Oct. 13, 1959 J. L. GRATZMULLER 2,908,251

SINGLE ACTING HYDRAULIC MOTOR

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FIG.2

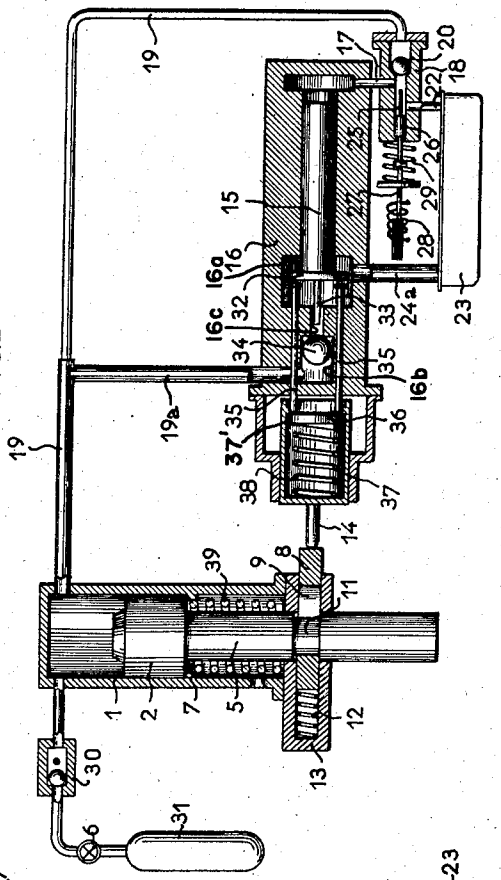
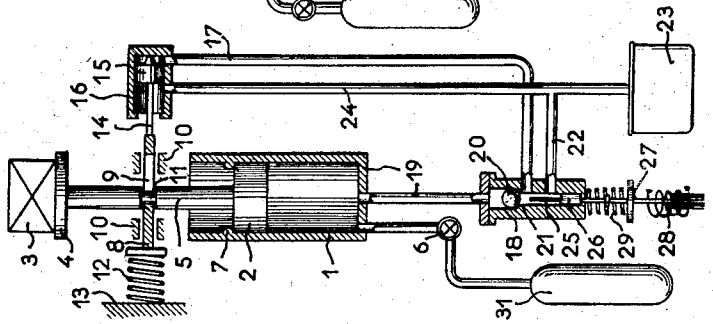


FIG.1



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SINGLE ACTING HYDRAULIC MOTOR

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10 Claims. (Cl. 121—40)

This invention relates to servo motor installations incorporating a single-acting hydraulic motor, of the kind in which the hydraulic pressure is opposed by a permanent returning force, exerted for instance by a weight or resilient means, such as a spring.

The invention is more especially concerned with installations of this nature in which the operative stroke of the motor is the return stroke, the hydraulic pressure being used to extend the motor against the returning force and bring it into readiness for the return stroke which takes place when the motor is exhausted. Such installations are adapted to the operation of the circuit-breakers.

If such a motor is maintained in readiness for actuation by the returning force solely by the hydraulic pressure, loss of pressure, due for instance to leakage or failure of the pressure source, may lead to premature actuation, either complete or partial.

An object of the present invention is the provision of means for automatically locking the motor on reaching its extended position of readiness for the return stroke, and for ensuring that the motor is unlocked substantially concurrently with or, more exactly, just before it is intentionally exhausted for the operative return stroke.

More particularly, it is an object of this invention to provide a locking member movable by a spring or like means to a position in which it engages and positively locks the movable member of the motor (hereafter referred to for better identification as the "main" motor) when said movable member reaches the extended position, said locking member being disengageable from said movable member to free the main motor by an auxiliary motor controlled by a primary valve which also controls the exhausting of the main motor.

A further object of the invention is to provide means for ensuring that the auxiliary motor cannot be prematurely actuated to free the main motor by leakage of liquid under pressure past the primary valve, said means including a drain communicating with a low-pressure region for receiving such leakage and means for blocking said drain when the primary valve is intentionally actuated to energise the auxiliary motor and exhaust the main motor.

Yet, another object of the invention is to provide means ensuring that the main motor cannot be exhausted until it is freed by the action of the auxiliary motor, such means comprising secondary valve means controlling the exhausting of the main motor, said secondary valve means being operated by the auxiliary motor, after the latter has disengaged the locking member from the movable member of the main motor, to exhaust the main motor.

