April 3, 1934. J. N. KIEP 1,953,486

ENGINE PLANT

Filed July 7, 1931 2 Sheets-Sheet 1

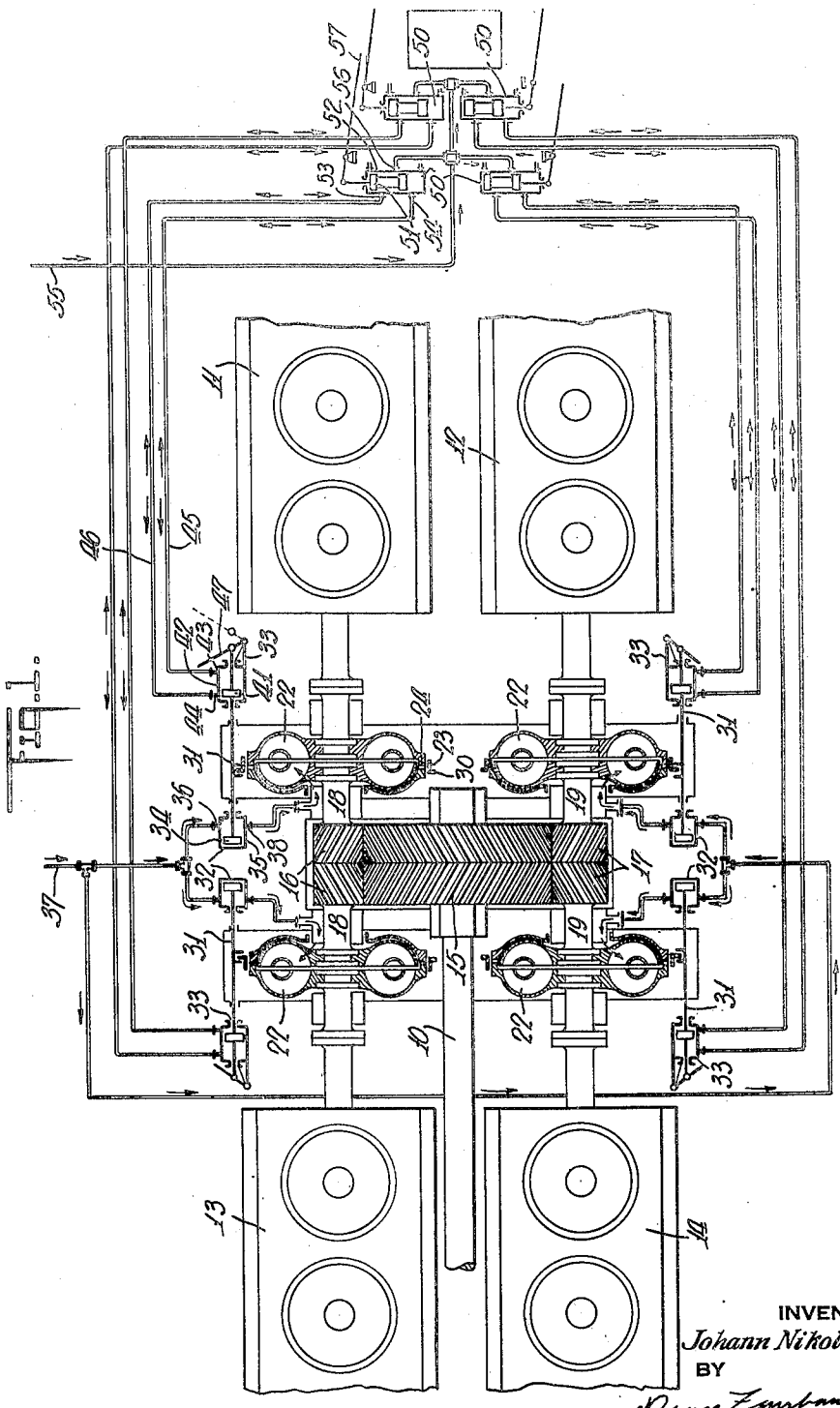


Fig. 1.

