This invention relates to fluid power systems and more especially to apparatus for use in the same.

An object of my invention is the provision of a practical and reliable fluid motor assembly having sequentially operative fluid motors therein for different operating functions.

Another object of my invention is that of providing a simple and effective fluid power system wherein a plurality of fluid motors achieve sequential operation in a thoroughly satisfactory manner as from a single source of pressure fluid supply.

Another object of this invention is the provision of an efficient and reliable pump operated fluid power system wherein a plurality of fluid piston motors are sequentially operable on the fluid supply for effectively achieving different outputs of power.

A further object of my invention is the provision of a practical and reliable fluid motor assembly wherein a plurality of fluid motors are effectively controlled for operation in sequence.

A still further object of this invention is that of providing a simple and compact fluid motor assembly having a plurality of piston motors therein which are operable relative to each other in sequential cycles.

Other objects of my invention in part will be obvious and in part pointed out hereinafter.

The invention accordingly consists in the combination of elements, features of construction, and the resulting manner of operation, and the relation of each of the same to one or more of the others as described herein, the scope of the application of which is indicated in the following claims.

In the accompanying drawing which represents a preferred embodiment of my invention:

Figure 1 is a longitudinal section showing a fluid motor unit of the plural piston type in bottom stroke position of operation;

Figure 2 is a transverse section of the fluid motor unit, taken along the line A—A of Figure 1, and representing certain features of a dent in the unit;

Figure 3 is a longitudinal section of the motor unit, corresponding to Figure 1 and representing top stroke position of operation;

Figure 4 schematically represents a fluid power system including the motor unit of the preceding figures, the system being set for operating the motor unit from Figure 1 to Figure 3 position;

Figure 5 illustrates the system of Figure 4 reset to operate the motor unit from Figure 3 to Figure 1 position;

Figure 6 represents a neutral position of this same system and;

Figure 7 is a longitudinal section of a metering valve which I prefer to employ in conjunction with operation of my multiple fluid motor system.

As conduite to a clearer understanding of certain features of my invention, it may be noted at this point that fluid motors and systems including these motors are in ever growing demand for performing any of a wide variety of particular functions. Frequently, in this connection, it becomes important to employ a plurality of motors for achieving different functions and in this to arrest one of the motors relative to the operation of another so as to establish an operation sequence. Among the examples of possible uses for sequence controlled fluid motors is that of employing one of the motors for raising and lowering a press head while another motor operates in sequence to move a body such as metal work or a receptacle to and from a point where the head comes down and seats. In another category of possible uses is that of employing a fluid motor for raising and lowering retractable landing gear of an aeroplane, and using another motor for operating a locking mechanism to hold and release the gear at the inner or retracted position. There are, of course, many other possible uses for sequence controlled apparatus and systems, the above being intended merely as illustrative.

Some few types of motor sequence control systems are known in the prior art, but for the most part these amount to hydraulic or other fluid operated systems which include motors and shut-off valves for controlling the motor sequence. Many of these depend solely upon manual operation of the valves and, accordingly, produce an automatically attained sequence. There are other heretofore known systems in which the operation of sequence control equipment is unduly cumbersome and expensive, to say nothing of the cost of installation and maintenance inherent in the use of the equipment. In still other sequence control systems, as heretofore known, the very nature of the apparatus, including the vast amount of control equipment necessary to operation, eliminates all possibility of embodying the apparatus in compact form such as for those instances where a compact installation is most essential.

An outstanding object of my invention, accordingly, is to provide fluid motors having a simple, compact and reliable automatic sequence control as an incident to their operation, and which are well suited for operation on pressure fluid supply and amenable to easy control of the supply for starting and stopping.

Referring now more particularly to the practice of my invention, I employ several fluid motors and control their sequence of operation by dent means which for example alternately blocks operation of one of the motors while the other is operating. In this, the motors themselves importantly control the movement of the dents from blocking position to unblocking position, thus to assure their own operating sequence. In certain instances, I find advantage in using the several motors for sequentially driving separate loads. There are other occasions though where for example I employ one of the sequentially operated motors for intermittently powering a load, and another of the motors free of any load except for operating the dents means.

In the embodiment of my invention disclosed in the accompanying drawing (see particularly Fig. 1), I provide operation control apparatus which includes a motor, such as a primary motor 10, and another motor, such as a secondary motor 48, controlled for operation in sequence by dent means. The primary motor for example is rendered motile by hydraulic fluid delivered under pressure from a suitable source of supply, such as from a hydraulic pump 50. In further particular, the fluid primary motor 18 comprises a cylinder, here dissipative as provided by a cup-shaped metal casing 11 closed off at the open end by an included end plate 12. Along the longitudinal axis of the primary motor cylinder there is a piston rod 13, this extending through an opening 14 centrally disposed in the end plate 12 and through an opposite centrally disposed opening 16 at the other end of the cylinder. The walls of the cylinder are un-
nularly recessed around the piston rod 13 and receive packing rings at these points for sealing the rod during its reciprocating movement in the cylinde and to prevent the escape of fluid. These rings preferably provide a multiple seal around the rod at each of the openings, such as the double seal provided by rings 16 and 17 seated in longitudinally spaced annular recesses in the wall of opening 14 or by rings 18 and 19 in similar recesses in the wall of opening 15.

