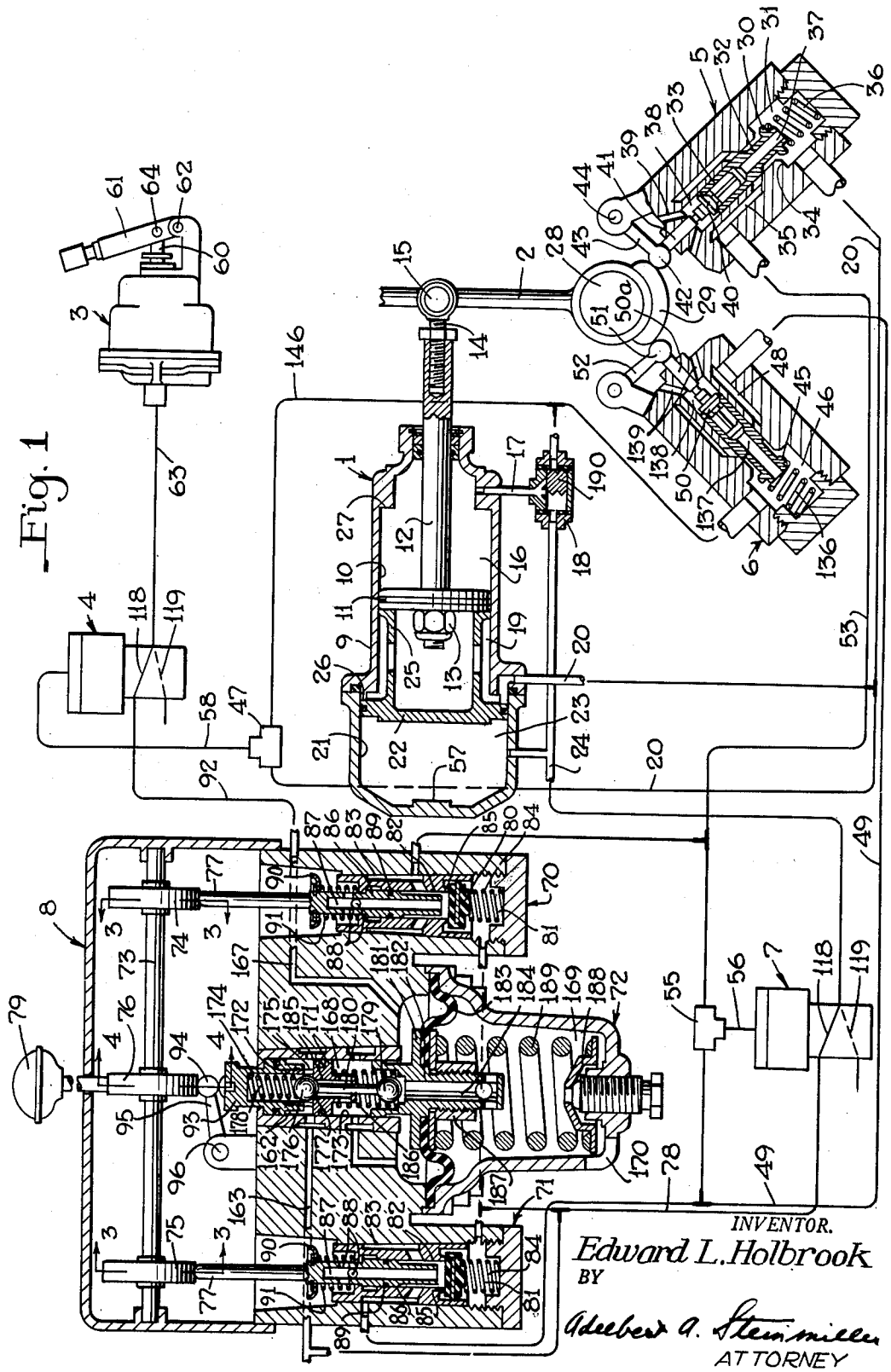
Oct. 25, 1955 E. L. HOLBROOK 2,721,637

CLUTCH AND THROTTLE CONTROL APPARATUS FOR COMBUSTION ENGINES

Filed July 5, 1952 2 Sheets-Sheet 1

Fig. 1



INVENTOR.
Edward L. Holbrook
BY
Adelbert A. Steinmiller
ATTORNEY

Oct. 25, 1955 E. L. HOLBROOK 2,721,637

CLUTCH AND THROTTLE CONTROL APPARATUS FOR COMBUSTION ENGINES

Filed July 5, 1952 2 Sheets-Sheet 2

Fig. 2

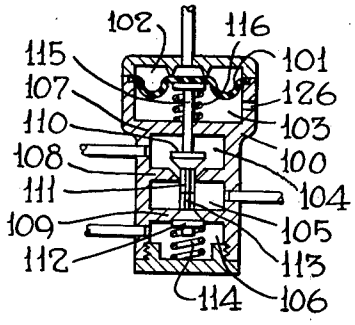


Fig. 3

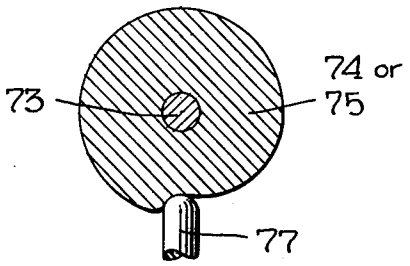
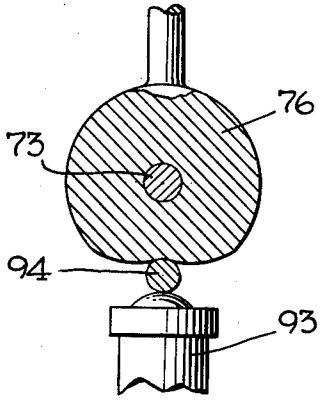


