Dec. 26, 1944. W. F. F. MARTIN-HURST 2,366,121

ELECTRICALLY-CONTROLLED FLUID-PRESSURE OPERATED MOTOR

Filed March 25, 1943 2 Sheets-Sheet 1

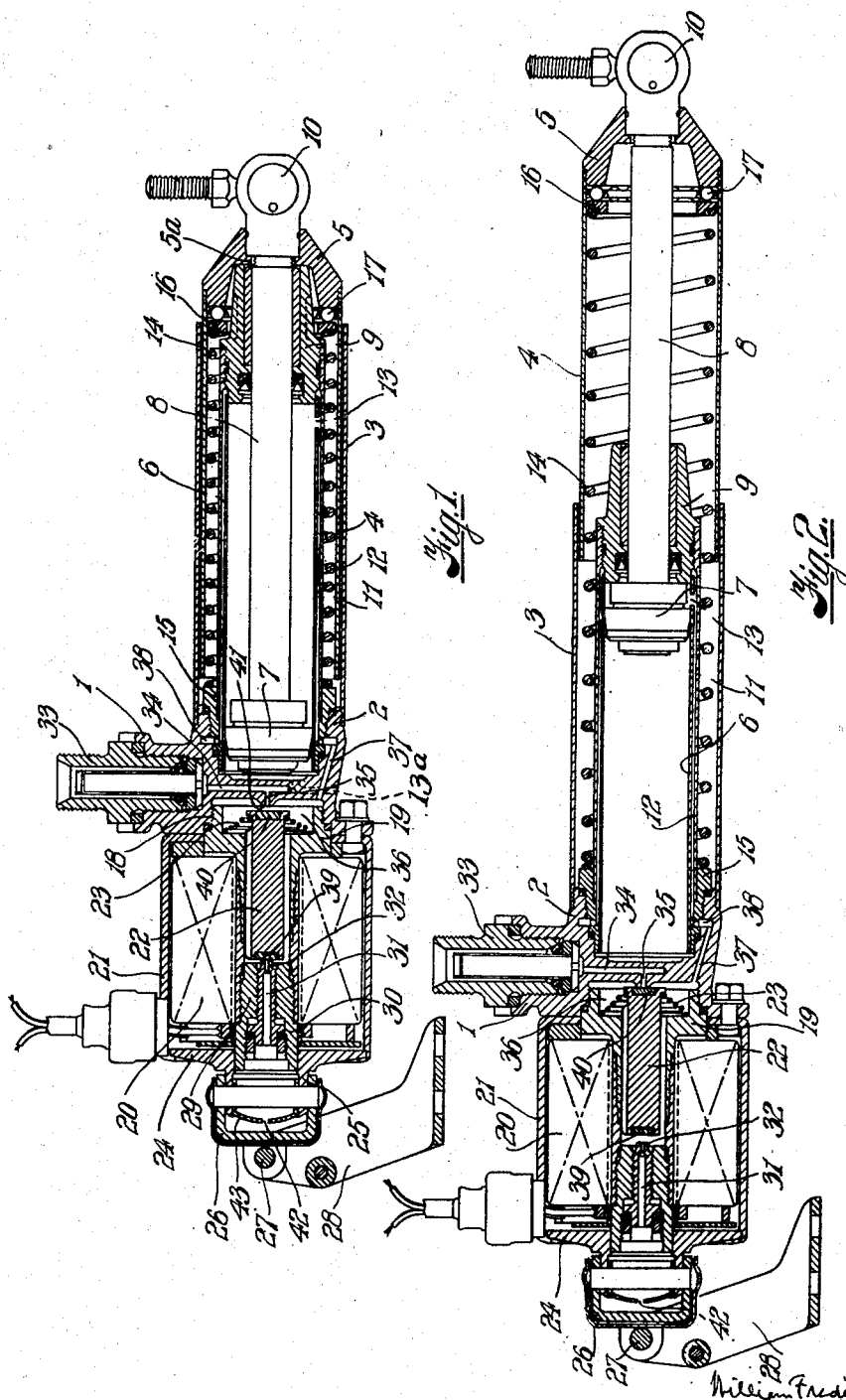


Fig. 1.

Fig. 2.