A still further object of the invention is to protect the mutually engaging surfaces of the locking member of the movable member of the main motor against undue wear or eventual damage caused by excessive friction between them, by interposing between the auxiliary motor and the locking member a resilient effort-limiting device.

How these objects are attained, together with others as may hereinafter appear, will be more fully understood from the following description of two typical embodiments of the invention having reference to the accompanying drawings and given by way of example only, without implied limitation of the scope of the invention, which is defined in the hereto appended claims.

In the drawings:

Fig. 1 is a schematic, partly sectional elevation of the first embodiment and

Fig. 2 is a schematic, partly sectional view of the second embodiment.

Referring to Fig. 1, the single-acting main motor comprises a cylinder **1** and a piston **2**, which together with a piston rod **5** and a support **4** constitutes the movable member of the motor. Support **4** supports a weight **3** which provides the returning force. Extension of the movable member is limited by stops **7** which engage the piston **2**. Rod **5** passes through an elongated slot **9** in a locking member or bolt **8** which can slide transversely of rod **5** in guides **10**. When the movable member reaches the position of full extension, as shown in the figure, under the action of the hydraulic pressure of liquid supplied to the working space of the motor below the piston from a source **31** through a control cock **6**, the bolt **8** registers with a square-section groove **11** in rod **5** and the part of bolt **8** at one end of slot **9** is automatically caused to enter groove **11** to retain the movable member **2, 5, 4** in the extended position by the action of a compression spring **12**, which is interposed between the bolt **8** and a fixed abutment **13**.

Bolt **8** is displaceable from this position to free the rod **5** and piston **2** by a single-acting auxiliary motor comprising a cylinder **16** and piston **15**, whose rod **14** engages or is fixed to the end of bolt **8** remote from spring **12**.

The working space of cylinder **1** communicates with that of cylinder **16** by a passage constituted by a pipe **19** a valve chamber formed in a housing **18** and a pipe **17**. Housing **18** contains a primary valve constituted by a ball **20** and a seating **21** formed in the chamber of housing **18**. Ball **20** is removed from its seat by a push rod **25** constituting an extension of the armature of an electromagnet **28**, constituting a controllable means for actuating the valve. Excitation of magnet **28** displaces the armature and rod **25** (upwards in the figure) against the action of a loading spring **29**, trapped between a collar **27** fixed to rod **25** and a fixed abutment at the base of housing **18**, to unseat the ball **20**. This puts the working space of cylinder **16** into communication with the source **31** of liquid under pressure through the passage **17, 18, 19** and the working space of cylinder **1**, causing the piston **15** of the auxiliary motor to move (to the left in the figure) and displace the bolt **8** to free the rod **5** and piston **2**. When, and only when, this has taken place, the piston **15** uncovers a port in cylinder **16** whose working space is thereby put into communication with a drain pipe **24** leading to a sump **23**. Piston **15** thus constitutes a secondary valve means which, when the main motor has been unlocked, enables its working space to be exhausted to the sump through the passage **17, 18, 19**, the working space of the auxiliary motor and pipe **24**.

Normally, the chamber of housing **18** below the seating **21** is in communication with the sump **23** through a drain **22**, which removes any liquid leaking past the ball **20** when seated. Such leakage cannot therefore build up pressure in the auxiliary motor and cause its premature actuation. When, however, the magnet **28** is excited to raise the push rod **25** and unseat the ball **20**, a valve piston **26**, which is secured on rod **25** and fits closely in the chamber of housing **18**, blocks drain **22**, enabling pressure to be applied to the auxiliary motor through pipe **17**.

The operation of the assembly may thus be summarized as follows:

On applying hydraulic pressure to the main motor 1, 2 from source 31, the motor is extended against the returning force of weight 3. When fully extended, the motor is locked automatically by engagement of bolt 8 with groove 11 under the action of spring 12. Loss of pressure in motor 1, 2 will therefore not cause the weight 3 to return the piston 2 and rod 5 to idle position, so that the pressure cock 6 may now be closed. When the motor 1, 2 is required to perform its operative return stroke under the action of weight 3, magnet 28 is excited by appropriate switch means (not shown) to unseat ball 20 and thereby apply pressure from source 31 to the auxiliary motor 16, 15 which thereupon first displaces bolt 8 to free the main motor 1, 2, 5 and then, by putting pipes 17 and 24 into mutual communication, enables the hydraulic pressure in the main motor to be relieved through passage 17, 18, 19 and pipe 24 and the operative return stroke of the main motor to be effected by weight 3, the liquid in the main motor being exhausted through passage 17, 18, 19, cylinder 16 and pipe 24.