Fig. 4



INVENTOR.
Edward L. Holbrook
BY
Adelbert A. Steinmeier
ATTORNEY

United States Patent Office 2,721,637
Patented Oct. 25, 1955

2,721,637

CLUTCH AND THROTTLE CONTROL APPARATUS FOR COMBUSTION ENGINES

Edward L. Holbrook, Arlington, Va., assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application July 5, 1952, Serial No. 297,301

7 Claims. (Cl. 192—.098)

This invention relates to fluid pressure control apparatus for selectively controlling a multiple position clutch and throttle for an engine.

One object of the invention is the provision of an improved control apparatus of the above type.

Another object of the invention is the provision of an apparatus of the above general type by which the speed of the engine and the position of the clutch may be determined by the manipulation of a single handle in a single plane of rotation.

Another object of the invention is the provision of an apparatus of the above general type which operates automatically to return the throttle control to idling position when the clutch control is placed in neutral position.

A still further object of the invention is the provision of such an apparatus embodying means which operates automatically to relieve the clutch control motor means of fluid pressure after the motor means has come to a complete stop.

Other objects and advantages will be apparent from the following more detailed description of the invention.

In the accompanying drawing, Fig. 1 is a diagrammatic view of a control apparatus embodying the invention; Fig. 2 is a sectional view of a relay valve device of the type shown in outline in Fig. 1; Fig. 3 is a sectional view taken on the lines 3—3 of Fig. 1; and Fig. 4 is a sectional view taken on the lines 4—4 of Fig. 1.

As shown in the drawing, the reference numeral 1 indicates a power motor device for positioning a three position clutch control member 2, and the numeral 3 indicates a throttle adjusting motor. Reference numeral 4 refers to a relay valve device for controlling communication to the throttle adjusting motor 3 as determined by pressure of fluid supplied from one or the other of two pilot or relay valve devices 5 and 6, each of which also controls one supply of fluid under pressure to motor device 1. Another supply of fluid under pressure to power motor device 1 is controlled by a relay valve device 7 operative in response to pressure of fluid supplied from a manually operative control valve device 8 to one or the other of pilot valve devices 5 and 6.

The motor device 1 may be of the same general type as that shown and described in Patent No. 2,604,878, issued July 29, 1952, to Roy R. Stevens, and assigned to the assignee of the present invention, and for that reason a detailed description at this time is not deemed necessary to a clear understanding of the invention.

The motor device 1 comprises a casing 9 having a bore 10 containing a piston 11, which is coupled to clutch control member 2 by means of a piston stem 12 secured at one end to piston 11 by screw-threaded means 13 and connected at the other end to said member by an eyebolt 14 and a pin 15. At one side of piston 11 is a chamber 16 which is connected through a passage and pipe 17 to the outlet side of a double check valve 18. At the other side of piston 11 is a chamber 19 which is connected through a passage and pipe 20 to pilot valve device 5 and to control valve device 8.

Contained in a bore 21 in casing 9 is a piston 22 of larger diameter than piston 11 and having chamber 19 at one side and at the other side a chamber 23 which is connected to passage and pipe 24 leading to the delivery side of relay valve device 7. The piston 22 is provided with an integral skirt portion 25 which extends into chamber 19, and when disposed at the right hand end of bore 21 in contact with a shoulder 26, as shown in Fig. 1 of the drawing, serves as a stop to limit movement of piston 11 and thereby define a neutral position of clutch control member 2, in which position it is shown in the drawing.

Movement of piston 11 to neutral position in which it is shown is arranged to be effected by supplying fluid under pressure to chambers 16 and 23 to act on the outer faces of said pistons when fluid under pressure is released from chamber 19, in response to which piston 22 moves inward to a position defined by contact with shoulder 26 while piston 11 moves inward to a position defined by contact with skirt portion 25. Movement of piston 11 to a forward position is arranged to be effected by supplying fluid under pressure to chamber 19 to act on the inner face of piston 11 while fluid under pressure is released from chamber 16, in response to which piston 11 moves outward to said forward position defined by contact with a shoulder 27 at the inner end of bore 10. Movement of piston 11 to a reverse position is arranged to be effected by supplying fluid under pressure to chamber 16 to act on the outer, or right-hand face of piston 11 while fluid under pressure is released from chamber 23, in response to which piston 22 moves to its extreme left-hand position and piston 11 moves inward to its extreme left-hand or said reverse position defined by contact with the end of skirt 25.

The clutch control member 2 is secured by any suitable means to a clutch control shaft 28 for operating same and is provided at its lower end below shaft 28 with a cam 29 for operating the pilot valve devices 5 and 6 to control the supply of fluid under pressure to and from chambers 19 and 16, respectively, in a manner hereinafter described.