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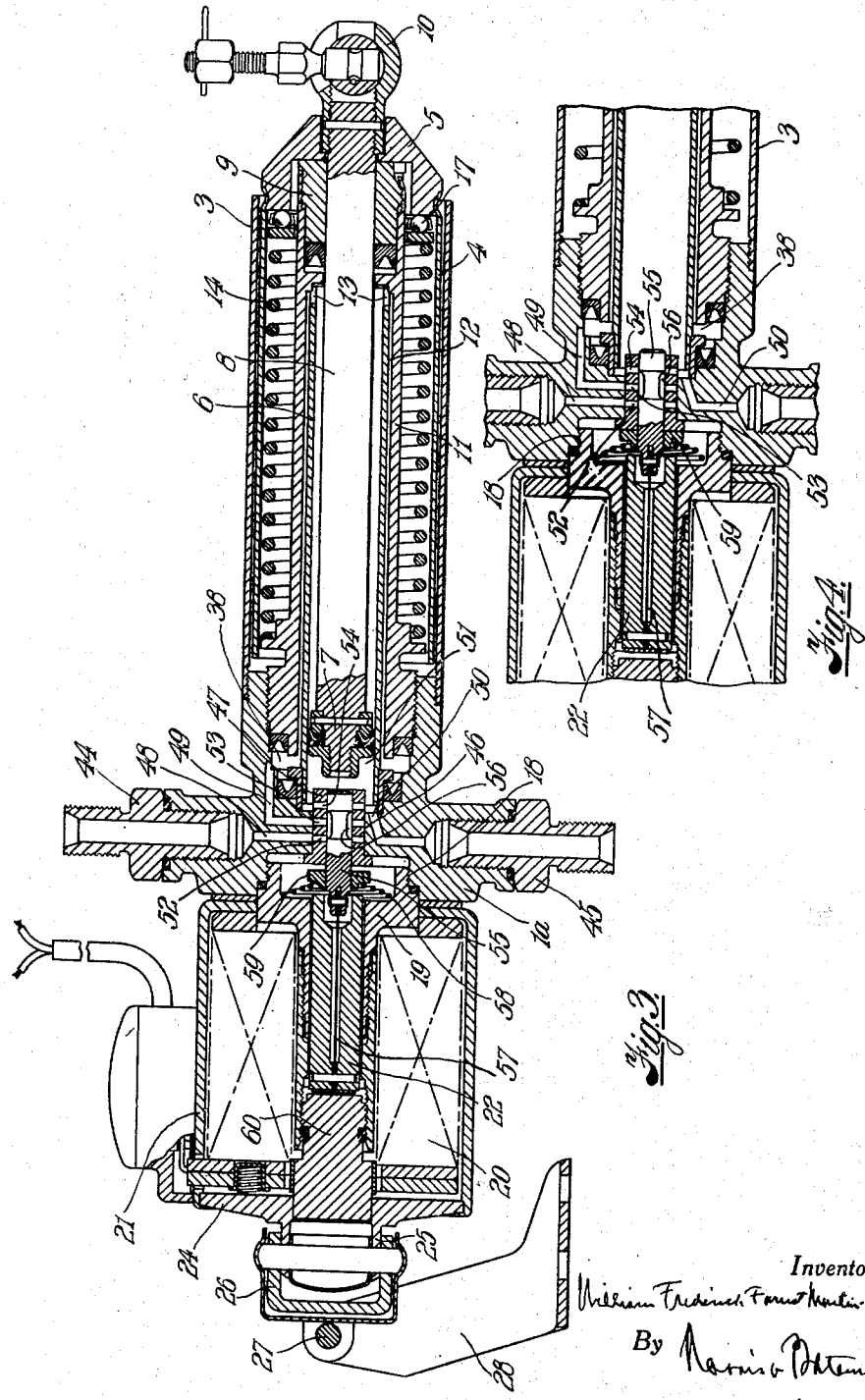


Fig. 4

Fig. 3

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ELECTRICALLY CONTROLLED FLUID-PRESSURE OPERATED MOTOR

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Application March 25, 1943, Serial No. 480,564
In Great Britain October 16, 1942

7 Claims. (Cl. 121—38)

This invention relates to electrically-controlled, fluid-pressure operated motors such as are used for operating control members on aircraft and the like, the invention having particular but not exclusive application to electrically-controlled pneumatic or hydraulic motors used for actuating a two-speed supercharger control gear under control of a manual or a barometric, thermostatic or other automatic switch.

