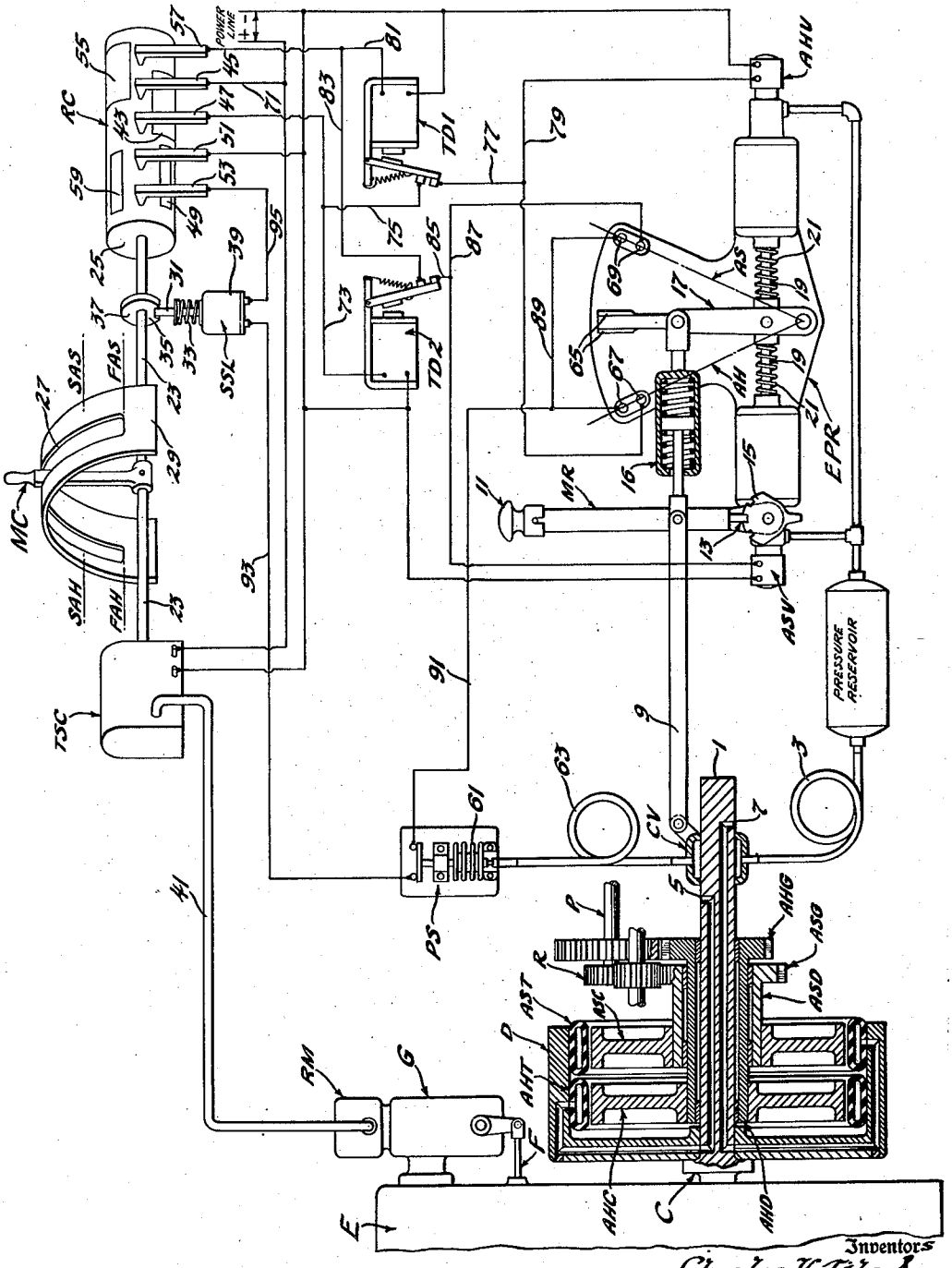
Oct. 9, 1945. C. H. FIKE ET AL 2,386,391

SHIP DRIVE AND MANEUVERING CONTROL SYSTEM

Filed Sept. 13, 1943



Inventors
Charles H. Fike &
Harry R. Ketnzen

By Blackmon, Spencer & Allen
Attorneys

Patented Oct. 9, 1945 2,386,391

UNITED STATES PATENT OFFICE

2,386,391

SHIP DRIVE AND MANEUVERING CONTROL SYSTEM

Charles H. Fike and Harry R. Heinzen, Cleveland, Ohio, assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application September 13, 1943, Serial No. 502,098

13 Claims. (Cl. 192—.01)

The present invention generally relates to mechanical drive and control systems and more particularly to maneuvering control means for a marine engine and reversing gear combination.