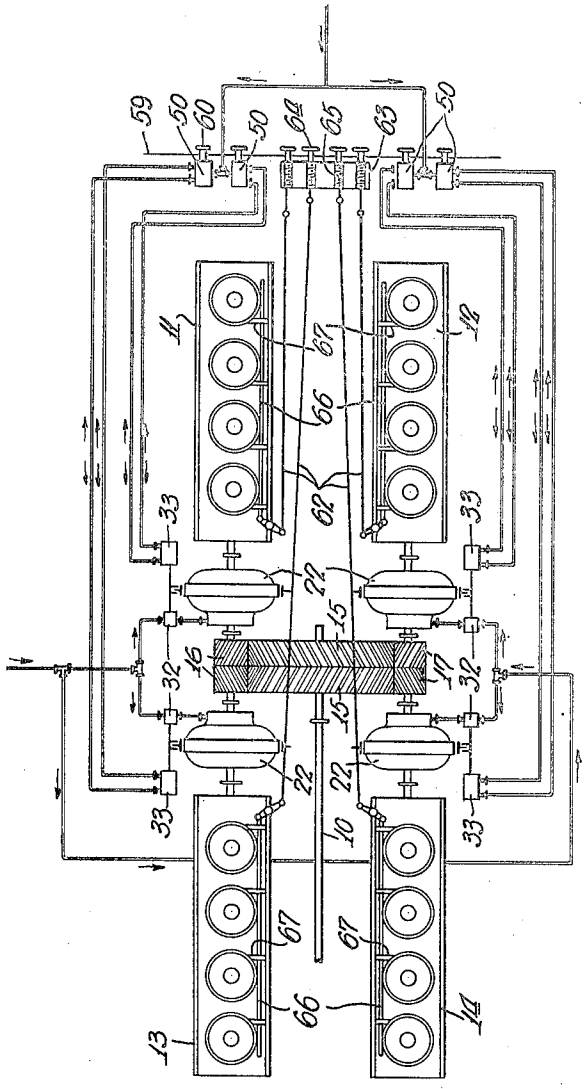
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Fig. 2.



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ENGINE PLANT

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Application July 7, 1931, Serial No. 549,305
In Germany August 27, 1928

3 Claims. (Cl. 60—97)

The present invention is a continuation in part of my copending application for Engine plant, Serial No. 385,640, filed August 13, 1929.

In ship engine plants for operating propeller shafts, the change in direction of rotation of the propeller shaft has heretofore been effected by reversing the prime movers each time such change is to be made. In cases where these prime movers is an oil engine, the reversal of such engine is usually effected by compressed air. When maneuvering ships, as for instance in harbors or around docks or wharfs, or when sailing around buoys, the propeller shaft must frequently be reversed in rapid succession. If several oil engines are in operation, this rapid succession of reversals entails a large consumption of compressed air. Furthermore, the reversing of the oil engines is attended with a great loss of time in as much as these engines must first be stopped and then started up again in the other direction of rotation. Furthermore, the rapid change from hot gases to cold compressed air in the cylinders of the engines frequently causes the formation of cracks in the cylinder walls.

One object of the present invention is to provide a method of operating a ship power plant during maneuvering operations, in which there is eliminated the necessity of reversing the engines for effecting the rapid succession of reversals of the propeller shaft.

Another object of the present invention is to provide a method for maneuvering a ship having a propeller shaft connected to a pair of reversible oil engines by means of gear wheels and liquid couplings, and includes the steps of operating said engines continuously, one in a direction adapted to drive the propeller shaft in one direction, and the other for operating it in opposite direction, during maneuvering operations, the succession of changes in direction of the propeller shafts being effected merely by connecting or disconnecting the coupling associated with each engine, so that the direction of rotation of the propeller shaft may be correspondingly changed without changing the direction of said engines.

Another object of the invention is to provide a power plant for operating a propeller shaft of a ship from a plurality of reversible prime movers, such as oil engines, connected to the propeller shaft by means of gear wheels and liquid couplings, the arrangement being so controlled that any selective group of the engines may be utilized for operating the shaft in one direction, and any selective group of engines utilized for reversing the shaft in the other direction, the arrangement being such as to permit the quick reversal of the shaft by merely filling or discharging the working chamber of the coupling involved.