The fluid primary motor 10 also includes a piston 20 for displacement by the operating fluid supplied to the primary motor cylinder. This piston conveniently is pinned to the shaft or rod 13 by a pin 19 extending through aligned openings laterally of the piston and rod and secured in place as by press fit. There are openings 21 and 22 (see Fig. 2) for ingress and egress of fluid at opposite ends of the primary motor cylinder, these for connecting the opposite sides of the fluid piston 20 to the exterior. The piston 20 advantageously has annular flanges 20a and 20b adjacent to the opposite pressure faces thereof and closing off these faces from each other by fitting within substantially close tolerances to the inner wall surface of the primary motor cylinder. Between these flanges, and in a recess formed by the same with the main body of the piston 20, is a sealing ring 21 or other suitable packing material to arrest fluid which may otherwise pass from one side of the motor piston to the other side. This ring conveniently rolls or slides from one of the flanges 20a and 20b to the other during reciprocation of the piston so as to lodge in front of whichever flange is behind in the direction of the piston stroke. A quantity of oil or other operating fluid for the primary hydraulic motor thus usually can pass by the advanced or unsealed flange to assure lubrication.

The fluid primary motor 10 illustratively has one of the outer ends of its piston rod 13 suited for connection with means which the motor is to operate, such for example as the power head of the motor disclosed in my copending application for patent, Serial No. 380,244, filed September 19, 1953. This outer end of the piston rod conveniently has a longitudinal bore having threaded walls for receiving the threaded shank of an eye-headed bolt or other connector 24. The eye-shaped end of this bolt conveniently connects a lever or the like (not shown) of the apparatus which the fluid primary motor is to operate. A nut 25 advantageously serves on the shank of the bolt, as a locking means to hold the bolt against unscrewing. For this purpose, the nut is tightened down against the outer end of the rod 13, and may be loosened and then again to lock the connector 24 to a newly adjusted position selected for lengthening or shortening the rod 13.

At the other outer end of piston rod 13, remote from the connector 24, I provide detent means 30 for selectively arresting the operation of the primary motor 10. This detent means (see Fig. 2) preferably includes parallel links 31 and 32 for example of the same shape and size and advantageously in the form of bell-cranks spaced directly opposite each other so as to admit the piston rod 13 therewith. These cranks have aligned openings 31a and 32a intermediate their effective lever ends and these openings respectively receive pivot pins 33 and 34 which conveniently afford fixed points relative to the primary motor piston rod 13. The pins 33 and 34 for example are mounted on a fixed annular extension of the cylinder end plate 12 which surrounds the rod and permits passage thereof. One corresponding adjacent set of effective lever ends of the bell-cranks 31 and 32 have aligned openings 31b and 32b, between which there is a detent roller 35 having an axial opening which is also in alignment, thus to receive a bolt 36. The bolt 36 and a corresponding nut 37 serve to hold these ends of the bell-cranks and the roller in assembled relation so that the latter may be moved about pins 33 and 34 as a center to and from restraining position relative to the piston rod 13, such as to and from the path of the corresponding outer end of the roller. The roller 35 preferably is so disposed relative to pins 33 and 34 as to roll along the longitudinal surface of the rod 13 when in non-restraining position. To facilitate this rolling action, the detent roller preferably has ball bearings or some other suitable anti-friction mounting relative to bolt 36. Also, if desired, the opposite end of the detent roller 35 may be separated from the adjacent ends of the bell-cranks by suitable bearings or clearance to decrease friction.

The other effective lever ends of the bell-cranks 31 and 32 conveniently have aligned openings which receive the opposite ends of a strut or spacing element 37 for the cranks. This spacing element for example 73 has suitably small diameter ends as compared with its intermediate body portion which is too large to pass through the crank openings and thus affords a stop. The relatively small ends of the spacing element conveniently are upset against the outer surfaces of the cranks thus to hold the same in assembled relation. Both the detent roller 35 and the spacing element 37 are sufficiently long in the present embodiment to separate the bell-cranks onto the pivot pins 33 and 34 and prevent escape from this position.

