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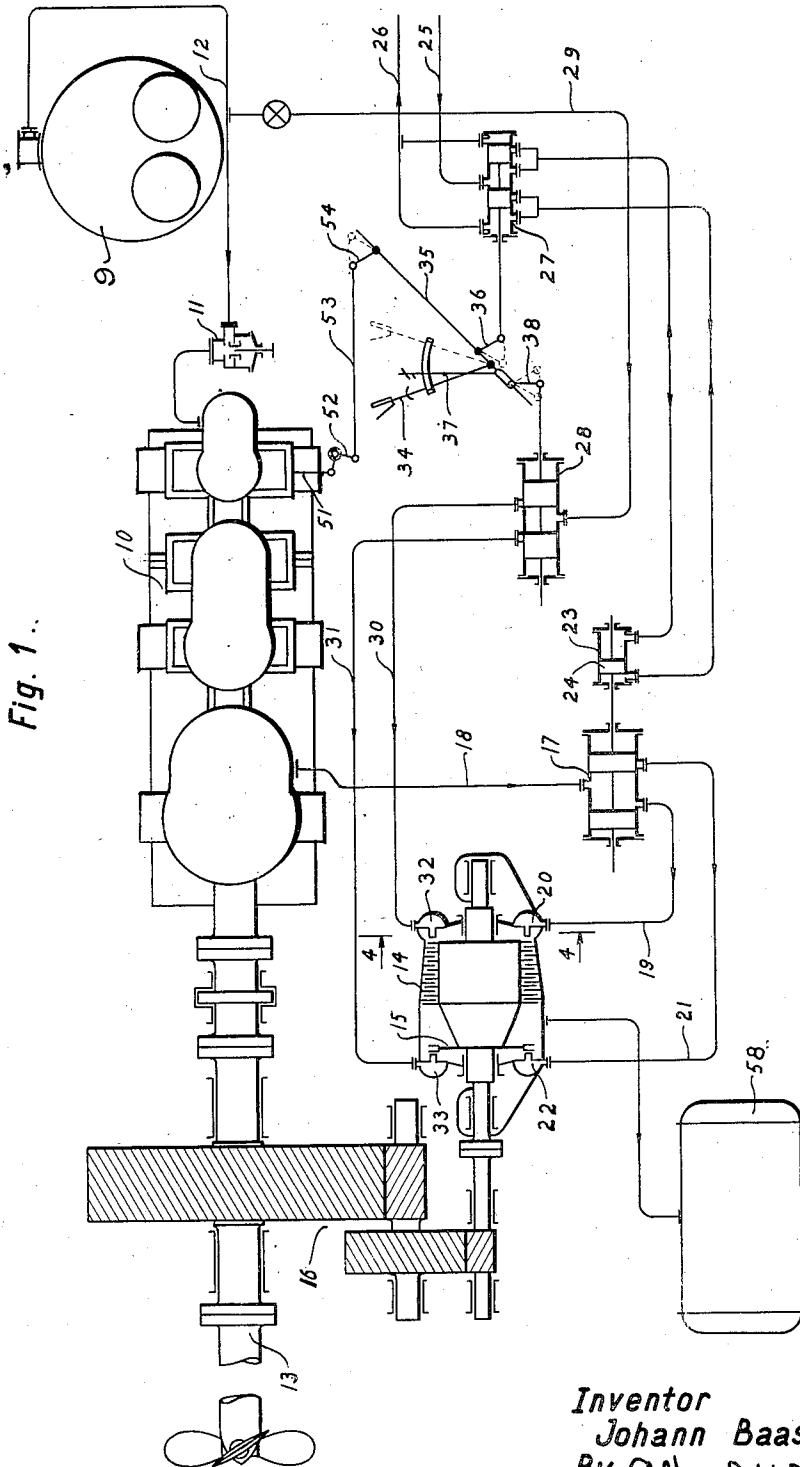
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2,006,337

SHIP PROPULSION SYSTEM

Filed Feb. 2, 1929

3 Sheets-Sheet 1



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Fig. 2.