The arrangement of the present invention is such as to make it possible on the one hand to have the entire capacity of the power plant available for operating the propeller shaft in either direction. Furthermore, during maneuvering operation, it permits reversal in rapid succession inasmuch as it eliminates the necessity for reversing the driving engines. By means of this invention, the amount of compressed air necessary is reduced, and the subjection of the cylinder walls to alternate cold and hot gases is eliminated.

In the specific embodiment of the invention, two or more reversible power oil engines are provided which are connected by means of meshing gear wheels, and liquid couplings to a propeller shaft. These couplings are preferably of the Fottinger type which are rendered operative or inoperative by filling or discharging the working chamber thereof. This type of coupling is shown and broadly claimed in the Fottinger Patent No. 1,199,359, and the ring valve of the general type referred to is shown in Patent No. 1,860,701 to Bauer et al. These engines may be continuously operated in sets during maneuvering so that one set is rotating for driving the propeller shaft in one direction, and the other set operates to rotate the propeller shaft in the other direction. Associated with each of these sets are control means which permit each engine group to be put into and out of operative engagement, by merely controlling the operation of the corresponding coupling. This control also permits the utilization of the entire capacity of the power plant for either direction of rotation of the propeller shaft.

Where it is desired to maneuver with frequent change in the direction of rotation of the propeller shaft, the plant is operated by merely discharging or filling the couplings of one or the other of the engine groups in accordance with the direction desired, without changing the direction of rotation of the engines. The arrangement is also such and is so controlled that if desired, in cases where there are, for instance, four driving engines, all of said engines may be made available for driving in a forward direction, or the four engines may be utilized for reverse operation, or three engines may be utilized for forward operation and only one for return op-

eration, or any other combination of power distribution may be effected. Thus a flexible mode of operation is permitted whereby any group of engines may be used, singly or in combination, in accordance with any selective distribution of power desired.

In the accompanying drawings, there is shown for the purpose of illustration, certain embodiments of the invention, in which

Fig. 1 is a diagrammatic view partly in section of a ship power plant, and

Fig. 2 is a diagrammatic view of a ship power plant similar to that of Fig. 1, but having another form of control for the various units thereof.

In a specific embodiment of the present invention, a propeller shaft 10 is provided which is driven by four prime movers in the form of Diesel engines 11, 12, 13 and 14. Although the invention is herein shown as particularly adapted for the operation of oil engines, it should be understood that as far as the broad aspects of the invention are concerned, it may be adapted for the operation of turbines or other similar prime movers.

For effecting the driving connection between the propeller shaft 10 and the oil engines, said shaft has connected thereto a large gear wheel 15 which meshes with two sets of pinion gear wheels 16 and 17. These pinions 16 and 17 are mounted on shafts 18 and 19 respectively, the ends of which have connected thereto the driven members of couplings 22. These hydraulic couplings 22 are preferably of the Fottinger type shown in prior Patents 1,199,359 and 1,613,154, each of said couplings being adapted to be filled with impelling liquid from a point near the inner periphery of the working chamber thereof, and emptied from a point near the outer periphery of said working chamber. The emptying of these couplings is controlled in any suitable manner, as for instance, by valve means, which in the form shown, includes a ring 23 encircling the coupling and adapted to be moved to cover or uncover discharge passages 24, and operated by control means hereinafter described. The driving members of each of these hydraulic couplings are respectively connected to the crank shafts of the engines 11, 12, 13 and 14.

In order to control the discharge of impelling liquid from the passages 24 of each of the couplings 22, the control ring 23 embracing the outlet of each of said couplings has connected thereto a flange member 30 which is engaged by a pair of fingers extending from a slide rod 31. This rod 31 is connected to valve means, for instance a valve 32, for controlling the flow of impelling fluid into the inlet of the hydraulic coupling 22, and the other end of the rod 31 is provided with a servomotor 33 for actuating the rod.