The object of the invention is to provide an improved and compact form of motor which will function efficiently under all operating conditions.

According to the invention the improved motor comprises a spring-controlled telescopic housing, a plunger movable within a pressure cylinder and coupled to one of the telescopic housing members, means for supplying pressure fluid to one end of said cylinder to extend or collapse the housing against the action of the spring, and electromagnetically operated valve means for controlling the supply and release of pressure fluid to the said pressure cylinder.

Reference will now be made to the accompanying drawings which illustrate by way of example two embodiments of the invention and wherein

Fig. 1 is a longitudinal sectional elevation through an electro-pneumatic motor with the housing held in the collapsed position,

Fig. 2 is a view similar to Fig. 1 but showing the housing held in the extended position,

Fig. 3 is a view similar to Fig. 1 but showing an electro-hydraulic housing and

Fig. 4 is a fragmentary view showing the valve mechanism of Fig. 3 in the position to set and hold the housing in the extended position.

Referring first to the construction shown in Figs. 1 and 2, there is provided a main body 1 formed at one side with a tubular, screw-threaded extension 2 upon which is mounted the outer member 3 of a telescopic housing, the inner member 4 of said housing being mounted to slide in the member 3 and being closed at its end remote from the body 1 by a cap 5. Mounted coaxially within the housing member 3 is a pressure cylinder 6, a plunger 7 working in said cylinder being carried by a rod 8 which extends through a plug 9 closing the end of the cylinder and which also carries at its end a swivel 10 constructed for attachment to the control member to be actuated. The cylinder 6 is enclosed by a casing 11 which is spaced from said cylinder so as to provide an annular passage 12, the latter communicating with the interior of the cylinder by means of one or more ports 13, the inner end of the cylinder 6 having a vent 13a communicating with the atmosphere. The cap 5 is formed with a shoulder 5a which bears against the swivel 10 and a compression spring 14 surrounding the casing 11 normally urges the housing to the extended position, the said spring bearing at one end against a sleeve 15 securing the casing 11 to the extension 2 and at the other end against a ring 16 which bears against the cap 5 through the intermediary of a thrust bearing 17. The provision of the bearing 17 enables the inner housing member 4 together with the swivel to be rotated to any desired position for convenient attachment to the member to be controlled.

On the side of the body 1 opposite to that at which the motor is mounted there is provided a screw-threaded recess 18 adapted to receive a tubular member 19 which extends within a solenoid 20, the latter being enclosed by a housing 21 bolted to the main body 1. Mounted for axial movement within the tubular member 19 is an armature 22 which is urged to the right by a spiral spring 23 interposed between a shoulder on the member 19 and a flange on the end of the armature, and is moved to the left against the action of the spring by the action of the solenoid. The end of the casing 21 remote from the body 1 is closed by a cover plate 24 provided with a hollow extension 25, the said extension being pivotally mounted in a yoke 26 which in turn is carried by a pivot pin 27 mounted in a supporting bracket 28 whereby the motor can be swung to any angular position relative to the bracket. The cover plate 24 also supports a core member 29 arranged coaxial with the armature 22 and threaded to receive a detachable plug 30 having an axial bore 31, the end of the plug adjacent the armature being formed to provide a valve seating 32.

Mounted in the main body 1 is a pressure fluid inlet connection 33 communicating with a bore 34 from which a lateral passage 35 leads to a chamber 36 formed in the end of the tubular member 19. A further passage 37 connects the chamber 36 with an annular chamber 38 in communication with the annular passage 12. The armature is provided at its ends with valve elements 39, 40 respectively, said valve elements consisting each of a disc of rubber or similar resilient material recessed into the respective end walls of the armature, the valve 39 cooperating with the seating 32 whilst the valve 40 cooperates with a seating 41 formed at the outlet of the lateral passage 35.

