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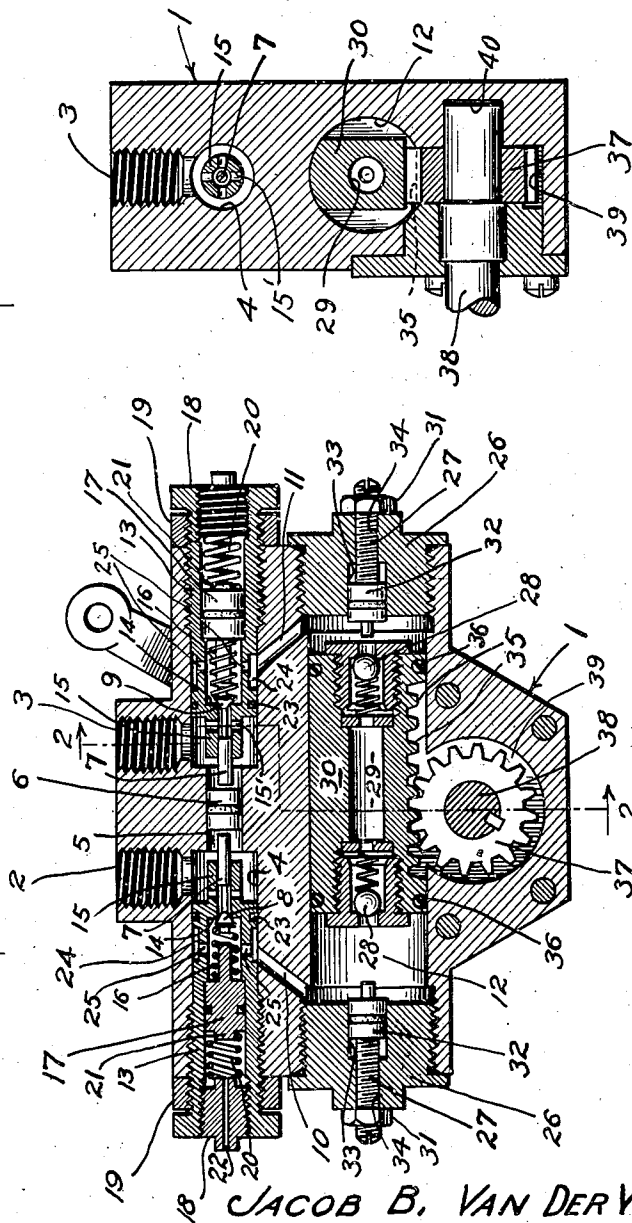
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HYDRAULIC MOTOR UNIT

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Fig. 2.

Fig. 1.



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HYDRAULIC MOTOR UNIT

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3 Claims. (Cl. 60—54.6)

This invention relates to hydraulic remote control systems by means of which aircraft engine throttles and other aircraft controls may be hydraulically operated and controlled, and more particularly relates to an improved hydraulic motor unit which is remotely controlled by means of a master or pump unit.

This application is a division of my application for United States Letters Patent Ser. No. 448,102, filed June 23, 1942, which issued as Patent No. 2,359,949 on Oct. 10, 1944, for Hydraulic remote control system.

An object of the present invention is to provide an improved hydraulic motor unit such as described which will be positive and reliable of performance by reason of built-in valves and mechanism including hydraulic locking means which operates automatically upon cessation of flow of operating fluid thereto so that the airplane control or part operated by the unit is retained in the desired position regardless of external forces.

Another object of my invention is to provide a motor unit such as described which is provided with a novel means for communicating opposite ends of the cylinder thereof through the piston therein, when said piston reaches the limit of its stroke in either direction thereby permitting passage of the fluid from one end of the cylinder to the other, thus making possible removal of entrapped air and automatic synchronization of the motor unit with the aforesaid master or pump unit.

Another object of my invention is to provide a motor unit such as described which is provided with a means for relieving excessive pressures within the cylinder which may be caused by expansion of the fluid therein due to thermal effects.

With the foregoing objects in view, together with such other objects and advantages as may subsequently appear, the invention resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed, and illustrated by way of example in the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of a motor unit embodying my invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

Referring to the drawing more specifically, it is seen that a hydraulic motor unit made in accordance with this invention includes an elongated body 1 having ports 2 and 3 providing for connection of fluid lines, (not shown) for sup-

plying operating fluid to and returning fluid from the motor unit, said ports opening into a bore 4 extending longitudinally through the body. A portion of this bore between the ports 2 and 3 is reduced and forms a small cylinder bore 5 for a valve-actuating piston 6 which is shifted responsive to the delivery of fluid under pressure through one or the other of the ports 2 and 3.