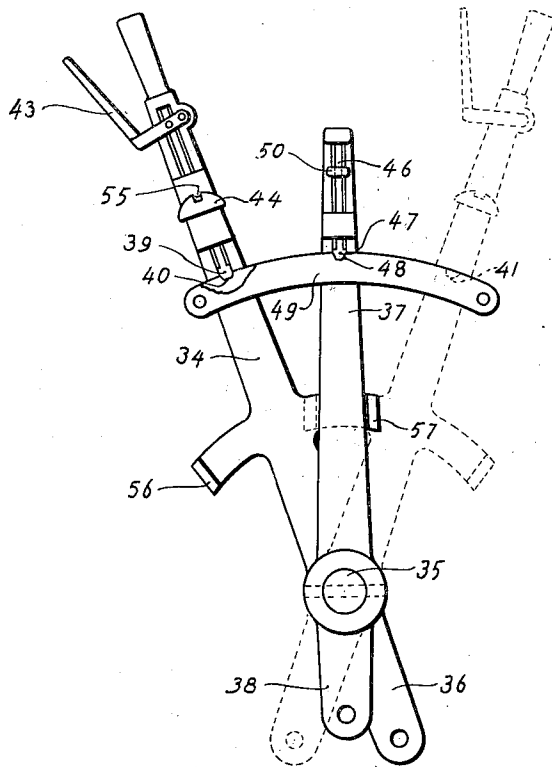


Fig. 3.

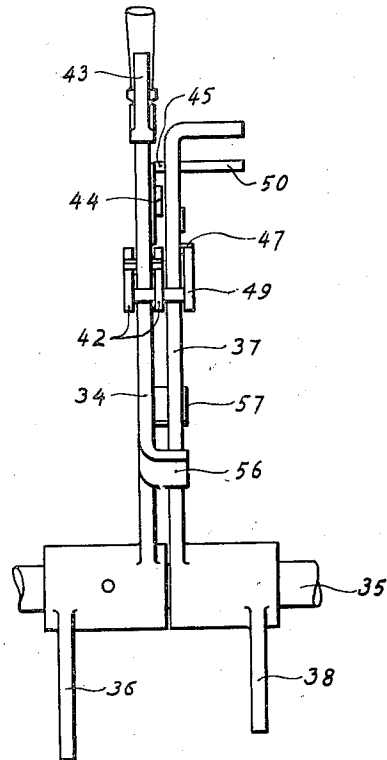
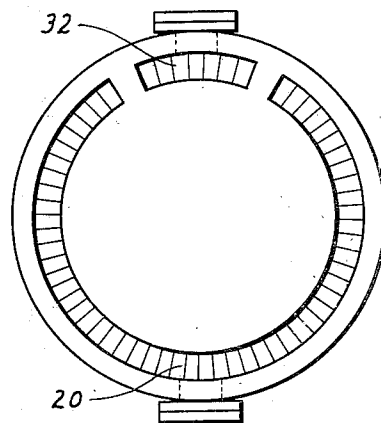


Fig. 4.