The valve 32 in the specific form shown, includes a valve plunger 34 connected to one end of the slide rod 31, and slidable in a cylinder 35. One end of this cylinder 35 is provided with an inlet port 36 which is connected to a supply liquid line 37 supplying all of the couplings 22 with impelling liquid. Disposed oppositely of said port 36 is an outlet port 38 connected by a conduit to the inlet of the working chamber of the hydraulic coupling. The valve 32 is so constructed that when disposed in the position shown in Fig. I, the impelling liquid may flow from a supply reservoir (not shown) into the inlet port 36 and out through the outlet port 38 into the interior of its associated coupling 22. When the plunger 34 is disposed at the opposite end of the cylinder 35, the passage of impelling liquid through the cylinder and into its associated coupling is blocked.

In order to control the operation of the control ring 23 and the valve 32, there is provided a fluid actuated servomotor 33 connected to the slide rod 31 on the end opposite the position of the valve 32, and comprising a plunger 41 reciprocably mounted in a cylinder 42 provided with two ports 43 and 44 at opposite ends thereof. These ports 43 and 44 are connected to conduits 45 and 46 respectively, leading from a suitable source of fluid pressure. The valve 32 and servomotor 33 are so interconnected through the agency of the slide rod 31 that the valve 32 is opened to permit the passage of impelling liquid into the working chamber of its associated hydraulic coupling 22, when the control ring 23 is shifted to close the discharge passage. Also, when the plunger of the valve 32 is moved into position in which the passage of impelling liquid into the working chamber of the hydraulic coupling is blocked, the control ring 23 will be shifted into position to permit the escape of impelling liquid from the outlet 24 under the action of centrifugal force. Each of the valves 32 and the associated discharge control ring 23 may be operated by means of a hand lever 47 connected to the rod 31 or an extension thereof. However, it is advantageous to provide means for controlling the operation of the slide valve 31 from a remote point. For that purpose, each of the servomotors 33 is controlled by a remotely disposed valve 50 which, in the specific form shown, comprises a plunger 51 reciprocably mounted in a cylinder 52 having ports 53 and 54 at opposite ends thereof connected to the conduits 46 and 45 respectively. The fluid for actuating the valve 50 is introduced into the cylinder 52 through a pipe 55 connected to a port 56 intermediate of the ends of said cylinder 52, and serving to feed all of the valves 50.

Each of the valves 50 is controlled by a handle or lever 57 connected to the plunger 51, and serving to move the plunger 51 to connect either one of the ports 53 or 54 with the port 56 and the other port 53 or 54 with an exhaust. This valve serves to control the delivery of liquid to either of the ports 43 or 44 of the servomotor 33, thereby operating the plunger 34 of the valve 32, and the corresponding position of the discharge control ring or valve 23. All of these control valves 50 may be mounted adjacent each other so as to render them all accessible to the operator without the necessity of changing his position. Also by means of this control, the selective operation of any engine or engines, singly or in combination, in sets or groups, may be very quickly effected.

In Fig. 2 is shown an arrangement which is similar to that of Fig. 1, but in which the remote control valves 50 are all mounted in a way whereby they may be operated from a single control board 59. For that purpose, the slidable movement of the valve plungers 51 of these valves 50 is obtained through the agency of handles 60 connected to the stems of these plungers. Also, on the same control board, there is provided means for reversing the engines, and for that purpose, each of the reversing valves associated with the oil engines is connected by means of connecting members 62 to a control unit 63, said connecting members being operated by means of hand wheels 64 and suitable screw members 65. These con-

necting members 62 serve to adjust the cam shafts 66 or time cams 67 mounted thereon thereby serving to control the direction of rotation of the engines. The engine reversing means is only diagrammatically illustrated as any mechanism used in the art for that purpose may be employed.

In the ordinary course of operation, all of the four engines 11, 12, 13 and 14 may be operated to rotate the propeller shaft in one direction, thereby utilizing the full capacity of the power plant. When it is desired to reverse frequently, one or more of the engines is reversed so that one group is adapted to drive the propeller shaft in one direction, and the other group is adapted to drive said shaft in the opposite direction.

By effecting the connection through liquid couplings of the Fottinger type, there is no mechanical engagement of the driving and driven parts of the coupling, and the liquid may be let in while an engine is going at full speed in one direction, and the propeller is going in the opposite direction. The liquid will exert a powerful braking action to stop the propeller, and the same influence will continue to act to start the propeller going in the opposite direction, and bring it up to speed.