It has been found where power operated speed and reversing control means are remotely controlled by a single maneuvering control lever, that interlocking and motion limiting and retarding means are necessary to insure proper operation of the control lever and proper sequence of operation of the speed and reversing means controlled thereby. The usual means provided to insure proper operation of the combined controlling means are complicated and have the disadvantage of delaying operation of the speed and reversing control means which reduces the maneuverability of the ship.

The principal object of the present invention is to provide simple control and interlocking means in a maneuovering control system for insuring prompt response and proper sequence of operation of power operated speed and reversing control means which are remotely controlled by a single maneuvering control lever which is also provided with motion controlling means controlled by the power operated means in order to provide proper maneuverability of a ship.

The maneuvering control system by which the above object is accomplished, together with other features included therein, will be better understood by reference to the following detailed description and single accompanying drawing illustrating diagrammatically one form of our control system as applied to a well known type of marine propulsion system.

The propulsion system generally comprises a prime mover E of the Diesel type for driving a propeller shaft P by means of a reversing gear shown generally at R which includes fluid pressure operated reversing means for causing ahead and astern rotation of the propeller shaft P.

The engine E is provided with speed controlling means comprising a governor G of a well known type which acts to control variations in the engine speed by operating the engine fuel rack F in a well known manner. The governor G is provided with a well known type of electric receiving motor RM which is operatively connected in any well known manner to the governor in order to vary the speed settings thereof in order to cause operation of the engine at any one of a plurality of preselected constant values of speed betweeen idle and full speed values.

The reversing gear R includes ahead and astern driving shafts AHD and ASD, shown arranged concentrically with respect to and rotatably mounted on a shaft 1, shown connected directly to the engine crankshaft C. A clutch driving member D is secured to the shaft 1 and ahead and astern clutch driven members AHC and ASC are secured respectively to each of the driving shafts AHD and ASD. Separate ahead and astern driving gear trains shown generally at AHG and ASG are provided for connecting each of the driving shafts to the propeller shaft P. Inflatable clutch tires AHT and AST are secured to the clutch driving member D adjacent each of the clutch driven members AHC and ASC to cause driving engagement between either of the clutch driven members and the driving member in conventional manner in order to cause either ahead or astern rotation of the propeller shaft P.

Inflation of either tire to cause either ahead or astern rotation of the propeller shaft, or deflation of both tires to prevent drive of the propeller shaft is controlled by a clutch control valve CV. The control valve CV is provided with a pressure cavity shown connected by a flexible hose connection 3 to a pressure reservoir, and this valve is mounted on the rotatable shaft 1 for forward or rearward sliding movement thereon from a neutral position, as shown, in which the valve is positioned midway between axially spaced ports 5 and 7 shown provided in the shaft 1. The ports 5 and 7 are respectively connected by separate fluid passages in the shaft 1 and clutch driving member D with the interior of each of the tires AHT and AST. It will be evident that when the ports 5 and 7 are uncovered and open to the atmosphere by movement of the control valve CV to the neutral position, as shown, both tires are deflated to prevent drive of the propeller shaft P by the engine E. When the valve CV is moved forwardly so that the pressure cavity therein is in register with the forward port 5 the ahead clutch tire AHC is inflated to cause ahead drive of the propeller shaft and when the valve is moved rearwardly so that the pressure cavity is in register with the rear port 7 the astern clutch tire ASC is inflated to cause astern drive of the propeller shaft P.

The valve CV is moved between the above mentioned control positions by means of a conventional type of electropneumatic reverser shown generally at EPR, or by means of a manually operable reverse lever MR shown pivotally mounted on the reverser. The control valve CV is connected by means of a link 9 to the lever MR, which is provided with a movable handle or knob 11 for causing disengagement or engagement of

a lever latch 13 with notches in a lever quadrant 15 also fixed on the reverser to permit movement of the control valve CV between, or to hold it in any of its controlling positions. A pin and slot connection is shown provided between the knob 11 and the lever MR which allows manual rotation of the nob 11 with respect to the lever MR, after the latch 13 is withdrawn from the quadrant notches by upward movement of the knob 11 with respect to the lever, to prevent re-entry of the latch into the quadrant notches. The manually operable reverse lever MR is also connected by means of a resiliently extensible and compressible link 16 to a pivotally mounted actuating lever 17 of the reverser EPR for movement of the lever MR and valve CV by the reverser actuating lever. The reverser actuating lever 17 is connected by piston rods 19 of pistons, not shown, which are slidably mounted in reverser cylinders shown located on opposite sides of the lever 17. Centering springs 21 are located on each of the piston rods to urge the lever 17 to a neutral position, as shown. Electropneumatic ahead and astern valves AHV and ASV, of a well known type, are connected between the respective reverser cylinders and the pressure reservoir in which pressure is maintained at constant pressure by a compressor, not shown. The electropneumatic valves AHV and ASV permit air pressure from the reservoir to enter either reverser cylinder to cause movement of the reverser actuating lever 17 to the ahead or astern controlling positions upon electrical energization of the electromagnetic winding of either valve, and upon deenergization of both valve windings both reverser cylinders are vented to atmosphere which permits the centering springs 21 to cause the return of the reverser actuating lever 17 to the neutral position. It will be evident that, when the latch 13 of the manually operable reverse lever MR is prevented from entering the slots in the lever quadrant 15, movement of the reverser actuating lever 17 between neutral and ahead or astern controlling positions causes movement of the lever MR and control valve CV to corresponding controlling positions by reason of the linkage connections 9 and 16 therebetween. It will also be evident that the control valve CV may be held in any of its controlling positions when the latch 13 of the lever MR is entered into any of the notches of the quadrant 15 and that the resilient connection 16 then permits relative movement of the reverser actuating lever 17 with respect to the lever MR and control valve CV.