The forward pilot valve device 5 comprises a supply valve 30 contained in a chamber 31, which valve is connected by a stem 32 to a plunger 33 slidably mounted in a suitable bore in the casing. A wall 34 separates chamber 31 from a supply chamber 35 and the stem 32 extends through an opening in this wall, the wall being provided with a seat around said opening for engagement by the valve 30 to control communication between chambers 31 and 35. A spring 36 mounted in chamber 31 acts on supply valve 30 for urging it into contact with its seat. The supply valve 30, stem 32 and plunger 33 are provided with a through axial bore 37, which is open at one end to chamber 31 and open at the opposite end through a valve seat to a chamber 38, which is open to atmosphere through ports 39. A release valve 40 contained in chamber 38 is arranged to cooperate with plunger 33 for controlling release of fluid under pressure from chamber 31 to chamber 38. The release valve 40 is arranged to be controlled by an abutting plunger 41, which is operatively connected to the peripheral surface of cam 29 through the medium of a ball-like end 42 of an arm 43, the opposite end of which is mounted to rock about a fulcrum 44 provided in the casing.

The reverse pilot valve device 6 is structurally identical to the forward pilot valve device 5 and comprises a supply valve 45 contained in a chamber 46 which is connected to a pipe 146 leading to an inlet side of double check valve 18 and an inlet side of a double check valve 47, said valve being arranged to control supply of fluid under pressure from said chamber to a chamber 48 connected to a pipe 49 leading to the control valve device

8. The reverse pilot valve device 6 further comprises a release valve 50 and an abutting plunger 50*a* arranged to cooperate through the medium of a ball-like end 51 of an arm 52 with the cam 29 on the clutch control member 2.

It will be observed that the contour of cam 29 is such that when the clutch control member 2 is in its vertical or neutral position both release valves 40 and 50 are held seated and both supply valves 30 and 45 are held unseated. However, with the control valve device 8 in neutral position shown control pipes 53 and 49 leading to chambers 35 and 48, respectively, are open to atmosphere through said valve device and consequently, chamber 35 connected to pipe 20 leading to chamber 19 and to one inlet side of check valve 47 is at atmospheric pressure as is chamber 48 connected to pipe 146 leading to inlet sides of double check valves 18 and 47, respectively.

Control pipes 49 and 53 are connected to respective, opposite inlet sides of a double check valve 55, the outlet side of which is connected through pipe 56 to a control chamber 102 in relay valve device 7.

When clutch control member 2 is rocked in a clockwise direction to its forward position, spring 36 in pilot valve device 5 will be permitted by cam 29 to seat valve 30, cutting off flow of fluid under pressure to chamber 19 in motor device 1. At the same time fluid under pressure in chamber 19 is vented to atmosphere through pipe 20, chamber 31, bore 37, chamber 38 and port 39, such pressure blowing valve 40 from its seat. When clutch control member 2 is rocked in a counter-clockwise direction to its reverse position, spring 136 in pilot valve device 6 will be permitted to seat valve 45, cutting off flow of fluid under pressure to chamber 16 in motor device 1, and at the same time fluid under pressure in chamber 16 is vented to atmosphere through pipe 17, check valve 18, pipe 146, chamber 46 in pilot valve device 6, bore 137, chamber 138 and ports 139, such pressure blowing valve 250 from its seat under this condition.

The relay valve devices 4 and 7 for sake of schematic illustration may be alike. Referring to Fig. 2, each of the devices 4 and 7 may comprise a casing 100 having a diaphragm 101 disposed therein and subject to pressure of fluid in a diaphragm control chamber 102 on its one side and to pressure of fluid in a chamber 103 on its opposite side. Also formed in the casing 100 are chambers 104, 105 and 106, chamber 104 being separated from chamber 103 by a partition 107 and from chamber 105 by a partition 108. A partition 109 separates the chamber 105 from a chamber 106. A valve 110 is disposed in the chamber 104 for controlling communication between the chamber 103 and aforesaid chamber 104. The valve 110 may be secured to a fluted stem 111 slidably mounted in a suitable bore extending through the partition 108, a valve seat being formed at the end of the bore opening into chamber 104 to accommodate the valve 110. A valve 112, similar to the valve 110, is disposed in the chamber 106 for controlling communication between the chamber 105 and said chamber 106. The valve 112 is provided with a fluted stem 113 which is slidably mounted in a suitable bore extending through the partition 109, a valve seat being formed in the end of said bore opening into the chamber 106 to accommodate the valve 112. Both of the fluted stems 111 and 113 project into and meet in the chamber 105. A bias spring 114 is disposed in the chamber 106 and arranged to urge the valve 112 toward its seat and, at the same time, through engagement of stems 111 and 113, to urge the valve 110 away from its seat. The valve 110 is operably connected to the diaphragm 101 by means of a rod or stem 115 extending through a bore in the partition 107. A control spring 116 is provided in chamber 103 to oppose deflection of the diaphragm 101 in the direction of the chamber 103.

