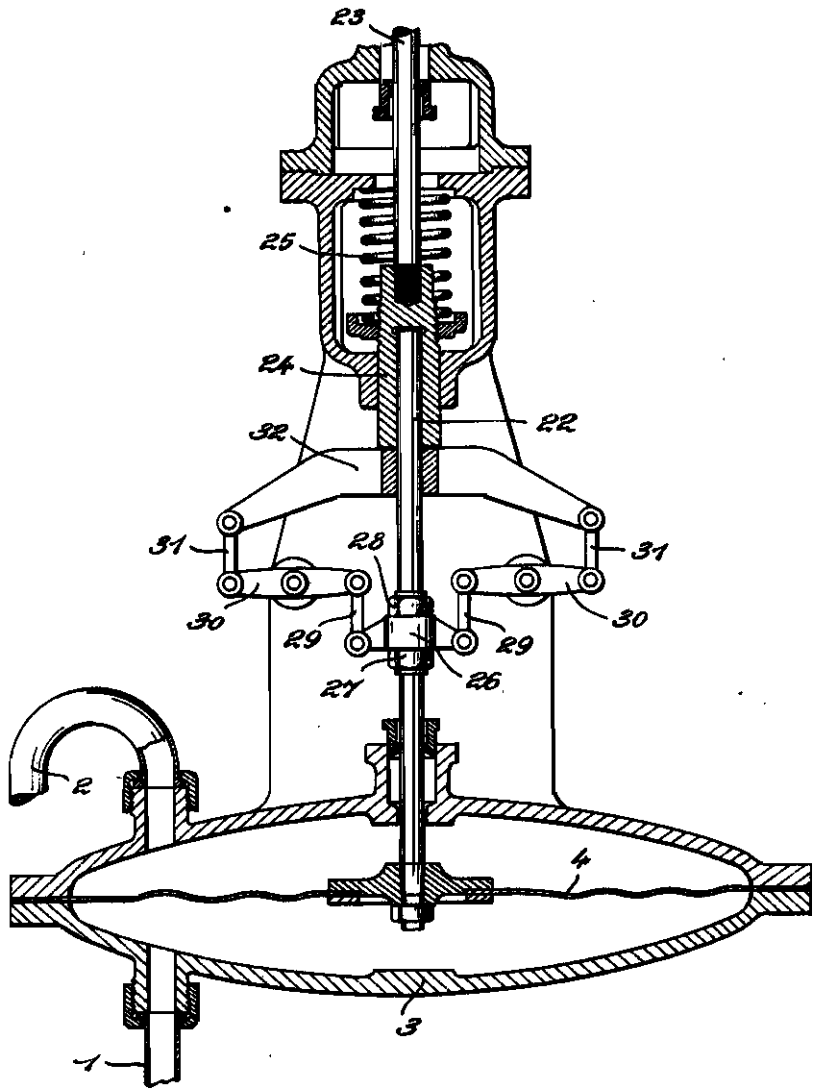


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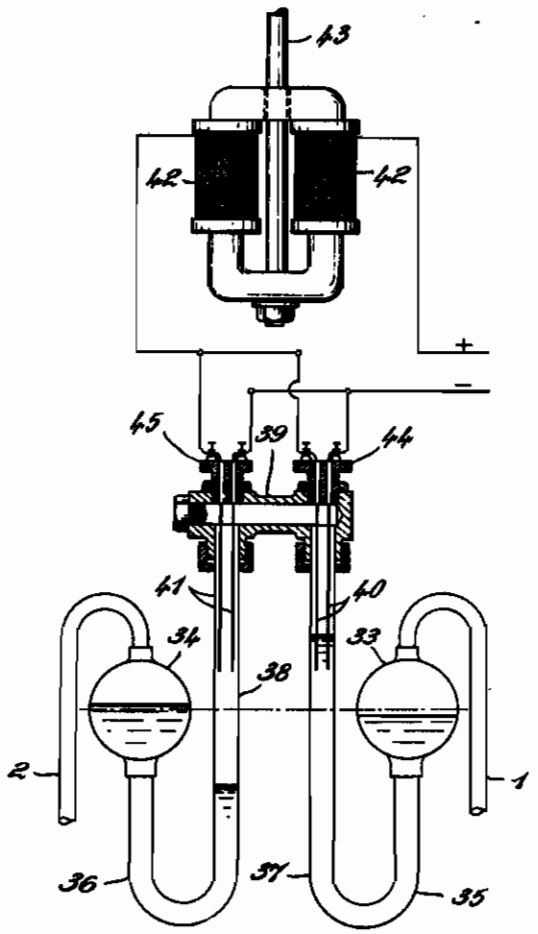
Fig. 4

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# ALIEN PROPERTY CUSTODIAN

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

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In some propelling apparatus of fast ships the water circulation in the condensers is naturally obtained by conveniently shaping the water inlet and outlet openings at sea, so that it is possible to utilise the relative speed of sea-water with respect to the bottom in order to produce the head necessary for circulation.