The embodiment of Fig. 2 and its operation are generally similar to that of Fig. 1, corresponding parts being designated by the same reference characters. It is only necessary therefore to describe the respects in which this second embodiment differs from the first in structure and function.

Referring to Fig. 2, a non-return valve 30 is interposed between the pressure cock 6 and the main motor 1, 2. The force 3 of Fig. 1 is replaced by a spring 39. The auxiliary motor piston 15 has a head 32 which actuates the bolt 8 by displacing push rods 35, a telescopic assembly comprising a piston like disc 36 and a cylindrical casing 37, between which is trapped a compression spring 38, and a push-rod 14 secured to casing 37. The telescopic assembly 36, 37, 38 constitutes an effort-limiting spring device, whose spring 38 is pre-loaded to a predetermined extent, the disc 36 being retained in the position shown in the figure by a shoulder formed on the inner surface 37′ of the casing 37. This device 36–38 will prevent the auxiliary motor 16, 15 from releasing the main motor piston and rod 2, 5 for the operative return stroke if excessive friction between the bolt 8 and the flanks of groove 11 is developed, in which case repeated forcible disengagement of the bolt 8 from groove 11 would cause excessive wear of, and eventual serious damage to, the interengaging surfaces of bolt 8 and rod 5. Such excessive friction can result from slight leakage in the main motor 1, 2 causing a loss of pressure therein which, while insufficient to make the auxiliary motor inoperative, may significantly increase the bearing load of the upper flank of groove 11 on the bolt 8.

The secondary valve through which the main motor is exhausted in this embodiment is constituted by a ball 34, which is disposed in a separate chamber 16*b* formed in the auxiliary motor cylinder 16 and normally held on its seating by the pressure in the main motor whose working space is directly connected with the above mentioned separate chamber by a pipe 19*a* of larger diameter than and branched from pipe 19 between the main motor and the primary valve 18, 20. Ball 34 is unseatable by a push rod 33 fixed to head 32, and lying in bore 16*c* communicating with the chamber and cavity 16*a* but only after the latter has been displaced sufficiently to disengage the bolt 8 from the groove 11 of the main motor piston rod 5.

When ball 34 is unseated, pipe 19*a* is put into communication, via a cavity 16*a* in the cylinder 16, with a drain 24*a* leading to sump 23.

In this arrangement therefore, the main motor 1, 2 is exhausted to the sump 23 via pipe 19*a*, the above mentioned separate ball chamber and cavity, and pipe 24*a*, and not through the working space of cylinder 16. The capacity of the passages for exhausting the main motor can thus be made great enough to ensure a sufficiently rapid return stroke under the action of spring 39, without correspondingly increasing the capacity of the passages and primary valve through which the auxiliary motor is fed with liquid.

It is to be understood that the foregoing description is given by way of example only and that the invention includes all and any modifications, changes of shape, arrangement and the like and substitution of equivalent parts and/or mechanisms as may be within the competence of those skilled in the art and are comprised within the scope of the hereto appended claims.

What is claimed is:

1. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure from said main motor to move the locking member to inoperative position, normally closed valve means preventing admission of fluid under pressure from said main motor to the auxiliary motor, said valve means also preventing exhaust of the main motor, discharge passage means controlled by said auxiliary motor for exhausting said main motor, and controllable means for opening said valve means to admit hydraulic pressure from the main motor to the auxiliary motor to thereby allow the main motor to be exhausted when the locking member has been displaced to inoperative position.

2. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with said movable member displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, a passage means interconnecting the main and auxiliary motors, a primary valve means normally closing said passage means, controllable means for opening said primary valve means to admit fluid under pressure from the main motor to the auxiliary motor, and secondary valve means actuated by the auxiliary motor for exhausting the main motor when and not until the auxiliary motor has moved the locking member to inoperative position.

3. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with the movable member displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the

extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor comprising a fixed cylinder and a movable piston operative on the admission of hydraulic pressure to said cylinder to move the locking member to inoperative position, a passage interconnecting said cylinder with the main motor, a primary valve normally closing said passage, controllable means for opening said primary valve to admit liquid under pressure from the main motor to said cylinder, a port in said cylinder and a drain connected thereto, said port being placed so as to be uncovered by said piston to allow the main motor to be exhausted through said passage and said cylinder when the said piston has moved the locking member to inoperative position.

4. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means applying a steady force to said movable member tending to return it to a retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, a passage interconnecting the main and auxiliary motors, a primary valve normally closing said passage, controllable means for opening said primary valve to admit liquid under pressure from the main motor to the auxiliary motor, a chamber, a passage interconnecting the main motor and said chamber, an opening in said chamber constituting a ball-seating, a ball normally seated thereon, a drain communicating with said opening, and a member actuated by the auxiliary motor and adapted, when the auxiliary motor has moved the locking member to inoperative position, to unseat said ball and thereby allow the main motor to be exhausted through said second-named passage, said chamber and said drain.

5. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with the movable member and displaceable between an operative position and an inoperative position and adapted when in operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, normally closed valve means preventing the admission of fluid under pressure to the auxiliary motor, said valve means also preventing exhaust of the main motor, discharge passage means for exhausting said main motor, controllable means for opening said valve to admit hydraulic pressure to the auxiliary motor and to allow the main motor to be exhausted, a drain adapted to receive leakage past said valve when closed, and other valve means actuated by said controllable means for blocking said drain when said first-named valve is opened.

6. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, a valve comprising a ball-seating and a ball normally seated thereon to prevent the admission of hydraulic pressure to the auxiliary motor and the exhausting of the main motor, discharge passage means for exhausting the main motor, a push rod adapted to unseat said ball, and controllable means for actuating said push rod to unseat said ball and thereby to admit hydraulic pressure to the auxiliary motor and to allow the main motor to be exhausted when the locking member has been displaced to inoperative position.

7. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, a valve comprising a ball-seating and a ball normally seated thereon to prevent the admission of hydraulic pressure to the auxiliary motor and the exhausting of the main motor, discharge passage means for exhausting the main motor, a push rod adapted to unseat said ball, a drain adapted to receive leakage past said ball when seated, a member mounted on said push rod and adapted, when said push rod is moved to unseat said ball, to block said drain, and controllable means for actuating said push rod to block said drain and to unseat said ball and thereby to admit hydraulic pressure to the auxiliary motor and to allow the main motor to be exhausted when the locking member has been displaced to inoperative position.

8. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for constantly applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to a retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, a normally closed valve preventing the admission of pressure to the auxiliary motor and the exhausting of the main motor, discharge passage means for exhausting the main motor, and controllable means comprising an electromagnet for opening said valve to admit fluid under pressure to the auxiliary motor and to allow the

main motor to be exhausted when the locking member has been displaced to inoperative position.

9. In combination with a main single-acting hydraulic motor comprising a fixed member, a movable member, means for constantly applying fluid under pressure to the motor to move said movable member to an extended position and means constantly applying a force to said movable member in a direction tending to return it to retracted position, a locking member directly cooperable with said movable member and displaceable between an operative position and an inoperative position and adapted when in the operative position to directly engage and positively lock said movable member when the latter is in the extended position, means constantly applying a force on said locking member in a direction urging it to operative position, an auxiliary single-acting hydraulic motor operative on the admission thereto of fluid under pressure to move the locking member to inoperative position, effort-limiting resilient means interposed between the auxiliary motor and the locking member, normally closed valve means preventing the admission of fluid under pressure to the auxiliary motor and the exhausting of the main motor, discharge passage means for exhausting the main motor, and controllable means for opening said valve to admit hydraulic pressure to the auxiliary motor and to allow the main motor to be exhausted when the locking member has been displaced to inoperative position.

10. The combination defined in claim 9, in which the effort-limiting resilient means comprises a first member displaceable by the auxiliary motor, a second member telescopically slidable on said first member, a compression spring trapped between said first and second members, and a locking member-actuating push rod mounted on said second member.

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