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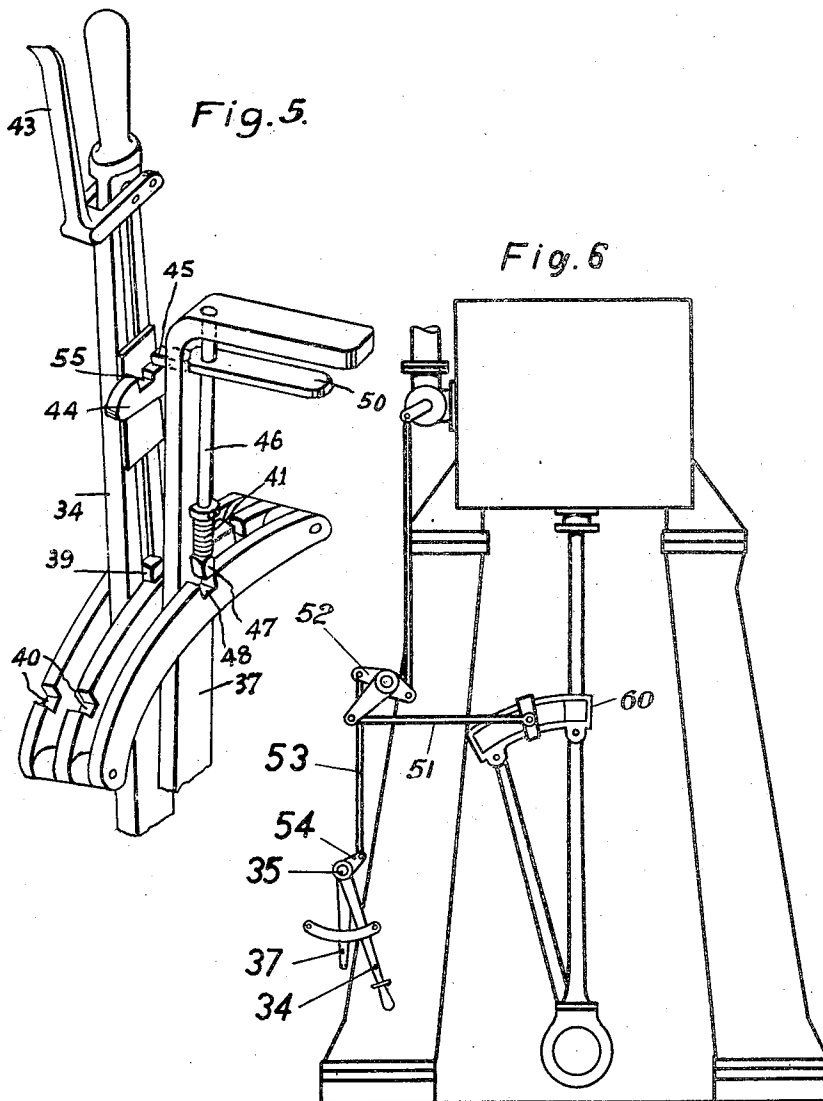
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SHIP PROPULSION SYSTEM

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3 Sheets-Sheet 3



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2,006,337

SHIP PROPULSION SYSTEM

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4 Claims. (Cl. 60—21)

This invention relates to improvements in ship propulsion systems.

One of the objects of the present invention is to provide an improved ship propulsion system comprising a reciprocating engine and steam turbine apparatus connected to a propeller shaft, the arrangement and manner of operation being such as to provide for more rapid reversal of the engine and turbine apparatus than has been possible in the various systems used heretofore.

Other objects and advantages will hereinafter appear.

For the purpose of illustrating the invention, one embodiment thereof is shown in the drawings, wherein

Figure 1 is a diagrammatic layout of a ship propulsion system embodying the present improvements;

Fig. 2 is an enlarged elevational view, partly broken away, of the control levers;

Fig. 3 is an elevational view, looking toward the right in Fig. 2;

Fig. 4 is an enlarged sectional view, the section being taken on the line 4—4 in Fig. 1;

Fig. 5 is an enlarged, detail perspective view of the manually-operated control levers in Fig. 1; and

Fig. 6 is a simplified, elevational view of a practical arrangement of certain of the control apparatus in Fig. 1.

In carrying out my invention, a reversible reciprocating steam engine is connected directly to the propeller shaft in a ship propulsion system. A high-speed, exhaust-steam, forward turbine is connected through reduction gearing to the propeller shaft. During operation at the normal forward speed the engine, which is the main prime mover, develops a preponderance of the total developed power, and the forward turbine is connected in series with the engine to improve the economy at this speed. The forward turbine is provided with first and second nozzle groups for supplying steam to the first rotor stage thereof. During forward operation, only exhaust steam from the engine is fed to the forward turbine thorough the second nozzle group.