Upon diminution of the ship's speed there ensues that the natural circulation diminishes remarkably in activity, but said activity may notwithstanding result equally sufficient because the quantity of steam to be condensed decreases contemporarily in a considerable degree. However, should one want to obtain an elevated vacuum in the condenser at low speeds, it may be necessary to keep the circulating pump in motion.

It may be indispensable in any case to keep the circulating pump in function when motion reversing manoeuvres are executed, because there are periods wherein the natural circulation is completely lacking and contemporarily the quantity of steam being discharged into the condenser may be remarkable and have a heat contents 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 inconveniences.

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 insufficient and taking off steam on the other hand when the natural circulation is restored with its necessary activity.

The fundamental feature of the device according to the invention consists in the fact that within the piping for admission of steam to the driving machine of the pump, a valve subjected to an actioning device obeying to flexible calibrated means constantly tending to open the valve, and simultaneously subjected to a moveable body acting in counter sense to said flexible calibrated opening means is inserted and pressed by the difference between the hydrodynamic pressures generated within two piezometric tubes the lower ends whereof are immersed in the same water as the ship and are directed towards the bow and stern of the ship respectively.

Said moveable body may comprise a deformable diaphragm mounted within a watertight casing and dividing the cavity thereof into two chambers respectively in communication with said two piezometric tubes. Said body may be also constituted by a piston running within a watertight cylinder and dividing the cavity thereof into two chambers respectively in communication with said piezometric tubes. The moveable body may also be formed by a mass of oil comprised between two masses of mercury in a watertight piping at the ends of which the piezometric tubes already mentioned terminate.

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 aforementioned lubricating oil or also electrically by means of an electromagnet.

The connection between the moveable body and said actioning device that the valve is subjected to, may in its turn be rigid and in this case the moveable body and the valve move in the same direction, or it may occur by means of a device impressing to the valve control device to move in the same direction as the moveable body or to always move in the same direction whatever may be the direction of the movement of the moveable body. Even in this last case the connection may occur by means of mechanical devices or by means of an electric current in circuits which, by two parallel couples of contacts, are alternately closed by said two masses of mercury.

In the accompanying drawings some preferred forms of realisation of the invention are illustrated by way of explicative and limitative examples.

Fig. 1 shows in a diagrammatic comprehensive view a first example; Fig. 2 shows a detail thereof in axial section; Fig. 3 shows a further example of realisation in an axial, fragmentary section; Fig. 4 shows another example of realisation in a semi-diagrammatic way.

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 tube 1, having an opening directed bowwards, and the upper one communicating with the sea by means of tube 2 having an opening sternwards. 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.

The oil under pressure derived from the lubrication piping is sent into the cylinder 10 above or beneath the piston 11 by the distributor 9

while the oil on the opposite side is discharged through the same distributor.

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

Supposing the ahead speed of the ship, indicated in the figure by arrow V, be such as to produce a sufficient natural circulation of the refrigerating water in the condenser, the pressure within the lower chamber of casing 3 results greater than that in the upper chamber owing to the direction of the openings of tubes 1 and 2 on seawards side: consequently the corrugated diaphragm will be inflected upwards 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 closing valve 12, and thus obstructing 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 downwards producing the opening of valve 12.

By screwing the nut 7 up more or less, the compression of spring 6 is varied and consequently the advancing speed of the ship at which the passage from the natural to the forced speed and vice versa takes place, is controlled.

Rod 14 connecting piston 11 with the obturator of valve 12 has a projection 15 running within sleeve 16. This sleeve, as illustrated in the figure, may be displaced upwards or downwards 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 opening position by means of the projection 15 when it is at the end of the upward stroke on the other hand the valve's movements are left free so that said valve obeys the apparatus for the automatic manoeuvres above mentioned.