As here shown the ends of valve-actuating piston 6 are adapted to abut the stems 7 of poppet valves 8 and 9 mounted in the bore 4 so as to control the flow of fluid through cylinder passages 10 and 11 leading from opposite end portions of said bore into opposite ends of a cylinder 12 formed in the body member in spaced parallel relation to the bore 4.

Each of the valves 8 and 9 is mounted in a tubular cage 13 screwed into an end of the bore 4 so as to be axially adjustable therein. Each cage has a valve seat 14 at its inner end, also a valve stem guide member 15. Springs 16 are arranged to urge the valves 8 and 9 into seated position and to return the piston 6 to neutral position in which both of the valves are closed.

Piston members 17 are reciprocally mounted in the bores of the tubular cage 13 between the valves 8 and 9 and adjustable screw plugs 18 in the outer ends of said cages. The cages are extended beyond the ends of the body 1 and are externally screw threaded for reception of lock nuts 19 which abut the ends of the body 1. Springs 20 are arranged between the piston members 17 and the plugs 18 to normally hold the piston members extended toward the valves 8 and 9. The valve springs 16 are mounted on the keepers 21 on the piston member 17 as shown in the left end of Fig. 1. This arrangement of the piston members 17 provides means which yieldingly oppose fluid pressure in thermal expansion chambers in the bores of the valve cages 13 so that on thermal expansion of fluid in unit or upon excessive pressure of this fluid due to other causes the piston members 17 will be forced outwardly against the actions of the springs 20 to enlarge said chambers and relieve the excess pressure. Upon contraction of the fluid in the unit, the pistons 17 will be moved by the springs 20 to force fluid into the cylinder 12.

Ports 22 in the plugs 18 vent to the atmosphere the spaces between the plugs and piston members 17 to prevent formation of vacuum in said spaces and consequent inoperativeness of said pistons. The plugs 18 may be readily adjusted to provide for changing the tension of the springs

20 and varying the setting of the aforesaid thermal expansion relief means associated therewith.

The cages 13 are sealed at their inner ends by means of sealing rings 23, and at points adjacent said inner ends are formed with peripheral grooves 24 registering with the cylinder passages 10 and 11. The tubular valve stem guides 15 of the cages have portions of their bores of greater diameter than the portions of the valve stems 7 therein so that radial ports 15' formed in said guides will provide for passage of fluid into the bores of the members 15 and through the valve seats and the bores of the cages 13. Radial ports 25 in the cages afford communication of the interior of the bores of the cages 13, through the grooves 24, with the passages 10 and 11 whereby when the valves 8 and 9 are opened fluid passages are provided from the ports 2 and 3 to the ends of cylinder 12.

The cylinder 12 is closed at its ends by means of screw plugs 26 carrying suitably sealed and adjustable valve operating pins 27 for engaging and opening check valves 28 in the ends of a passage 29 extending through the motor piston 30 in said cylinder. The check valves seat towards the outer ends of the passage 29 and when the piston reaches a limit of its stroke in either direction one check valve 28 will be opened by one of the pins 27 while the other check valve 28 will be opened by pressure of the fluid against it, thereby opening the passage 29 through the piston and providing for a synchronizing displacement of fluid with respect to the end portions of the cylinder, as well as for removal of any trapped air in the motor unit.

Each of the pins 27 extends outwardly beyond the outer face of its associated plug 26 and is held in adjusted position by means of a nut 31. A piston-like guide 32 is provided on each pin 27 and is slidable in a counterbore 33 of the screw threaded opening 34 in which the pin is adjustable.

As here provided the motor piston 30 operates a drive means which includes a series of rack teeth 35 on the piston intermediate the piston ends which latter are provided with sealing rings 36. The teeth 35 mesh with pinion 37 keyed to a shaft 38 extending transversely through the body of the motor unit. The pinion 37 operates in a counterbore 39 of the bore 40 for the shaft 38 and this counterbore intersects the cylinder 12 so that the rack teeth and pinion may be enmeshed. The shaft 38 is adapted to be operatively connected by any suitable means (not shown) with the device, control member or mechanism of the aircraft (also not shown) which is to be operated or controlled thereby.

Operation

When fluid under pressure derived from a hydraulic system (not shown) is introduced through the intake port 2, the piston 6 is shifted to the right and opens the valve 9 while the pressure of said fluid is effective to open the valve 8, thereby applying pressure fluid through the passage 10 into the left end of the cylinder 12 and causing the motor piston 30 to be shifted to the right. On this movement of the piston, the rack teeth 35 and pinion 37 drive the shaft 38 so that the device or mechanism (not shown) and which is connected to the shaft, will be operated. Fluid displaced by the motor piston 30 will flow through passage 11, past open valve 9 and out through the port 3 into the hydraulic system (not shown).