The control means whereby prompt and proper sequence of operation of the above described reversing and speed controlling means is obtained is controlled by a single maneuvering lever MC which is secured directly to a controller shaft 23 of a well known type of transmitting speed controller TSC for controlling movement of the receiver motor RM. A drum 25 of an electrical reversing controller RC, is also secured on the controller shaft 23 for also controlling the operation of the electropneumatic reverser EPR. The maneuvering control lever MC is shown in a neutral position in a maneuvering slot 27 of a stationary maneuvering lever quadrant 29. The lever MC is manually movable from the neutral position to slow and full speed ahead and astern controlling positions, indicated at SAH, FAH, SAS and FAS, in order to control the speed and direction of rotation of the propeller shaft P by the engine E.

The maneuvering lever MC is normally limited to movement only between the neutral and slow speed ahead and astern controlling positions by means of an electromagnetically releasable slow speed latching mechanism shown generally at SSL. The latching mechanism comprises a latch 31 biased by means of a spring 33 into a detent slot 35 of a collar 37 secured to the controller shaft 23 and an electromagnet having a winding 39 is electrically energized to pull the latch 35 out of the slot 33 to then permit further manual movement of the maneuvering lever MC to either the full ahead or astern controlling positions FAH or FAS.

Suitable electrical control connections, shown generally at 41, are connected between the transmitter speed controller TSC and the receiving motor RM to cause the receiver motor RM to follow movements of the transmitter controller TSC only when the latter is moved between the slow and full speed ahead or astern controlling positions to cause a variation in the engine speed between slow or idling speed and full speed values.

Electrical control connections, to be described, shown extending between the reversing controller RC and reverser EPR include time delay relays TD1 and TD2, a pressure operated switch PS and electrical contact means to be described which are operable by the reverser in order to cause prompt and proper sequential operation of the speed and reversing control means in response to movement of the maneuvering control lever MC and also to control the slow speed latching means SSL in order to insure proper manual operation of the control lever.

The reverser controller drum 25 is shown provided with two pairs of electrical contacts and stationary contact fingers engageable therewith upon movement of the drum by movement of the maneuvering control lever MC either side of the neutral position, as shown. The drum contacts are arranged so that a drum contact 43 is brought into electrical contact with the stationary contact fingers 45 and 47 upon initial movement of the maneuvering lever MC toward the slow speed ahead controlling position from the neutral position, and this drum contact thereafter remains in contact with these fingers upon further movement of the lever MC to the slow and full speed ahead positions SAH and FAH. A drum contact 49 is also provided to bridge the contact fingers 51 and 53 only upon movement of the lever MC to the slow speed ahead controlling position SAH. Another controller drum contact 55 is provided which is brought into contact with the stationary contact fingers 45 and 57 upon initial movement of the lever MC toward the slow speed astern controlling position SAS from the neutral position and this drum contact thereafter remains in contact with these fingers upon further movement of the lever MC to the slow and full speed astern controlling positions SAS and FAS. The remaining controller drum contact 59 is brought into engagement with the stationary contact fingers 51 and 53 only upon movement of the lever MC to the slow speed astern controlling position SAS.

The previously mentioned time delay relays TD1 and TD2 are identical and are of a well known type. Each of these relays include a pair of stationary electrical contacts, an armature contact normally spring biased into electrical contact with the stationary contacts, and a magnetic core provided with a relay winding which

is energizable to move the armature out of contact with the stationary contacts. The armature is provided with a non-magnetic shunt for delaying the decay of the magnetic flux in the relay core, upon deenergization of the winding, in order to delay reclosure of the relay contacts. The delaying action of these relays is adjustable by applying different thickness non-magnetic shims and/or by changing the spring biasing force on the armature.