In operation of the valve device shown in Fig. 2, with the chamber 103 open to atmosphere, upon supply of fluid under a pressure sufficient to overcome action of the control spring 116, the diaphragm 101 will deflect in the direction of the chamber 103 against the action of bias spring 114 and cause seating of the valve 110 and unseating of the valve 112. With valve 110 closed and the valve 112 open, chamber 105 will be closed to the chamber 104 and open to the chamber 106. Upon subsequent reduction in pressure of fluid below a certain value as determined by compression of spring 116, the bias spring 114 and the control spring 116 will return the diaphragm 101 and valves 110 and 112 to the position in which they are shown in the drawing, the valve 112 being seated and the valve 110 being unseated. With valve 110 unseated and valve 112 seated, the chamber 105 will be closed to the chamber 106 and open to the chamber 104.

Upon referring to relay valve devices 4 and 7 as shown in Fig. 1, when valve 110 is unseated and valve 112 seated, as shown in Fig. 2, a communication, indicated symbolically in Fig. 1 of the drawing by a solid line bearing the reference numeral 118, will be established to connect chamber 105 to chamber 104. Similarly, when valve 110 is seated and valve 112 unseated, a communication, indicated symbolically by a broken line bearing the reference numeral 119, will be established to connect chamber 105 to atmosphere. When one of the communications 118, 119 is established, the other of said communications simultaneously will be disestablished.

The throttle adjusting motor 3 may be any of the usual fluid pressure responsive type having a spring-pressed diaphragm (not shown) positively connected to a stem 60 which at its outer end is pivotally connected by means of a pin 64 to a throttle control lever 61 intermediate its ends. As shown in the drawing, the lever 61 is held in its idling position by the spring and is adapted to be rocked in a clockwise direction about a fulcrum 62 at its one end for advancing the throttle as the pressure of fluid supplied through a pipe 63 from relay valve device 4 is increased.

The operator's control valve device 8 is provided for manually controlling operation of the apparatus above described. The operator's control valve device comprises what may be called forward and reverse control valve devices 70 and 71, respectively, and a self-lapping throttle control valve device 72. The control valve device 8 further comprises a shaft 73 supported and journaled at its ends in the casing of the device and provided with three cams 74, 75 and 76 rigidly secured to said shaft for operating the forward and reverse control valve devices 70, 71 and the throttle control valve device 72, respectively.

The forward and reverse control valve devices 70 and 71 are arranged with the axes of release valve stems 77 at right angles to the axes of the cams 74 and 75. The cam 74 (Fig. 3) is so designed as to actuate the forward control valve device 70 to connect a fluid pressure supply pipe 78 to the forward control pipe 53 when a control handle 79, which is rigidly secured to shaft 73, is pushed forward of its central neutral position and to connect said control pipe 53 to atmosphere in neutral and reverse positions. The cam 75 is identical to cam 74 but reversely arranged so as to actuate the reverse control valve device 71 to connect supply pipe 78 to reverse control pipe 49 when control handle 79 is pulled back of neutral position and to connect control pipe 49 to atmosphere in all other positions.

The control valve devices 70 and 71 are identical in structure, so the corresponding parts in each structure will be numbered the same. Each of these devices comprises a supply valve 80 contained in a supply chamber 81 which is open to supply pipe 78, said valve being arranged to control communication from chamber 81 through a bore 82 to a chamber 83 which is in constant communication

with control pipe 53 in the case of the forward control valve device 70 and with control pipe 49 in the case of the reverse control valve device 71. Also contained in chamber 81 is a bias spring 84 which constantly urges valve 80 into seating engagement with a seat rib 85 encircling the bore 82.

Slidably mounted in bore 82 is a plunger 86 having an axial bore 87 open at one end to said chamber and open at the other end to atmosphere by way of cross-ports 88. The plunger 86 makes sealing engagement with the wall of bore 82 by means of a sealing ring 89 located in a suitable groove between the cross-ports 88 and the open end. Interposed between a spring seat 90 mounted on plunger 86 and the casing is a spring 91 which presses said plunger into operative engagement with the peripheral surface of either cam 74 or 75, as the case may be.

The throttle control valve device 72 is of the self-lapping type provided to vary pressure of fluid in a throttle control pipe 92 to govern means, not shown in the drawing and which form no part of the present invention, for varying the speed or power output of an engine in proportion to the pressure of such fluid. In brief, the device 72 comprises a control plunger 93 and a valve means (about to be described) operable upon displacement of said plunger from a normal position, in which it is shown in the drawing, into the device to provide fluid in pipe 92 at a pressure corresponding to the degree of such displacement. With plunger 93 in its normal or outermost position a minimum pressure of fluid such as atmospheric will be provided in pipe 92 which is adapted to cause operation of the engine at idling speed.

The cam 76 (Fig. 4) is provided for controlling the displacement of plunger 93 and is operatively connected thereto through the medium of a ball end 94 of an arm 95, the opposite end of which is fulcrumed to rock on a pin 96 in the casing. The cam 76 is so designed as to allow the plunger 93 to remain in its normal position shown in Fig. 1 of the drawing with the operator's lever 79 in its upright "Idle" position and is operable upon movement of the lever in either a push or pull direction to depress the plunger a degree in proportion to the extent of such movement. The maximum displacement of plunger 93 into the device and maximum pressure in pipe 92 will be obtained upon movement of lever 79 to its extreme forward or backward position.