In reversing the system from forward to reverse operation, the exhaust-steam supply from the engine to the turbine is cut off, but the driving connections between the propeller shaft and the engine and the rapidly rotating rotor of the forward turbine are maintained. To make this feasible, and still effect the reversal in a very

short time regardless of the fact that the kinetic energy of the rapidly rotating turbine rotor may be as much as twenty to thirty times that of the reciprocating engine plus the propeller shaft, together with the fact that the largest gear in the reduction gear train between the turbine rotor and the propeller shaft is fixed on the latter, a high-speed braking or reverse turbine is supplied and also connected to the propeller shaft through the same gear train. At the time the exhaust-steam supply is cut off from the forward turbine, live steam is supplied to the reverse turbine, which is then effective, with the reciprocating engine, to brake or retard the rapidly rotating rotor of the forward turbine from maximum to zero and to reaccelerate this rotor to normal, full-speed in the reverse direction, all of which the engine could not do alone in the time available. When normal or full-speed is reached in the reverse direction, at which time the reciprocating engine is supplying substantially all or at least a preponderance of the total developed power, the live steam supply to the braking turbine is cut off.

In reversing the system from reverse to forward operation, the driving connections between the propeller shaft and the engine and the rapidly rotating turbine rotors are maintained, as before. To make this feasible also, and still effect the reversal in a very short time, live steam is supplied to the forward turbine through the first nozzle group thereof, and the exhaust steam from the reciprocating engine is substantially simultaneously supplied again to the forward turbine through the second nozzle group thereof. The forward turbine is then effective, with the reciprocating engine, to brake or retard the rapidly rotating rotors from maximum to zero and to reaccelerate the rotors to normal, full-speed in the forward direction, all of which the engine could not do alone in the time available. When normal or full-speed is reached in the forward direction, the live steam supply to the first nozzle group of the forward turbine is cut off.

With reference now, more particularly, to Fig. 1, a steam engine 10 of the usual reciprocating type is supplied, through a suitable valve 11, with operating steam from connection 12, a source of steam supply such as a boiler 9 and drives a propeller shaft 13.

The turbines 14 and 15, shown as being mounted on the same shaft, are connected to the propeller shaft through the reduction gear unit, in-

indicated generally by reference numeral 16. Turbine 14 operates with engine 10 to drive the propeller shaft during forward operation, while turbine 15 operates with the engine during reverse operation of the plant.

The valve unit 17, which may be of any suitable construction, operates when in its left-hand position, as shown, to provide communication between connection 18, leading to the exhaust side of engine 10, and connection 19 leading to the nozzle group 20 of forward turbine 14. When valve 17 is in its right-hand position, such communication is cut off, and communication established between connection 18 and connection 21 leading to the nozzle group 22 of reverse turbine 15. Valve 17 is operated by a servo motor 23 having the piston 24, and which is connected with the fluid-pressure supply line 25 and the exhaust line 26 by the valve means which may be of any suitable construction, and which is indicated generally by reference numeral 27.

The arrangement is such that when valve 27 is moved to its right-hand position, as shown, communication is established between supply line 25 and the right side of piston 24, and between exhaust line 26 and the left side of the piston. Upon reversal of valve 27 to its left-hand position, pressure conditions on opposite sides of piston 24 are reversed, as will be apparent, the servo motor 23 then operating to move valve 17 to its right-hand position.

The valve means 28, which may be of any suitable construction, provides for communication between connection 29 leading to supply line 12, and either of the connections 30 or 31 leading respectively to nozzle group 32 of turbine 14 and nozzle group 33 of turbine 15. Valve 28 is shown as being in its central position, whereat the same cuts off both nozzle groups 32 and 33 from the supply. Movement of valve 28 to its right-hand position provides communication between nozzle group 32 and supply line 12, while movement of this valve to its left-hand position provides communication between nozzle group 33 and the supply line.