The pressure switch PS comprises a pair of stationary electrical contacts and an armature contact movable into contact with the stationary contacts by a pressure Sylphon 61 operably connected to the armature. The interior of the Sylphon 61 is also shown connected by a flexible hose connection 63 to the cavity in the control valve CV, so that when the valve is in the neutral position full reservoir pressure is applied to the Sylphon to hold the armature contact of the pressure switch PS in electrical contact with the stationary switch contacts. When, however, the valve CV is moved into register with either of the ports 5 and 7 in the shaft 1 to inflate either of the tires AHT or AST, a drop in pressure takes place in the cavity of the valve CV and Sylphon 61 of the switch PS, and this drop in pressure then causes the Sylphon to contact and move the switch armature contact out of contact with the stationary contacts until the pressure in either of the tires is substantially equal to the reservoir pressure. Either of the tires AHT or AST are fully inflated to cause non-slipping driving engagement between either the ahead or astern clutch driven members AHC or AST and the clutch driving member D when the tire pressure is substantially equal to the reservoir pressure which then causes closure of the contacts of the pressure switch PS. The contacts of the switch PS, however, remain open while either of the tires are being inflated to the value of the pressure in the reservoir.

In order to cause release of the electromagnetically releasable latching mechanism SSL to permit movement of the maneuvering control lever MC to either the full speed ahead or astern positions FAH or FAS from the slow speed ahead or astern positions, the contacts of the pressure switch must be closed and these contacts are interconnected with interlocking contacts provided on the reverser EPR so that it is also necessary for the reverser actuating lever 17 to be moved to either the ahead or astern position AH or AS to also cause closure of the interlocking contacts on the reverser before the latching mechanism SSL can be released.

The interlocking contacts on the reverser include a pair of electrical contacts 65 secured on the reverser actuating lever 17 and either of these contacts are moved into electrical contact with one or the other of two pairs of stationary interlocking electrical contacts 67 secured to the reverser only when the lever 17 is moved to the ahead or astern controlling positions AH or AS.

The electrical control and interlocking connections between the above described controller, relays, pressure switch and the speed and reversing means will now be described.

A positive conductor of a power line is shown directly connected to one terminal of the transmitting controller TSC and a branch conductor 71 is connected between the positive conductor and the reverser controller contact finger 45; and separate interconnected return conductors, not numbered, are shown connected between the other terminal of the transmitter speed controller TSC, the reverser controller contact finger 51 and one winding terminal of each of the time delay relays TD1 and TD2 and electropneumatic valves AHV and ASV to a negative power line conductor. The reverser controller contact finger 47 is connected by conductors 73 and 75 to one winding terminal of the time delay relay TD2 and one stationary contact of the time delay relay TD1. The other stationary contact of the relay TD1 is connected by conductors 77 and 79 to the other winding terminal of the ahead electropneumatic valve AHV and the lower contact of the pair of stationary interlocking contacts 67 provided on the reverser EPR. The other winding terminal of the time delay relay TD1 and one of the stationary contacts of the time delay relay TD2 are connected by conductors 81 and 83 to the contact finger 57 of the reversing controller and the other stationary contact of the time delay relay TD2 is connected by conductors 85 and 87 to the other winding terminal of the astern electropneumatic ASV and the lower stationary interlocking contact of the other pair of stationary pair of interlocking contacts 69 on the reverser EPR. The upper contacts of each pair of stationary interlocking contacts 67 and 69 on the reverser EPR are connected by conductors 89, 91, 93 and 95 in series relation with the stationary contacts of the pressure switch PS and the winding of the electromagnetic latching mechanism SSL to the contact finger 53 of the reverser controller RC.

With the control elements described above in the positions shown, the engine E will be operated at low or idling speed and the propeller shaft will be disconnected from the engine. Initial movement of the maneuvering control lever MC from the neutral position toward the slow speed ahead position causes the reversing controller drum contact 43 to be moved into contact with the contact fingers 45 and 57 which causes energization of the winding of the time delay relay TD2 through these controller contacts and the conductor 73 which is then connected directly to the positive power line conductor. Energization of the winding of the time delay relay TD2 causes the opening of the contacts thereof by movement of the relay armature. The winding of the ahead electropneumatic valve AHV is also simultaneously energized through the conductors 75, 77 and 79 which are then also connected to the conductor 73 through the closed contacts of the time delay relay TD1. Energization of the valve AHV causes air to enter the right hand reverser cylinder to cause movement of the reverser actuating lever 17 toward the ahead controlling position AH. Movement of the actuating lever 17 acting through the resiliently extensible and compressible link 16 will cause counterclockwise movement of the manually operable reversing lever MR, providing the latch 13 thereon is disengaged from the slots quadrant in the lever quadrant 15 in the manner previously described, and this movement of the lever MR causes the control valve CV to be moved forwardly or to the left by the link 9 until the cavity in the valve CV is brought into register with the forward port 5 in the shaft 1. Wth the valve CV in this position air from the reservoir will rush into the ahead clutch tire AHT and the resulting reduction in pressure in the valve cavity causes a corresponding reduction in pressure in the Sylphon 61 of the pressure switch PS which causes downward movement of the switch armature out of contact with the sta-