The throttle control valve device 72 further comprises a casing having a fluid pressure supply chamber 162 connected through a passage 163 to supply pipe 78 and a delivery chamber 168 connected through a passage 167 to throttle control pipe 92, and an exhaust chamber 169 open to atmosphere through a port 170 in the casing. A supply valve seat member 171, secured to the plunger 93 by screw-thread means 172 is slidably mounted in a bore 173 in the casing for movement by said plunger. The valve seat member 171 together with plunger 93 form a chamber 174 which is also open to supply chamber 162 by way of ports 175 and may be connected to delivery chamber 168 by way of a central opening 185. Contained in the chamber 174 is a ball-shaped supply valve 176 for cooperation with a valve seat 177 encircling the opening 185 to control flow of fluid under pressure from supply chamber 162 to delivery chamber 168. Also contained in chamber 174 is a bias spring 178 constantly urging supply valve 176 towards its seated position shown.

A ball-shaped release valve 179 contained in delivery chamber 168 is rigidly connected to supply valve 176 by means of a stem 180 which extends through opening 185. A follower member 181 which extends through and is clamped to the perimeter of a central opening 182 in a diaphragm 183 is provided with an axial conduit 184 through which fluid under pressure may flow from chamber 168 above said diaphragm to exhaust chamber 169 at the lower side of said diaphragm, and thence to atmosphere through the opening 170 in the casing. Contained in chamber 168 and interposed between valve seat member 171 and diaphragm follower member 181 is a bias spring 186. Contained in chamber 169 and interposed between a follower nut 187 and an adjustable spring seat 188 is a control spring 189 provided for the purpose of determining the degree of fluid pressure to be obtained in delivery chamber 168 for a given degree of displacement of plunger 93.

In operation, let it be assumed that the engine is idling and that the various parts of the clutch and throttle control apparatus are positioned as shown in the drawing. With relay valve device 7 positioned as shown, fluid under pressure will be supplied from a suitable source (not shown) through pipe 78, communication 118 in said relay valve device and pipe 24 to chamber 23 to act on the outer face of piston 22 in motor device 1. Fluid under pressure thus supplied to pipe 24 will also flow past valve 190 in check valve device 18 and through pipe 17 into chamber 16 to act on the outer face of piston 11 in motor device 1. Fluid under pressure supplied to pipe 78 will also flow to supply chambers 81, 81 and 162 in forward and reverse control valve devices 70 and 71, and throttle control valve device 72, respectively.

Now if the operator wishes to proceed in a forward direction he will push the handle forward a limited amount sufficient to operate the clutch control mechanism 70 to rock the shaft 28 in a clockwise direction, as viewed in Fig. 1, to a position for forward movement. As can be seen from Fig. 3 initial movement of cam 74 will actuate the plunger 86 of valve device 70 downward against the force of spring 91 into contact with supply valve 80, thereby closing off connection of chamber 83 to atmosphere. Further clockwise movement of cam 74 will cause supply valve 80 to move away from the seat rib 85 against the additional force of spring 84. With valve 80 unseated, fluid under pressure supplied to chamber 81 through pipe 78 will flow through opening 82 to chamber 83, whence it will flow through pipe 53 to chamber 31 in pilot valve device 5.

With cam 29 and pilot valve 5 positioned as shown in Fig. 1, fluid under pressure supplied to chamber 35 will flow past valve 30 into chamber 31, whence it will flow through pipe 20 to chamber 19 where it will act outwardly on pistons 11 and 22.

Fluid under pressure supplied to pipe 53 at this time will also flow through check valve device 55 and pipe 56 to chamber 102 (Fig. 2) in relay valve device 7, there to deflect diaphragm 101 downwardly and cause communication 118 therein to be cut off and communication 119 to be opened. Fluid under pressure previously supplied to chamber 23 through communication 118 in relay valve device 7 will now flow through pipe 24 to atmosphere through communication 119 in said device. Likewise, fluid under pressure previously supplied to chamber 16 will flow to atmosphere through pipe 17, check valve device 18, pipe 24 and communication 119. With pressure of fluid in chambers 16 and 23 reduced to atmosphere, piston 22 will move outwardly to the left from the position shown and piston 11 will move outwardly to the right from the position shown in response to pressure of fluid in chamber 19.

When outward movement of piston 11 has been stopped by contact with shoulder 27, clutch control member 2 will have been rocked to its forward drive position in which spring 36 in pilot valve device 5 will be permitted by cam 29 to close valve 30, cutting off further flow of fluid under pressure to chamber 19, and to permit opening of valve 40, thereby connecting chamber 19 to atmosphere through pipe 20, chamber 31, bore 37, chamber 38 and ports 39. Pistons 11 and 22 will now be relieved of pressure of fluid above atmosphere.

It will be observed that fluid under pressure supplied to pipe 20 may also flow through double check valve 47 (similar in structure to check valve 18) to control chamber 102 in relay valve device 4, in response to which com-

munication 118 therein will be cut off and the communication 119 will connect pipe 63 to atmosphere. If the throttle control lever 61 had not already been in idling position by reason of chamber 168 being at atmospheric pressure, the operation of relay valve device 4 just described would insure its assuming such position before operation of the throttle control is undertaken. When pipe 20 is vented to atmosphere, as described in the preceding paragraph, relay valve device 4 will operate to connect pipe 92 to pipe 63 through its communication 118 to provide for control of the throttle through manipulation of handle 79 into the forward speed zone.