The motor above described operates in the following manner:

When the solenoid is energised the armature is moved to the left hand position (shown in Fig. 1) closing valve 39 upon seating 32 and moving valve 40 off seating 41. Air under pressure is thus admitted to chamber 36 via passages 34 and 35 and from this chamber it passes through passage 37, annular chamber 38, annular passage 12 and ports 13 to the interior of cylinder 6 where, acting upon the rear side of the plunger, it moves the plunger assembly to and holds it in the retracted position. When the solenoid is de-energised, the spring 23 moves the armature to the right hand position (see Fig. 2), opening valve 39, 32 and closing valve 40, 41. Supply of compressed air is thus cut off and the housing is moved to the fully extended position by the spring 14. During this outward movement of the plunger assembly, the air in the cylinder is exhausted through ports 13, annular passage 12, annular chamber 38, passage 37, chamber 36, the spaces between the armature and the tubular body 19, and passage 31, the air finally escaping to atmosphere through an aperture 42 formed in a cover 43 closing the end of the tubular extension 25.

Referring now to the embodiment illustrated in Figs. 3 and 4 in which the motor is hydraulically operated, the telescopic housing, the solenoid and its housing and the motor supporting means are all constructed as in the form previously described and the component parts thereof are indicated by like reference numerals. In this form, the main body 1a is provided with pressure fluid inlet and outlet connections 44, 45 respectively and has a central bore 46 adapted to receive a ported sleeve 47. A passage 48 leads from the bore 46 to the inlet connection and a second passage 49 leads from the said bore to the annular chamber 38. A third passage 50 leads from the outlet connection to a chamber 51 into which, the end of the sleeve 47 projects. The sleeve 47 is provided with three radial ports 52, 53, 54 which communicate with the passages 48, 49 and chamber 51 respectively. Mounted to slide within the sleeve 47 and having a close fit therein is a valve member 55 provided with a peripheral groove 56 which is adapted to connect the ports 52 and 53 or 53 and 54 as will be more fully explained hereafter. The valve member is actuated by the armature 22, to which it is attached by a flexible blade 57, and is urged to the right by a spiral spring 58 bearing against a collar 59 fast on said valve member.

When the solenoid is energised, the armature and valve member are moved to the left, the movement being limited by the engagement of the armature with a core plug 60. In this position, shown in Fig. 3, the groove 56 connects the ports 52, 53 so that high presure liquid in passage 48 can pass into passage 49 and then through anuular chamber 38, annular passage 12 and ports 13 to the interior of pressure cylinder 6. In this manner the housing is moved to and held in the collapsed position. When the solenoid is de-energised, the spiral spring 58 returns the valve member 55 to the position shown in Fig. 4 where the port 52 is covered and ports 53 and 54 are connected by the groove 56 in the valve member. The pressure being thus cut off, the spring 14 extends the housing, the liquid in the cylinder being exhausted via ports 13, annular passage 12, annular chamber 38, passage 49, port 53, groove 56 and port 54 to chamber 51 from which it flows to the outlet 45 through passage 50.

For illustrative purposes, the inlet and outlet connections 44, 45 have been shown at diametrically opposed points on the main body 1a but it will be understood that they may be arranged at a closer angular disposition, for example at 90°, for convenience in attaching pipe lines which are led in the same direction.

Where the motor is employed to actuate a two-speed supercharger control gear for an aircraft engine and is under control of an altitude operated switch, it is preferred to so mount the motor that the housing is extended when holding the control gear in the position corresponding to the lower speed. In this manner, failure of the electric or fluid pressure supply leaves the supercharger operating at the lower speed and thus avoids the possibility of causing damage to the engine by excessive supercharging at low altitudes.

It will be seen that the invention provides a simple and compact form of motor capable of application to many forms of control gear and which, having relatively few moving parts, can be installed and maintained with the minimum of skilled attention.

I claim:

1. A fluid pressure operated motor including a main body, a motor cylinder supported at one end by said body, a plunger mounted to reciprocate in said cylinder, a rod carrying said plunger, a telescopic housing comprising members enclosing said cylinder, one member of said housing being mounted on one side of said body and another member thereof being movable and carried by the plunger rod, a casing enclosing the motor cylinder and providing an annular, axially extending passage through which pressure fluid is led to the outer end of the cylinder to move the plunger towards the inner end of the motor cylinder, spring means mounted externally of the motor cylinder and enclosing casing and urging the plunger towards the outer end of the cylinder, a pressure fluid inlet connection on said main body, an exhaust port, an axially movable valve member, communications controlled by said valve member being provided between said pressure fluid inlet and the exhaust port and said annular passage, and an electromagnetic device for actuating said valve member, said electromagnetic device being also carried by the main body and being mounted on the side thereof opposite to that at which the motor cylinder is supported.