tionary switch contacts. Continued movement of the maneuvering control lever MC to the slow speed ahead position SAH, where it is prevented from further movement by the electromagnetic latching mechanism SSL, causes the reversing controller drum 49 to then be moved into contact with the controller contact fingers 51 and 53 which sets up a return circuit for the winding of the electromagnetic latching means SSL. This circuit is completed only by continued movement of the reverser actuating lever 17 to the head controlling position AH to cause the stationary contacts 67 on the reverser to then be bridged by one of the contacts 65 on the actuating lever and upon reclosure of the contacts of the pressure switch PS upon an increase in the air pressure in the switch Sylphon 61 corresponding to a pressure value in the ahead clutch tire AHT necessary to cause ahead driving engagement between the engine driven clutch driving element D and the ahead clutch driven member AHC thereby causing slow speed ahead rotation of the propeller shaft P. When the interlocking contacts 65 and 67 of the reverser are closed and also the contacts of pressure operated switch PS are closed, the winding of the slow speed electromagnetic latching means SSL will be energized through these contacts and conductors 79, 91, 93 and 95 and the previously mentioned return circuit set up by movement of the reverser controller drum contact 49 into contact with the contact fingers 51 and 53. Energization of the winding of the latching means SSL causes the latch 31 to be withdrawn from the detent slot 35 in the collar 37 secured on the controller shaft 23 which then permits manual movement of the maneuvering control lever MC to the full speed ahead position FAH. As previously described, when the lever MC is moved between slow and full speed ahead positions the transmitter speed controller is moved further and the receiver motor RM follows the movement thereof due to the arrangement of the control connections 41 therebetween so that the engine speed is increased from a slow or idle speed value to the full speed value which causes a corresponding increase in the speed of the propeller shaft P. Movement of the maneuvering lever MC from the slow speed ahead position SAH to the full speed ahead position also causes movement of the reverser controller drum contact 43 out from the contact fingers 51 and 53 which causes deenergization of the winding of the electromagnetic latching means SSL and the spring 33 thereon accordingly moves the latch 31 back into contact with the portion of the collar 37 adjacent the detent slot 35 therein. The maneuvering lever MC is then freely movable from the full speed ahead position FAH to the slow speed astern position SAS where it is stopped by the latching by the latching mechanism SSL. Movement of the lever MC from the full speed ahead position FAH to the slow speed ahead position SAH causes reverse movement of the transmitter speed controller TSC and follow-up movement of the receiver motor RM which causes a reduction in the engine speed from full speed value to slow or idling speed value. Movement of the lever MC through the slow speed ahead position SAH toward the neutral position causes the reverser controller drum contact 49 to momentarily contact the contact fingers 51 and 53 which causes momentary energization and release of the latching mechanism and therefore the immediate return of the latch 31 into the detent slot 35 of the collar 37 on the controller shaft 23. Further movement of the lever MC to the idle position causes the reverser controller drum contact 49 to be moved out of contact with the contact fingers 45 and 47 which breaks the energizing connection 71 to the winding of the relay TD2 and also breaks the energizing circuit connection through the closed contacts of the relay TD1 and conductors 71, 73, 75, 77 and 79 to the winding of the ahead electropneumatic valve AHV of the reverser EPR. Deenergization of the valve AHV shuts off the pressure to the right hand reverser cylinder from the pressure reservoir and vents this cylinder to atmosphere and one of the centering springs 21 then acts to cause movement of the reverser actuating lever 17, lever MR and valve CV to the neutral position. Movement of the valve CV and cavity therein out of register with the forward port 5 in the shaft 1 vents the ahead clutch tire AHT to atmosphere to start deflation of this tire. Movement of the reverser actuating lever 17 from the ahead position AH also breaks the electrical connection comprising conductors 91 between the interlocking contacts 65 and 67 and the contacts of the pressure switch PS. Further movement of the lever MC from the idle to the slow speed astern position SAS, in which as explained it is stopped by the latching means SSL, initially causes the reverser controller drum contact 55 to be moved into contact with the contact fingers 45 and 57 to complete an energizing circuit comprising conductors 81 and 83 to the winding of the time delay relay TD1 which causes its contacts to open and also sets up a circuit through these same conductors to one of the stationary contacts of the time delay TD2. When these stationary contacts of the time delay TD2 are subsequently closed by decay of the flux in the relay core the relay armature is moved by the spring into electrical contact with the stationary contacts. Closure of the contacts of the relay TD2 completes an energizing circuit comprising conductors 81, 83, 85 and 87 to the winding of the astern electropneumatic valve ASV and also sets up a circuit to one of the stationary contacts 69 of the reverser EPR. It will be noted here that the astern valve ASV cannot be energized until closure of the contacts of time delay relay TD2 takes place and as these contacts are delayed in closing until the ahead clutch tire is completely deflated to prevent ahead drive of the propeller shaft P by the engine E. As explained above the time required for the contacts of either of the relays TD1 or TD2 is adjustable. The reverser actuating lever 17 is accordingly moved to and held in the neutral position by the centering springs 21 until the ahead clutch tire is completely deflated and when this takes place the contacts of the relay TD2 will then close to cause energization of the winding of the astern valve ASV to allow air pressure from the reservoir to enter the left hand reverser cylinder and start moving the reverser actuating lever toward the astern position AS. When the lever MC is in the slow speed astern position AS and is prevented from being moved to the full speed astern position by latching mechanism SSL, the reverser controller drum contact 59 is in contact with the contact fingers 51 and 53 which again sets up the return circuit from the winding electromagnetic latching means SSL through these controller contacts and the conductor 95. When the reverser actuating lever is moved toward the astern position from the neutral position, the lever MR and the control valve CV will likewise be moved to the right so that the cavity in the valve will then