The detent means 30 and its effect upon the operation of primary motor 10 are controlled by a fluid secondary motor 40 (see Fig. 1). This secondary motor preferably is a fluid piston type motor, advantageously having its piston 71 disposed in the casing of the primary motor 10. For this purpose, the primary motor piston 20 has a longitudinal bore through the body thereof between the annular flange bore 21 and the annular flanges 20a and 20b thus to provide a cylinder for the secondary motor 40, this cylinder opening to the primary motor cylinder on the opposite pressure faces of the primary motor piston 13. The secondary motor piston 71 advantageously has an unaltered recess 72 receiving a packing ring 73 for sealing off the opposite pressure faces of the latter piston. There is a rod 74 for the secondary motor piston, this rod for example being in two parts 74a and 74b axially disposed relative to this piston and extending away from the opposite pressure faces of the same. That part 74a of the rod that lies in the general parallel to the opening of the rod 13 and may be enclosed and then again to lock the connector 24 to a newly adjusted position selected for lengthening or shortening the rod 13.
Illustratively is used to operate. The link 44 conveniently serves to rotate a shaft 45 having a fixed axis 46, this shaft for example being that for tilting a fruit receiver cup to and from operative position relative to the press head of my citrus fruit juice extractor disclosed in a copending application herebefore noted. It will be seen that the motor assembly represented in the accompanying drawing has primary motor motor 20 and secondary motor motor 40 so disposed as to provide faces confronting the pressure fluid for operation whether this fluid be admitted through port 21 or 22 to the primary motor and hence to the secondary motor. The interfitting pistons 20 and 71 have their respective rods 13 and 74 substantially parallel in direction for transmitting the force of the pressure fluid brought to bear upon their faces. Also, in this embodiment, the longitudinal axes of the pistons 20 and 71 are substantially parallel to enable respective operation of the pistons in a manner which will be more fully described hereinafter.

A pump 50 (see Fig. 4) such as of the gear type, usually employed in my fluid power system, illustratively draws oil from a reservoir 70 to operate the primary motor 10 and the secondary motor 40. An electric motor 90 for example drives this pump as by means of a belt 29 or chain 30 and sprocket connection 95. On the intake side, the pump is connected with reservoir 70 by fluid supply line 51 which for example extends into the bottom of the reservoir to prevent the pumping of air. The pressure side of the pump preferably is connected to a distributing valve 60 for the fluid, the connection for example being through the casing of the valve at port 61. Inside the valve casing there is a rotary core having separate passages 65, 66 and 67 therethrough for selectively connecting the pressure side of the pump with cylinder ports 21 or 25 of the primary motor 10 or 20 of the secondary motor 70. For achieving these connections, the valve 60 has ports 62, 63 and 64 through the casing thereof, the ports 62 and 64 respectively being in communication with cylinder ports 21 and 22 through conduits 54 and 55, and port 63 being in communication with the reservoir 70 and conduit 63.

The disposition of the passages in the core of valve 60 relative to the ports in the valve casing enables the passage 65 to be set by rotation of the core to interconnect ports 61 and 62 (see Fig. 5); passage 66 at this time being blocked by the valve casing wall against the admission or exit of fluid, and the passage 67 for this position interconnecting the ports 63 and 64. A reverse setting of the valve core also may be had by rotating the same to position where the passage 67 interconnects ports 61 and 64 (see Fig. 4), at which time passage 65 interconnects the ports 62 and 63, while passage 66 remains blocked as before. In order to cut off both passages 65 and 67 from communication with any of the previously named ports the valve core may be rotated to neutral position (see Fig. 6) where the passage 66 interconnects the ports 61 and 65. The behavior of the fluid primary motor 10 and fluid secondary motor 40 corresponding to the several settings of the valve will now be described.