As may be seen in Fig. 4, the contour of the periphery of cam 76 is such that plunger 93 is depressed more and more as the cam is rotated by handle 79 in either direction from idling position, in which it is shown in the drawing. When plunger 93 is moved inwardly of the casing a certain distance the attached supply valve seat member 171 will carry, through the medium of supply valve 176 and stem 180, the exhaust valve 179 into sealing contact with follower member 182, thereby cutting off connection of delivery chamber 168 to atmosphere through conduit 184, chamber 169 and port 170. Further downward movement of the plunger 93 will carry the supply valve seat 177 away from the supply valve 176, which will be held stationary at this time by the follower member 181. Upon opening of supply valve 176 fluid under pressure supplied through pipe 78 to chamber 162 will flow to delivery chamber 168, whence it will flow through passage 167, pipe 92, communication 118 and pipe 63 to throttle adjusting motor 3. When the pressure of fluid in delivery chamber 168 has become sufficient to overcome the opposing force of spring 189, diaphragm 183 will deflect downwardly and permit spring 178 to close supply valve 176. In response to fluid pressure thus attained in chamber 168 the throttle control motor 3 will rock lever 61 about its fulcrum 62 to a position corresponding to the degree of pressure in said chamber. If it is desired to open the throttle further, the procedure just described may be repeated by pushing handle 79 further in the forward speed zone, increasing the pressure of fluid delivered to motor 3, and increasing the displacement of lever 61.

When the operator wishes to reduce the throttle opening, he may draw handle 79 toward neutral and idling position which will cause motor 3 to rock lever 61 counterclockwise to a corresponding position. As the cam 76 is rotated toward idling position, spring 186 will actuate seat member 171 upwardly, carrying exhaust valve 179 out of contact with follower member 181, which up to this time has been held stationary by the pressure of fluid in chamber 168. With valve 179 unseated fluid under pressure in chamber 168 will flow through conduit 184, chamber 169, and port 170, until pressure in chamber 168 balances with control spring 189 and follower 181 is actuated into sealing contact with exhaust valve 179. If handle 79 is returned to idling position, the various valve parts and lever 61 will assume the position in which they are shown in the drawing.

If the operator wishes to proceed in a reverse direction, he will draw the handle 79 backward from its neutral and idling position a limited amount sufficient to rock shaft 28 in counter-clockwise direction, as viewed in Fig. 3, to a position for reverse movement. The operation will be substantially the same as that described for forward movement. The reverse control valve device 71 will be operated by cam 75 to supply fluid under pressure to pilot valve device 6 and to relay valve device 7 in the same manner as that described in connection with operation of valve device 70 supplying fluid under pressure to pilot valve device 5 and relay valve device 7. The relay valve device 7 will operate as before described to vent fluid under pressure from chamber 23 to atmosphere. In this case, however, valve 190 in check valve device 18 will operate in response to pressure of fluid in pipe 146 to cut off the communication 119 in relay valve device 7 from chamber 16 and to connect pipe 17, leading to said chamber 16, to pipe 146 leading to pilot valve device 6.

Chamber 19 in motor device 1 is connected to atmosphere also through pipe 20, chambers 31 and 35 in pilot valve device 5, and chamber 83, bore 87 and ports 88 in forward valve device 70. With chambers 23 and 19 thus vented to atmosphere fluid under pressure supplied to chamber 16 will act on piston 11, and together with piston 22, move both pistons to their extreme left-hand position defined by piston 22 contacting a stop 57 at the left hand end of bore 21 and piston 11 contacting piston 22, in which position lever 2 will be positioned for movement in a reverse direction.

By this operation cam 29 will be rotated in a counterclockwise direction, as viewed in Fig. 1, to a position in which said cam will permit spring 136 to actuate valve 45 to cut off further supply of fluid under pressure to pipe 146 and permit unseating of valve 50 by pressure of fluid in said pipe to open said pipe to atmosphere in the same manner as that described in connection with control of pilot valve device 5 by cam 29.

As in the case of actuating clutch lever 2 to forward position, fluid under pressure supplied to motor device 1 for operating same is also supplied to the other inlet side of double check valve 47, and thence by way of a pipe 58 to control chamber 102 of relay valve device 4. In response to pressure of fluid thus supplied, relay valve device 4 will operate to cut off communication 118 and connect motor device 3 to atmosphere through pipe 63 and communication 119 with the result that throttle control lever 61 will be returned to its idling position in which it is shown.

As previously noted upon referring to Fig. 4, the radius of cam 76 increases in like amounts in opposite angular directions from a centrally located idling position. Consequently, the procedure for controlling the throttle in reverse movement will be the same as that for forward movement except that the direction of movement of handle 79 is reversed. That is to say, the further back the handle is drawn, the more the throttle will be opened, and vice versa.