be brought into register with the rear port 7 in the shaft 1 to start inflation of the astern clutch tire AST. The air pressure in the cavity of the valve CV and Sylphon 61 of the pressure switch PS will again drop and cause the opening of the contacts of the pressure switch PS until the astern clutch tire is fully inflated to establish the slow speed astern driving connection between the engine E and the propeller shaft, and when this occurs the contacts of the pressure switch will reclose as previously explained. With the contacts of the pressure switch PS closed and the reverser actuating lever 17 in the astern position AS, in which the reverser stationary interlocking contacts 69 are bridged by one of the contacts 65 on the reverser actuating lever, the energizing circuit for the electromagnetic latching means is completed through these contacts and conductors 85, 87, 89, 91, 93 and 95 and through the drum contact 59 and contact fingers 51 and 53 of the reversing controller RC. Upon energization of the winding of the latching means SSL the latch 31 will again be withdrawn from the detent slot 35 in the collar 37 on the controller shaft 23 to then permit movement of the lever MC to the full speed astern position FAS. Movement of the lever MC to this position causes movement of the transmitter speed controller TSC and corresponding follow-up movement of the receiver motor RM which again causes an increase in the engine speed from a slow or idle value to the full speed value which causes full speed astern rotation of the propeller shaft P.

Upon movement of the lever MC from the slow speed astern to the full speed astern position the reverser drum contact 59 will be moved out from under the contact fingers 51 and 53 to cause deenergization of the winding of the latching means SSL and re-engagement of the latch 31 with the collar 37. The lever MC may then be moved freely from the full speed astern position FAS to the slow speed ahead position SAH where it is stopped by the latching means SSL.

Movement of the lever MC from the full speed astern to the slow speed astern position SAS cause a reduction in the engine speed from the full speed to the slow or idle speed value with a corresponding reduction in the speed of the propeller shaft.

Movement of the lever MC through the slow speed astern position to the neutral position initially causes momentary energization and release of the latching mechanism by momentary bridging of the contact fingers 51 and 53 by the drum contact 59 of the reversing controller RC and finally causes deenergization of the winding of the relay TD1 and the winding of the astern electropneumatic valve ASV by movement of the reverser controller drum contact 55 from under the contact fingers 55 and 57. The contacts of the relay TD1 are delayed in closing in the same manner as those of the relay TD2 and when the astern clutch tire AST is completely deflated by movement of the valve CV back toward the neutral position by one of the reverser centering springs 21 upon the venting of the left hand reverser cylinder to atmosphere and the cutting off of reservoir pressure supplied thereto upon deenergization of the valve CV, the engine will operate at slow or idle speed and the propeller shaft P will be disconnected from the engine E.

As previously described the manually operable reversing lever MR may be operated to move the valve CV to any of its controlling positions and for locking the valve in any one of these positions by means of the lever latch 13 to prevent movement of the lever MR and valve CV by the reverser EPR. With the lever MR held by means of the latch 13 in either of the notches in the quadrant 13 any movement of the actuating lever 17 merely causes compression or extension of the resilient link 16.

The above described control system provides means whereby prompt reversal of drive followed by an increase in the speed may be obtained by manual movement of a single maneuvering control lever which can only be moved between slow and full speed controlling positions only when slow speed drive in either direction takes place.

We claim:

1. A control system for driving means including a prime mover, a reversing gear driven thereby having pressure engaged ahead and reverse driving clutches, speed varying means for said prime mover, clutch controlling means operable for controlling the pressure applied to either of said clutches and for venting both of said clutches to cause successive engagement and simultaneous disengagement of said clutches, time delay means for preventing operation of said clutch controlling means to cause engagement of either clutch until both are disengaged and a manually operable control lever for controlling operation of said clutch controlling means and said time delay means and also for controlling said speed varying means for said prime mover.