Valve 27 is actuated by the control lever 34 fixed on shaft 35 supported for rotary movement about its longitudinal axis and to which is fixed a crank arm 36 providing an operating connection with valve 27. A lever 37 is loosely mounted on shaft 35 for pivotal movement independently of lever 34, as more clearly shown in Fig. 3, and is provided with the depending crank arm 38 providing an operating connection with valve 28.

Lever 34 is provided with the latch 39 arranged to enter the recesses 40 and 41 in the spaced guide members 42 for the purpose of locking the lever in either of its extreme positions, the latch being moved upwardly out of interlocking engagement with members 42 by means of a suitable element 43 arranged and connected as more clearly shown in Fig. 2. A cam element 44 is carried by lever 34 and arranged to engage the extended end portion 45 of a latch 46 carried by lever 37 and operable to lock the latter in its vertical central position by engagement of its lower end portion 47 in a recess 48 in the upper edge of guide member 49. The latch 46 is provided with the extended portion 50 to permit of manual release of the same.

The reversing gear 60 of engine 10, which may be of usual construction, such as, for example, is shown in Patent No. 1,008,532 to Curtis et al.,

is actuated upon rotary movement of shaft 35 through rod 51, bell crank 52, connecting rod 53 and crank arm 54 fixed on shaft 35.

In Fig. 1, the various parts comprising the control mechanism of the power plant are shown as being in position for forward operation. That is, lever 34 is shown in its left-hand position whereat crank arm 54 is in position to hold the valve gear of engine 10 in position for forward operation thereof, the valve 27 being in its right-hand position to effect communication between connection 18 from the exhaust side of engine 10 and nozzle group 20 of forward turbine 14. At this time, lever 37 is in its vertical central position to place valve 28 in its central position and cut off communication between nozzle groups 32 and 33 and supply line 12.

If it is desired to reverse the rotation of propeller shaft 13, lever 34 is moved from its left-hand to its right-hand position, during which movement cam element 44 engages latch portion 45, as shown in Fig. 5, to effect upward releasing movement of latch 46, after which latch portion 45 drops into the recess 55 in the cam element to lock lever 37 to lever 34 for movement with the latter to the right-hand position. The depth of recess 55 is such as to prevent downward movement of latch 46 by such amount as would permit of latching engagement of the lower end portion 47 of the latch with recess 48. Such movement of lever 37 to its right-hand position effects left-hand movement of valve 28 to establish communication between supply line 12 and connection 31 leading to nozzle group 33 of reverse turbine 15. The reverse turbine 15 thus being supplied with live steam through nozzle group 33, provides for a relatively strong braking action on the rotor of the turbine apparatus, causing the same to reverse its direction of rotation in a period of time substantially shorter than has been possible heretofore and equal substantially to the period of time required for reversal of engine 10. Upon completion of the reversing operation, latch 46 is released by means of latch portion 50 and lever 37 returned to and locked in its vertical central position to cut off communication of nozzle group 33 with supply line 12. Reverse turbine 15 will then be supplied only with exhaust steam from engine 10.

Changing over from reverse to forward operation, the action is the same, that is, upon movement of lever 34 from its right-hand to its left-hand position, the same picks up lever 37 and moves the same from its vertical central position to the left-hand position, thereby effecting communication between supply line 12 and nozzle group 32 of the forward turbine 14. The live steam then supplied to nozzle group 32 operates to effect reversal of the turbine rotor in a period of time substantially less than has been possible heretofore, and equal substantially to the period of time required for reversal of engine 10. After such actuation of the various control parts has been completed to again provide for forward operation, latch 46 is manually released by means of latch portion 50 and lever 37 returned to and latched in its vertical central position to cut off communication between supply line 12 and nozzle group 32. At this time forward turbine 14 is then supplied only with exhaust steam from engine 10.