From the foregoing it will now be seen that the improved clutch and throttle control apparatus provides for selective control of the position of the clutch lever 2 and throttle control lever 61 through the manipulation of a single control handle in one plane of rotation. This apparatus also embodies automatic means operative upon actuating the clutch lever 2 to a selected directional position to return the throttle control to idling position for further operation by means of the control handle, and also, means for automatically relieving the power means for actuating the clutch lever of fluid pressure after attaining the selected directional position.

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

1. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to pressure of fluid in said first and third chambers to actuate said member to said neutral position, in response to pressure of fluid in said second chamber to actuate said member to said forward position, and in response to pressure of fluid in said third chamber to actuate said member to said reverse position, a double check valve controlling communication to said third chamber, a forward control pipe, a reverse control pipe, one pilot valve device operable by said clutch control member to make connection between said forward control

pipe and said second chamber when said member is in reverse or said neutral position and operable to close off said forward control pipe and to vent said second chamber to atmosphere when said member is in its forward position, another pilot valve device operable by said member to make connection between said reverse control pipe and one inlet side of said double check valve when said member is in forward or neutral position and operable to close off said reverse control pipe and to connect said one inlet side to atmosphere when said member is in its reverse position, a neutral control pipe leading to said first chamber and to the other inlet side of said double check valve, a relay valve device normally supplying fluid under pressure to said neutral control pipe operative in response to pressure of fluid supplied to either of said forward or reverse control pipes to cut off said neutral control pipe and to connect said neutral control pipe to atmosphere, and a control valve device comprising a control handle having a neutral position, a forward control valve operable by movement of said handle in a certain direction from its neutral position to supply fluid under pressure to said forward control pipe, and a reverse control valve operable by movement of said handle from its neutral position in a direction opposite to said certain direction to supply fluid under pressure to said reverse control pipe.

2. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to preponderance of fluid pressure in said first and third chambers over fluid pressure in said second chamber to actuate said member to said neutral position, in response to a preponderance of fluid pressure in said second chamber over fluid pressure in said third chamber to actuate said member to said forward position, and in response to a preponderance of fluid pressure in said third chamber over fluid pressure in said first and second chambers to actuate said member to said reverse position, a forward control pipe, a reverse control pipe, one pilot valve device operable by said member when said member is in said neutral or reverse position to connect said forward control pipe to said second chamber and operable when said member is in said forward position to close off said forward control pipe and to vent said second chamber to atmosphere, another pilot valve device operable by said member when said member is in its forward or neutral position to connect said reverse control pipe to said third chamber and operable when said member is in its reverse position to close off said reverse control pipe and connect said third chamber to atmosphere, a relay valve device having a normal position in which fluid under pressure is supplied to said first chamber and said third chamber and operative in response to pressure of fluid in said forward control pipe to vent said first chamber and said third chamber to atmosphere and operative in response to pressure of fluid in said reverse control pipe to vent fluid under pressure from said first chamber to atmosphere, and a control valve device comprising a control handle having a neutral position, a forward control valve operable by movement of said handle in a certain direction from its neutral position to supply fluid under pressure to said forward control pipe, and a reverse control pipe operable by movement of said handle from its neutral position in a direction opposite to said certain direction to supply fluid under pressure to said reverse control pipe.

3. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to fluid pressure in said first and third chambers to actuate said member to said neutral position, in response to fluid pressure in said second chamber to actuate said member to said forward position and in response to fluid pressure in said third chamber to actuate said member to said reverse position, a forward control pipe, a reverse control pipe, a forward delivery pipe leading to said second chamber, a reverse delivery pipe leading to said third chamber, one pilot valve device operable by said clutch control member when said member is in said neutral or said reverse position to connect said forward control pipe to said forward delivery pipe and when said member is in said forward position to close off said forward control pipe and vent said forward delivery pipe to atmosphere, another pilot valve device operable by said member when said member is in said neutral or in said forward position to connect said reverse control pipe to said reverse delivery pipe and operable when said member is in said reverse position to close off said reverse control pipe and vent said reverse delivery pipe to atmosphere, a relay valve device having a normal position in which fluid under pressure is supplied to said first chamber and said third chamber and operable in response to pressure of fluid in said forward control pipe to vent said first chamber and said third chamber to atmosphere and operative in response to pressure of fluid in said reverse control pipe to vent said first chamber to atmosphere, a speed control element, speed control means for said speed control element adjustable by fluid under pressure to position said element for a speed proportional to the pressure of such fluid, a speed control pipe, a second relay valve device normally connecting said speed control pipe to said speed control means and operative in response to pressure of fluid in either of said delivery pipes to cut off said speed control pipe and connect said control means to atmosphere, and a control valve device comprising a control handle, a self-lapping valve mechanism operable by said handle to increase pressure of fluid supplied to said speed control pipe in accordance with the angular displacement of said handle from its neutral position in either one of two opposite directions, a forward control valve operable by movement of said handle in a certain one of said two opposite directions to supply fluid under pressure to said forward control pipe, and a reverse control valve operable by movement of said handle in the other of said two opposite directions to supply fluid under pressure to said reverse control pipe.

4. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to fluid pressure in said first and third chambers to actuate said member to said neutral position, in response to fluid pressure in said second chamber to actuate said member to said forward position, and in response to fluid pressure in said third chamber to actuate said member to said reverse position, a double check valve controlling communication to said third chamber, a forward control pipe, a reverse control pipe, one pilot valve device operable by said clutch control member to make connection between said forward control pipe and said second chamber when said member is in reverse or neutral position and to cut off said connection and connect said second chamber to atmosphere when said member is actuated to said forward position, another pilot valve device operable by said member to make connection between said reverse control pipe and one inlet side of said double check valve when said member is in forward or neutral position and to cut off said connection and to connect said one inlet side to atmosphere when said member is actuated to said reverse position, a relay valve device normally supplying fluid under pressure to a pipe leading to said first chamber and to the other inlet side of said

double check valve and operative in response to pressure of fluid supplied to either of said control pipes to cut off said supply to the last said pipe and to connect the last said pipe to atmosphere, a prime mover, control means for said prime mover adjustable by fluid under pressure to effect operation of said prime mover at a speed proportional to the pressure of such fluid, a speed control pipe, a second relay valve device normally connecting said speed control pipe to said control means and operative in response to pressure of fluid supplied to either said second chamber or said one inlet side to cut off said speed control pipe and connect said control means to atmosphere and a control valve device comprising a control handle, a self-lapping valve mechanism operable by said handle to increase pressure of fluid supplied to said speed control pipe as said handle is displaced angularly in either of two opposite directions from its neutral position, a forward control valve operable by movement of said handle in a certain direction from its neutral position to supply fluid under pressure to said forward control pipe, and a reverse control valve operable by movement of said handle from its neutral position in a direction opposite to said certain direction to supply fluid under pressure to said reverse control pipe.

5. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to fluid pressure supplied to said first and third chambers to actuate said member to said neutral position, in response to pressure of fluid supplied to said second chamber to actuate said member to said forward position, and in response to pressure of fluid supplied to said third chamber to actuate said member to said reverse position, a forward control pipe for supplying fluid under pressure to said second chamber, a reverse control pipe for supplying fluid under pressure to said third chamber, a control valve device having a handle having a neutral position and valve means operable upon movement of said handle in a certain direction from said neutral position to supply fluid under pressure to said forward control pipe and operable upon movement of said handle in the opposite direction from said neutral position to supply fluid under pressure to said reverse control pipe, and pilot valve means interposed between said control valve device and said motor means operable upon movement of said member to said forward position to close off said forward control pipe and vent said second chamber to atmosphere and operable upon movement of said member to said reverse position to close off said reverse control pipe and vent said third chamber to atmosphere.

6. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to fluid pressure supplied to said first and third chambers to actuate said member to said neutral position, in response to pressure of fluid supplied to said second chamber to actuate said member to said forward position, and in response to pressure of fluid supplied to said third chamber to actuate said member to said reverse position, control means selectively operable to supply fluid under pressure to either said second chamber or said third chamber, relay valve means normally supplying fluid under pressure to said first and said third chambers and operative in response to pressure of fluid supplied from said control means to said second chamber to cut off the supply of fluid under pressure to said first and third chambers and connect said first and third chambers to atmosphere and operative in response to pressure of fluid supplied from said control means to said third chamber to cut off the supply to said first chamber and connect said first chamber to atmosphere, and pilot valve means interposed connectively between said control means and said motor means operative in neutral position of said member to connect said control means to said second chamber and said third chamber, in forward position of said member to cut off said second chamber from said control means and connect said second chamber to atmosphere, and in reverse position of said member to cut off said third chamber from said control means and connect said third chamber to atmosphere.

7. In combination, a clutch control member having a forward position, a reverse position and a neutral position intermediate the aforesaid positions, motor means for positioning said clutch control member in any one of said positions, said motor means having first, second and third chambers and being operative in response to fluid pressure supplied to said first and third chambers to actuate said member to said neutral position, in response to pressure of fluid supplied to said second chamber to actuate said member to said forward position, and in response to pressure of fluid supplied to said third chamber to actuate said member to said reverse position, control means selectively operable to supply fluid under pressure to either said second chamber or said third chamber, relay valve means normally supplying fluid under pressure to said first and said third chambers and operative in response to pressure of fluid supplied from said control means to said second chamber to cut off the supply of fluid under pressure to said first and third chambers and connect said first and third chambers to atmosphere and operative in response to pressure of fluid supplied from said control means to said third chamber to cut off the supply to said first chamber and connect said first chamber to atmosphere, pilot valve means interposed connectively between said control means and said motor means operative in neutral position of said member to connect said control means to said second chamber and said third chamber, in forward position of said member to cut off said second chamber from said control means and connect said second chamber to atmosphere, and in reverse position of said member to cut off said third chamber from said control means and connect said third chamber to atmosphere, a throttle control member, a second motor means for actuating said throttle control member in proportion to the degree of pressure of fluid supplied thereto, throttle control valve means associated with said control means for varying pressure of fluid supplied to said second motor means, and relay valve means normally connecting said throttle control valve means to said second motor means and operative in response to pressure of fluid supplied to either said second chamber or said third chamber to cut off said second motor means from said throttle control means and connect said second motor means to atmosphere.

References Cited in the file of this patent

UNITED STATES PATENTS

2,524,487	Stevens	Oct. 3, 1950
2,580,367	Stevens	Dec. 25, 1951