2. A control system for driving means including a prime mover, a reversing gear driven thereby having pressure engaged ahead and reverse driving clutches, speed varying means for said prime mover, clutch controlling means for controlling the pressure applied to one or the other of said clutches and for venting both simultaneously to cause successive engagement and simultaneous disengagement of said clutches, time delay means for preventing operation of said clutch controlling means in causing engagement of either clutch until both are disengaged, a manually operable control lever movable from a neutral to slow and full speed ahead and reverse controlling positions for successively controlling said time delay means, said clutch controlling means and said speed varying means.

3. A control system for driving means including a prime mover, a reversing gear driven thereby having pressure engaged ahead and reverse driving clutches, speed varying means for said prime mover, clutch controlling means for controlling the pressure applied to either of said clutches and for venting both simultaneously, time delay means for preventing control of either clutch by said clutch controlling means until both are vented and disengaged, a control lever movable successively from a neutral position to slow and full speed ahead and reverse driving controlling positions for successively controlling said time delay means, said clutch controlling means and said prime mover speed varying means, releasable lever latching means normally preventing movement of said lever to either full speed position, and means acting in response to an increase in pressure in either of said clutches by action of said clutch controlling means to control the release of said latching means to then permit further movement of said lever to either full speed position.

4. A control system for driving means including a prime mover having speed controlling means

and a reversing gear driven by the prime mover having pressure engaged ahead and reverse driving clutches and clutch controlling means, said control system comprising a manually operable control lever for controlling said clutch and speed controlling means, releasable latching means for said lever normally permitting necessary movement thereof to control engagement of either of said clutches and means acting in response to pressure in either clutch to control the release of said latching means in order to then permit further movement of said lever to control said speed controlling means in order to then control the prime mover speed and increase the speed of said prime mover to the full speed from a slow speed value.

5. A maneuvering control system for ship propulsion means including a prime mover having speed controlling means, a reversing gear having pressure engaged ahead and astern driving clutches driven by said prime mover and clutch controlling means for causing engagement of either of said clutches and disengagement of both, said control system comprising a maneuvering lever manually movable between a neutral and low and full speed ahead and astern controlling positions for controlling said clutch and speed controlling means, time delay means controlled by said lever to permit prompt control of said clutch controlling means by said lever in order to cause prompt engagement of either clutch only after disengagement of both clutches, releasable lever latching means normally preventing movement of said lever to said full speed controlling positions but releasable to permit movement thereto, and pressure responsive control means operable by the pressure necessary to cause engagement of either of said clutch driving means for causing the release of said latching means to then permit movement of said lever to the full speed controlling positions.

6. A maneuvering control system for ship driving means including a prime mover having power operated speed controlling means and a reversing gear driven by said prime mover having pressure engaged ahead and astern driving clutches, a valve for applying pressure to one or the other of said clutches or venting both, and power operated valve controlling means, said control system comprising control means for said power operated speed and valve controlling means including a manually operated maneuvering lever movable between a neutral non-driving and low and full speed ahead and astern driving controlling positions, lever latching means normally permitting movement of said lever only between the neutral and slow speed ahead and astern controlling positions and releasable only in response to operation of said valve operating means in causing a pressure rise in either clutch necessary to cause engagement thereof to either permit movement of said lever to the full speed ahead or astern driving controlling positions.

7. A maneuvering control system for a ship driving system including a prime mover having power operated speed varying means, a reversing gear driven by said prime mover and having pressure engaged ahead and astern driving clutches, a valve for applying pressure to either clutch and for venting both simultaneously, and power operated valve operating means, said control system comprising a controller means for said power operated speed varying and valve operating means, time delay means for delaying operation of said power operated valve operating means by said controller means to cause engagement of either clutch until both clutches are completely disengaged, a single manually operable maneuvering lever for operating said controller means, said lever being movable between a neutral non-driving controlling position and slow and full speed ahead and astern driving controlling positions either side of the neutral position, releasable lever latching means normally permitting movement of said lever between slow speed ahead and astern driving controlling positions only, said latching means being releasable to then permit further movement of said lever and controller means to the full speed ahead or astern controlling positions in order to cause an increase in the speed of the prime mover between low and full speed values and means acting in response to pressure in either clutch necessary to cause engagement thereof for controlling the release of said lever latching means.

8. A control system for a driving system including a prime mover having electrically operated speed varying means, a reversing gear driven by said prime mover having fluid pressure engaged ahead and reverse driving clutches, a valve for applying pressure to either clutch and for venting both simultaneously, and an electropneumatic reverser movable between neutral and ahead and astern positions for operating said valve, electrical controller means for said electrically operated speed varying means and said reverser, said controller being movable between neutral, slow and full speed ahead and reverse controlling positions, electrically releasable latching means for permitting movement of said controller means to said full speed controlling positions but normally allowing movement of said lever only between neutral and said slow speed positions only, energization and deenergization controlling means interconnected between said reverser, said latching means and said controller means, said energization and deenergization control means comprising time delay relays for delaying energization of said reverser until both of said clutches are disengaged and switching means operable by said reverser in causing engagement of either clutch and pressure operated switching means operable upon engagement of either clutch for jointly controlling energization of said releasable lever latching means to cause the release thereof.