Lever 34 is provided with the lugs 56 and 57 in the path of movement of lever 37 and arranged as shown to prevent inadvertent movement of lever 37 to such position as would establish communication between supply line 12 and the tur-

bine which is not operating at the time. In this connection, and referring more particularly to Fig. 2, it will be seen that lug 57 locks lever 37 against movement to its right-hand position to effect supply of live steam to reverse turbine 15, lever 34 being in its left-hand position for forward operation of engine 10 and the supply of exhaust steam from the engine to forward turbine 14.

The turbines 14 and 15 exhaust into a common condenser 58 of suitable construction.

From the foregoing, it will be seen that an improved ship propulsion system has been provided wherein more rapid reversal or maneuvering is possible than in systems of this character used heretofore, and that the improved action is obtained by supplying live steam to reverse turbine 15 during changeover from forward to reverse operation and by supplying live steam to forward turbine 14 during changeover from reverse to forward operation.

While but one embodiment of the invention has been shown and described, it will be understood that various changes might be made such as in the size, shape and arrangement of the parts without departing from the spirit of the invention or the scope of the claims.

The invention claimed is:

1. In a ship propulsion system, a source of fluid pressure supply, a fluid-pressure reciprocating engine supplied from said source, a forward turbine, a reverse turbine, means providing for an operating connection between the exhaust side of said engine and said forward turbine, means providing for reversal of operating conditions of said engine, a lever supported for movement to different positions, said lever being common with respect to said first and second-named means and being operable upon movement to one of said positions to effect forward operation of said engine and to effect an operating connection between said exhaust side and said forward turbine, said lever being operable upon movement thereof to another of said positions to effect reverse operation of said engine, means providing for communication between said supply and either of said turbines, actuating means for said last-named means, said actuating means including a second lever supported for movement with said first-named lever to said different positions, and means for preventing movement of said second lever to one of said positions while said first-named lever occupies the other of said positions.

2. In a reversible ship propulsion system of the character described, a turbine for causing operation of the same in the forward sense, a second turbine for causing operation of said system in the reverse sense, means for controlling operation of said system in either sense and including a lever movable to one position for operation of said system in the forward sense and to

a different position for operation of said system in the reverse sense, a fluid pressure supply, means for causing selective connection of said turbines with said supply and including a second lever supported for movement with said first-named lever to said positions, said second lever having a neutral position whereat communication is cut off between said supply and both turbines, and complementary means associated respectively with said levers for locking the same together upon movement of said first-named lever through said neutral position.

3. In the art of ship propulsion wherein a reciprocating reversible steam engine and a forward steam turbine and a reverse steam turbine are connected to a common propeller shaft, the method of operation which comprises utilizing the engine to supply a preponderance of the total developed power to said shaft during both forward and reverse operation at normal speed, running the turbines during both normal forward and normal reverse operation at rotor speeds many times that of the engine and propeller shafts, maintaining the driving connections between said propeller shaft and the engine and turbines during normal-speed operation in both directions and upon and during reversal in either direction, supplying live steam to the reverse turbine during reversal from forward to reverse operation in such manner and amount that said reverse turbine is effective to brake and reaccelerate the rotor of the forward turbine, and supplying live steam to the forward turbine during reversal from reverse to forward operation.

4. In the art of ship propulsion wherein a reciprocating reversible steam engine and a forward steam turbine and a reverse steam turbine are connected to a common propeller shaft, the method of operation which comprises utilizing the engine to supply a preponderance of the total developed power to said shaft during both forward and reverse operation at normal speed, running the turbines during both normal forward and normal reverse operation at rotor speeds many times that of the engine and propeller shafts, maintaining the driving connections between said propeller shaft and the engine and turbines during normal-speed operation in both directions and upon and during reversal in either direction, supplying live steam to the reverse turbine during reversal from forward to reverse operation in such manner and amount that said reverse turbine is effective to brake and reaccelerate the rotor of the forward turbine, supplying live steam to the forward turbine during reversal from reverse to forward operation, and cutting off the supply of live steam to the respective turbines substantially upon completion of the reversal in either direction.

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