When valve 12 is immobilised in the opening position the steam admission into the circulating turbo-pump may be regulated by hand by means of valve 13. The possibility of hand opening valve 12 has been studied not only to permit a modification of the automatic manoeuvre, but also for the case of a strong lowering of pressure in the lubricating piping rendering automatic manoeuvre impossible.

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

In the case of tubes 1 and 2 being obstructed owing to the introduction of foreign bodies through the sea communication ports, the obstruction may be removed by turning of 90° (by a single manoeuvre) the two threeway cocks 19, 20 and supplying fresh steam by means of the valve 21. The interception of the piping branches directed to casing 3, executed through the two cocks, is necessary in order to avoid that the steam pressure should damage corrugated diaphragm 4 which being easily deformed with a limited head, cannot have such a thickness as to resist the steam pressure without inconveniences.

The described system for the automatic control of the circulating pump allows, in its practical realisation, changes which cannot 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 respectively connected with the bottom and upper part of the cylinder.

The described device relates to the normal case that, even when the discharge outlet of the circulating conduit is decidedly directed towards the stern, the speed of the ship in reverse gear may never reach such values as to produce a tendency to reverse the sense of the circulation such as to sensibly impede the action of the pump (which is not reversible).

There are however special ships destined to navigate indifferently in both directions, wherein it may be convenient to have a natural circulation for both directions of motion.

It is then necessary to take off steam from the motor of the pump when the water naturally circulates within the condenser whatever the direction of the motion may be.

This result may be obtained in different ways. As an illustrative (non limitative) example two solutions may be mentioned, one with a mechanical, the other with an electric device.

The first solution is illustrated in Fig. 3.

Rod 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 tube 1 is greater than that within tube 2, diaphragm 4 is deformed upwards 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 upwards.

With the rod 22 there is rigidly connected the cross-bar 26 the position whereof is regulated by means of nuts 27 and 28; the two connecting rods 29 which have the other end articulated to one end of the swinging levers 36, are joined to rod 22; these, by means of the connecting rods 31, cause cross-bar 32, which slides along the rod 22 by running equal strokes but in opposite sense relative to the latter, to be parallelly raised or lowered.

When the advance direction of the ship is reversed, the pressure within tube 2 becomes greater than that within tube 1 and diaphragm 4 is deformed downwards: the diaphragm, by transmitting the motion through the described members, lift crossbar 32 which strikes against the lower end of the sleeve 24 determining the raising of the small piston of the oil distributor as was the case when the diaphragm was deformed upwards.

The consequence is that when the ship has a sufficient-high speed, whatever the advance direction of the same may be, the small piston of the oil distributor is always displaced upwards causing 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 small and it is not sufficient to compress the spring 25, therefor this spring pushes the rod 23 downwards 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 executed in such a way, that when the diaphragm is neither deformed upwards, nor downwards, the play between the end of rod **22** and the bottom of the hole in sleeve **24** results equal to that between crossbar **32** and the lower end of the same sleeve. The weight of rod **22**, of crossbar **26**, of nuts **27**, **28**, of connecting bars **29**, **31** and of crossbar **32** are to be regulated in such a way that the resulting total weight, which, through rod **22**, acts on the diaphragm, be approximately equilibrated by the hydrostatic thrust acting in the medium conditions of immersion of the ship on the surface corresponding to the section of rod **22**.

The second solution (with electric device) is illustrated in Fig. 4.

Piezometric tubes **1**—**2** end with their openings 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 correspondence with the tube branch **37** two small iron rods **40** isolated relatively to each other and penetrating into said branch up to a small distance from the mercury level, are fixed to the cross-bar. Furthermore, in correspondence with 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, and the nucleus of the relay transmits the movement to rod **43** of the small piston of the oil distributor.

The operation of this detail of the apparatus is the following.

If the ship moves in such a way 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** its difference is more sensible. If the speed of the ship is sufficiently high, the mercury in branch **37** achieves contact with the ends of small iron rods **40** which are in the same branch, and closes the electric circuit. The relay by attracting the nucleus pushes the rod **43** upwards and consequently the small piston of the oil distributor and this, also already mentioned above, produces the closure 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 the closure of the steam valve is thus 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 the one indicated with reference number **25** in Fig. 3, remains lowered and keeps valve **12**, Fig. 1, open.

The speed of the ship beneath 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 equal within the tubes **1** and **2**, may be varied.

The two containers **33** and **34** have been designed with object of obtaining, for an equal difference of pressure between the tubes **1** and **2**, a greater excursion of the mercury level in the branches of tube **37** and **38**.

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