9. A control system for a driving system comprising a prime mover having electrically operated speed controlling means, a reversing gear driven by said prime mover having pressure engaged ahead and reverse driving clutches, a valve for applying pressure to either clutch and for venting both simultaneously and an electropneumatic reverser for actuating said valve, electrical controller means movable between neutral non-driving and slow and full speed ahead and reverse driving controlling positions, electrically releasable latching means for preventing or permitting movement of said controller from slow to full speed driving controlling positions, energization and deenergization controlling means interconnected between said reverser, said latching means and said controller, said controlling means comprising time delay relays for delaying energization and operation of said reverser until both driving clutches are vented and disengaged, switching means operable by said reverser in causing pressure engagement of either clutch, and pressure operated switching means operable upon a rise in pressure of either clutch necessary to cause complete driving engagement of either

clutch for jointly controlling energization and release of said latching means in order to then permit movement of said controller means to either full speed driving controlling position, and a single manually operable control lever for operating said controller means.

10. A maneuvering control system for ship driving means comprising a prime mover, a reversing gear driven thereby including pressure engaged ahead and astern driving clutches, a propeller shaft operatively connected to said reversing gear, a clutch control valve movable to different positions for applying pressure to either clutch in order to cause successive engagement thereof and to a neutral position in order to cause the venting of both clutches and disengagement thereof, an electrically controlled reverser for operating said valve, electrically controlled speed varying means for said engine, electrical controller means movable in opposite directions to slow and full speed ahead and astern controlling positions from a neutral non-driving controlling position for controlling said reverser and speed varying means in sequence, time delay relays interconnected between said reverser and controller means for delaying energization of said reverser until both of said clutches are vented and disengaged, electrically releasable slow speed latching means for normally preventing movement of said controller means to the full speed positions but releasable to permit movement of said controller to the full speed positions, switching means interconnected between said controller means and said electrically releasable latching means for controlling energization and release thereof, said switching means including switching means operable by said reverser and switching means operable in response to pressure rise in said clutch control valve necessary to cause non-slipping driving engagement of either of said clutches and a manually operable maneuvering conntrol lever for operating said controller means.

11. A control system for driving means including a prime mover, speed controlling means for the prime mover, a reversing gear including pressure engaged ahead and reverse driving clutches driven by said prime mover, said control system comprising clutch controlling means including time delay means for causing engagement of either of said clutches only after complete disengagement of both of said clutches, a manually operable controller for controlling the time delay means and prime mover speed controlling means, said controller having releasable motion limiting means normally permitting control of said time delay means and either clutch, and means responsive to the pressure causing engagement of either clutch to render the motion limiting means inoperative in order to permit further movement of the controller whereby the engine speed controlling means is controlled to cause an increase in the engine speed.

12. A maneuvering control system for ship driving means including a prime mover, speed varying means therefor, a reversing gear driven by the prime mover and including pressure engaged ahead and astern driving clutches, said control system comprising a valve for applying pressure to either clutch and for simultaneously venting both clutches, valve operating means, control means for said valve operating means comprising time delay means for delaying control and operation of said valve operating means in order to delay engagement of either clutch until both are disengaged, a manually movable controller for controlling said time delay means and said prime mover speed varying means, said controller having releasable motion limiting means normally limiting movement of said controller to control engagement of either clutch and means acting automatically in response to the pressure causing engagement of either clutch to cause release of said controller motion limiting means whereby further movement of the controller causes an increase in the speed of the prime mover.

13. A control system for a driving system including a prime mover, speed varying means therefor, a reversing gear driven by the prime mover and including pressure engaged ahead and reverse driving clutches, and a valve movable to different controlling positions for applying pressure to either of said clutches to cause ahead or reverse driving engagement thereof and for simultaneously venting both of said clutches to cause simultaneous disengagement of both said clutches, a manually operable reversing lever provided with manually releasable latching means for moving said valve between and for holding said valve in any of said controlling positions, a power operated reverser resiliently connected to said reversing lever for moving said lever and valve to the different controlling positions when said lever latching means is released, a controller manually movable between neutral and slow and high speed forward and reversing controlling positions for controlling said prime mover speed varying means and also for controlling said reverser to cause movement of said valve to said different control positions and time delay means interconnected between said reverser and controller to prevent control and operation of said reverser upon movement of said controller to slow speed ahad or reverse positions until both of said clutches are vented and disengaged.

CHARLES H. FIKE.
HARRY R. HEINZEN.