When two or more engines are disconnected and are to be connected, then associated couplings may be filled in succession so that as the propeller increases in speed, successive increments of power are brought into operation. As far as the broad aspects of the invention are concerned, this novel mode of operation may be effected merely through the agency of two engines such as 11 and 12 or 13 and 14 connected as shown to the propeller shaft 10. If it is desired to utilize the minimum amount of power during maneuvering operations, either set 13 and 14 or 11 and 12 may be shut down entirely while the other group is operating. If the group 11 and 12 alone is operating during maneuvering operation, the engine 11 would be rotated in one direction and the engine 12 in the opposite direction, and either one of the hydraulic couplings 22 associated therewith may be operative or inoperative, in accordance with the desired direction of the propeller shaft. Under these conditions, if it is desired to instantly reverse the direction of the propeller shaft, all that is necessary is to empty the operating hydraulic coupling by the operation of the control valves already described, and fill the hydraulic coupling which is empty, thereby obtaining the instant reversal of the propeller shaft 10. If it is desired to utilize all of the engines during maneuvering operations, the engines 11 and 13, for instance, may be made to run continuously in one direction while the engines 12 and 14 are made to rotate in the opposite direction. Instead of grouping the engines 11 and 13, and 12 and 14 into sets as described, any other engine combination may be provided. For instance, engines 11 and 12 may be grouped together for cooperative rotation in one direction, and engines 13 and 14 grouped together for cooperative rotation in the other direction, or if desired, three engines may be grouped together for propeller shaft rotation in one direction, and the fourth operated for reverse rotation.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An apparatus for controlling the operation of the propeller shaft in a ship power plant, which plant includes a pair of oil engines, one adapted to operate in one direction and the other in the opposite direction, a gear mounted on said propeller shaft, pinions meshing with said gear, and connection means for connecting said pinions to or disconnecting them from the crank shafts of said engines, said apparatus including a pair of hydraulic couplings of the Fottinger type and serving as said connecting means, a pair of valves for each coupling, one controlling the admission of impelling liquid thereto and the other controlling the discharge of impelling liquid therefrom, separate hydraulic means for operating each pair of valves, and a pair of operating members disposed adjacent to each other and remote from said valves of both couplings for controlling the operation of all of said valves, whereby either coupling may be filled and the other emptied, and whereby said shaft may be driven in either direction or its direction of rotation reversed without reversing said engines or varying their speed.

2. An apparatus for controlling the operation of the propeller shaft in a ship power plant, which plant includes a pair of oil engines, one adapted to operate in one direction and the other in the opposite direction, a gear mounted on said propeller shaft, pinions meshing with said gear, and connection means for connecting said pinions to or disconnecting them from the crank shafts of said engine, said apparatus including a pair of hydraulic couplings of the Fottinger type and serving as said connecting means, a pair of valves for each coupling, one controlling the admission of impelling liquid thereto and the other controlling the discharge of impelling liquid therefrom, a pair of servomotors, one adjacent to each coupling, and each having a member mechanically connected to both of said valves of the corresponding coupling, and a pair of operating members disposed adjacent to each other and remote from said servomotors for controlling the operation of both servomotors and thereby operating all of said valves, whereby either coupling may be filled and the other emptied, and whereby said shaft may be driven in either direction or its direction of rotation reversed without reversing said engines or varying their speed.

3. An apparatus for controlling the operation of the propeller shaft in a ship power plant, which plant includes a pair of oil engines, one adapted to operate in one direction and the other in the opposite direction, a gear mounted on said propeller shaft, pinions meshing with said gear, and connection means for connecting said pinions to or disconnecting them from the crank shafts of said engines, said apparatus including a pair of hydraulic couplings of the Fottinger type and serving as said connecting means, a pair of valves for each coupling, one controlling the admission of impelling liquid thereto and the other controlling the discharge of impelling liquid therefrom, separate means for operating each pair of valves to substantially open one and close the other of the pair, and operating members disposed remote from said valves of both couplings for controlling the operation of all of said valves, whereby either coupling may be filled and the other emptied, and whereby said shaft may be driven in either direction or its direction of rotation reversed without reversing said engines or varying their speed.

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