2. A fluid pressure operated motor as claimed in claim 1, wherein said spring means consists of a helical compression spring surrounding the motor casing, one end of said spring bearing directly against said main body, and including a member connecting the movable member of the telescopic housing to the plunger rod, and a thrust race through the intermediary of which the other end of said spring bears against said connecting member.

3. A fluid pressure operated motor as claimed in claim 1, wherein said electromagnetic device comprises a solenoid and an axially movable armature therefore, and including a chamber communicating with said annular passage and having a port communicating with said pressure fluid inlet and a valve seat for said port, and a core plug mounted coaxial with said armature and having a bore leading to said exhaust port, and a seat controlling said bore, said armature being movable to one extreme position to engage one end

thereof with the seat on the core plug and thereby close the exhaust port and establish communication between said chamber and pressure fluid inlet, and movable to the other extreme position to engage the other end thereof with the seat on the wall of said chamber to cut off communication between said chamber and pressure fluid inlet and establish communication between said chamber and exhaust port.

4. A fluid pressure operated motor as claimed in claim 1, wherein said electromagnetic device comprises a solenoid and an axially movable armature, and said valve member is connected to said armature for movement therewith, and including a ported sleeve mounted in said main body and having ports communicating with said pressure fluid inlet, annular passage and exhaust port respectively, said valve member being mounted to slide in said sleeve and formed with a peripheral groove which cooperates with the ports in said sleeve to establish communication between the pressure fluid inlet and annular passage and close the exhaust port while the valve member is in one extreme position, and to close the pressure fluid inlet and establish communication between said annular passage and the exhaust port while the valve member is in the other extreme position.

5. A fluid pressure operated motor as claimed in claim 1, wherein said electromagnetic device comprises a solenoid and an axially movable armature, and including a spring urging the armature to a position to close the pressure fluid inlet and establish communication between said annular passage and exhaust port, and wherein said armature is moved by the solenoid to a position to close the exhaust port and establish communication between said annular passage and pressure fluid inlet.

6. A fluid pressure operated motor comprising a main body, a two-part telescopic housing mounted at one end on one side of said body, spring means urging the housing to the extended position, a pressure cylinder mounted coaxially within the housing and having a plunger movable therein and connected to the movable housing member, a casing enclosing the pressure cylinder and providing an annular passage through which pressure fluid is led to the outer end of the cylinder to collapse the housing, a pressure fluid inlet on said main body, an exhaust port, a solenoid mounted on the main body on the side thereof opposite to that on which the housing is mounted and having an armature movable axially therein, and two valve elements carried by the armature and cooperating with fixed valve seats communicating respectively with the pressure fluid inlet and exhaust port, and a spring urging said armature to one extreme position in which one of said valve elements engages the respective valve seat to close the pressure fluid inlet connection with said annular passage and to connect said passage to atmosphere through the exhaust port, said armature being moved by the solenoid to the other extreme position in which the other valve element engages the other seat to close the exhaust port connection with said annular passage and to establish communication between said annular passage and the pressure fluid inlet.

7. A fluid pressure operated motor comprising a main body, a two-part telescopic housing mounted at one end on one side of said body, spring means urging the housing to the extended position, a pressure cylinder mounted coaxially within the housing and having a plunger movable therein and connected to the movable housing member, a casing enclosing the pressure cylinder and providing an annular passage through which pressure fluid is led to the outer end of the cylinder to collapse the housing, pressure fluid inlet and outlet connections on said main body, a ported sleeve mounted in the main body and having ports therein, and passages for connecting said ports to the said pressure fluid inlet and outlet connections and said annular passage respectively, a solenoid mounted on said main body on the side thereof opposite to that at which said housing is mounted and having an armature movable axially therein, a valve member movable in said ported sleeve and connected to said armature, and a spring urging said valve member to one extreme position in which it shuts off communication between said fluid inlet and annular passage and establishes communication between said annular passage and the fluid outlet connection, and said valve member being moved by the solenoid to the other extreme position in which it closes communication between said annular passage and the fluid outlet connection and establishes communication between said annular passage and the pressure fluid inlet connection.

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