When pressure fluid is shut off from the motor unit the motor piston 30 will be hydraulically locked against movement, thereby assuring the retention of the device or mechanism operated by the motor unit in the desired position as gained by operation of the motor piston, regardless of external pressures and forces tending to move such devices and the motor piston. This hydraulic locking action is effected upon cessation of flow of fluid under pressure through either of the intake ports 2 and 3, at which time the springs 16 operate to close the valves 8 and 9 and at the same time move the piston 6 into neutral position in which no valve-opening force is applied thereby to said valves.

Both ends of the motor cylinder 12 are open to the expansion chambers in the inner end portions of the bores of the tubular cages 13 whereby when excessive pressure develops in either end of the cylinder due to thermal expansion or other causes, the pistons 17 are subject to movement to relieve the pressure. The springs 20 may be adjusted as hereinbefore noted to vary the setting of the pistons 17 so that they will yield to predetermined pressures.

When fluid under operating pressure is delivered through the port 3, the valve actuating piston 5 is moved to the left and against the valve stem of valve 8 and opens said valve while the pressure of the fluid opens valve 9. This allows operating fluid to enter the right end of cylinder 12 and move motor piston 30 to the left, the displaced fluid passing from the left end of the cylinder through passage 10, past open valve 8 and out through the port 3. This operation of the motor piston causes movement of the shaft 38 in the opposite direction to that which takes place when pressure fluid is delivered through the port 2.

It is now seen that the motor unit hereof is characterized by a particular construction, combination and relative arrangement of valves, fluid responsive actuating means, and associated parts and elements such that it will have greater reliability of performance and nicety of action and control than similar devices heretofore used in the art, and at the same time be automatic as to thermal and other fluid displacement compensating actions as well as to its hydraulic locking action of its motor piston.

While I have shown and described a specific embodiment of my invention I do not limit myself to the exact details of construction set forth, and the invention embraces such changes, modifications and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. A hydraulic motor unit subject to remote control, including a body member, a hydraulic cylinder associated with said body member, a reciprocable piston in said cylinder, a drive means responsive to movement of said piston and adapted for connection with an element or device to be controlled by said motor unit, said body member having ports adapted for connection with a source of operating fluid and provided with passages leading from said ports to opposite ends of said cylinder, valves for controlling said passages arranged to be closed in the direction of the flow of return fluid from said cylinder and to be opened responsive to the pressure of the operating fluid whereby upon cessation of flow of operating fluid the piston will be hydraulically

locked against movement, fluid responsive means movable in said body member for opening one of the valves simultaneously with the fluid effected opening of the other of said valves, fluid expansion chambers in said unit connected with said passages at points between said valves and said cylinder, and means in said chambers yieldingly opposing the fluid pressures in them.

2. A hydraulic motor unit subject to remote control, including a body member, a hydraulic cylinder associated with said body member, a reciprocable piston in said cylinder, a drive means responsive to movement of said piston and adapted for connection with an element or device to be controlled by said motor unit, said body member having ports adapted for connection with a source of operating fluid and provided with passages leading from said ports to opposite ends of said cylinder, valves for controlling said passages arranged to be closed in the direction of the flow of return fluid from said cylinder and to be opened responsive to the pressure of the operating fluid whereby upon cessation of flow of operating fluid, the piston will be hydraulically locked against movement, fluid responsive means movable in said body member for opening one of the valves simultaneously with the fluid effected opening of the other of said valves; fluid expansion chambers in said body member connected with said passages at points between the valves and the cylinder, and spring loaded pistons in said chambers arranged to be moved responsive to expansion and contraction of the fluid in said cylinder and passages.

3. In a hydraulic motor unit subject to remote control, a body member, a hydraulic cylinder associated with said body member, a reciprocable motor piston in said cylinder, said body member having ports adapted for connection with a source of operating fluid and provided with cylinder passages leading from said ports to opposite ends of said cylinder, spring loaded valves controlling the flow of fluid to and from said cylinder arranged in said passages to close in the direction of the flow of fluid from said cylinder and to open responsive to the pressure of operating fluid flowing into said passages toward said cylinder whereby upon cessation of flow of operating fluid into either of said passages the motor piston will be hydraulically locked against movement in either direction, a bore in said body member having its ends open to said passages between said valves and said ports, a valve-actuating piston moving in said bore into a valve-actuating position responsive to pressure of operating fluid entering either of said passages, valve engaging means which on fluid effected movement of said valve-actuating piston will open one of said valves substantially simultaneously with the fluid effected opening of the other of said valves, fluid expansion chambers coaxial with said valves and said bore and opening into said passages at points between said valves and said cylinder, and spring loaded pistons in said chambers arranged to move responsive to expansion and contraction of fluid in said cylinders.

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