With the pump 50 operating to draw oil from the reservoir 70 through the line 51, first assume that the valve 60 is set to the position indicated in Figure 4 and that the primary motor 10 and the secondary motor 40 are to be actuated in a set of upward directions beginning with the position represented in Figure 1. The pumped fluid accordingly passes from the pressure side of the pump through conduit 52 to port 61 of the valve 60 and thence through passage 67 to the port 64. From the exit side of the valve, this fluid goes through conduit 55 and enters the cylinder of primary motor 10 and then forth. Once in the primary motor cylinder, the fluid develops a pressure on the underneath side of the primary motor piston 20 (Figure 1) and effects an upward movement of this piston. In moving upward, the piston 20 effects a displacement of the corresponding piston rod 13, by virtue of the pin connection 19. This rod 13 of the primary motor thus slides upward in Figure 1 through openings 14 and 15 in the primary motor cylinder. In this movement the fluid seeps by the annular flange 20a and forces the packing ring 23 up against annular flange 20a where a positive seal is effected. The fluid behind this seal accordingly lubricates the section of the primary motor piston. The eye-shaped connector 24 transmits the force of the moving rod 13 to apparatus which the primary motor 10 is intended to drive and thus effects a driving action. During the upward movement of the primary motor piston 20, piston 71 of the secondary motor 40 also has its lower face exposed to the pressure fluid from the pump 50. The piston 71, however, is effectively arrested against an upward movement by virtue of the fact that its corresponding piston rod 74 is connected by link 77 to the detent means 30. In fact, the bell-crank arms 31 and 32 restrain the strut 37 and link 77, and thus the secondary motor piston rod 74 against upward movement by forcing the detent roller 35 downward in Figure 1 against the longitudinal side of the primary motor piston 13, this being a levering action about the fixed pivots 33 and 34 of the bell-crank. Thus, while the piston 13 of the primary motor moves upward the detent roller 35 rides along this rod and, accordingly, arrests upward action of the secondary motor piston 71. This arresting action continues until, for the example, the lower end of the primary motor piston rod 13 at or near the end of its stroke passes up beyond the detent roller 35. The secondary motor then is free to operate under the pressure of the fluid admitted through the primary motor cylinder port 22. The pressure of the fluid on the corresponding face of the piston 71 actuates this piston and, accordingly, the rod 74 thereof slides upward through openings 47 and 48 in the primary motor cylinder and exerts a driving action if desired as through link 43 and lever 44 on apparatus which the secondary motor 40 illustratively is used to operate. During the actuation of motor 40, the piston rod 74, as connected through link 77 and strut 43, exerts a lifting action on the adjoining ends of the bell-crank 31 and 32 which rotates the opposite ends of the cranks and the detent roller 35 in a counter-clockwise direction (Figure 1) about fixed pivots 31a and 32a. The detent roller 35 (see Fig. 3), accordingly, takes a position serving to block a reverse stroke of the primary motor piston rod 13, such as a position behind the lower end of this rod. In this new position, the detent roller for example again acts as a stop against continued upward movement of the secondary motor piston 71 such as by abutting the adjacent end of the primary motor piston rod 13. During the upward set of operations of the primary motor 10 and secondary motor 40 just described, port 21 in the primary motor casing is open and connected by conduit 54 (see Fig. 4) for outlet of fluid which may have remained on this side of the motors previous to operation in a reverse direction which will be described. In passing through port 21 and conduit 54, the fluid continues through port 62, passage 65 and port 63 of the valve 60 and then passes through conduit 53 to the supply reservoir 70.

By resetting the valve 60 to position represented in Figure 5 it is possible to reverse motors 10 and 40 for operation of their pistons in a downward direction. Thus, fluid drawn from reservoir 79 through conduit 51 by the pump 50 is supplied to this valve through conduit 52 and port 61 and from here goes through passage 65, port 62 and conduit 54 to port 21 of the primary motor cylinder. Under these conditions fluid admitted through the port 21 exerts itself against face of the primary motor piston 20 (see Fig. 3), but this piston is restrained against displacement under the action of the fluid by virtue of the fact that the detent roller 35 blocks...
this movement. The secondary motor 40, however, is free to operate and does so under the action of the fluid admitted through port 21 to the adjacent face of piston 71. A downward motion of rod 74 thus accompanies the operation of this piston, and the rod serves to actuate the detent means 36. In this component, 746 of the rod pushes link 77 and the adjoining ends of bell-crank 31 and 32 down rotating the cranks about their fixed pivots 31a and 32a in a clockwise direction thus carrying detent roller 35 away from the path of rod 13 of the primary motor piston 20. Where the secondary motor 40 also serves to actuate apparatus such as through link 43, lever 44 and shaft 45, this apparatus illustratively undergoes a reverse action during the downward stroke of the piston 71 as compared with an upward stroke of this piston.

With the piston 20 of the primary motor released by displacement of the detent roller 35 away from the path of rod 13, as described, the pressure of fluid admitted through the port 21 now is effective to operate the primary motor. Thus, piston 20 and its rod 13 slide downward in the primary motor cylinder, and the rod conveniently affords a stop for the detent roller 35 which therefore in turn arrests downward movement of the secondary motor piston 71. The primary motor 10, though, continues to operate in a downward direction, the detent roller conveniently rolling along the longitudinal surface of the rod 13. The apparatus driven by the primary motor 10 as through connection with the connector 24, illustratively undergoes a reverse operation corresponding to downward movement of the piston 20 as compared with the upward movement of this piston.

During the downward set of operation on the primary and secondary motor pistons, fluid on the advanced faces of these pistons conveniently passes through port 22 and thence through conduit 55, port 64, passage 67, port 63 and conduit 53 into the fluid supply reservoir 70 (see Fig. 5). The downward action of piston 20 which occurs after conduit 53 carves its downward operation, illustratively is arrested and reversed to the upward action by resetting the valve 60 (see Fig. 4) thus to supply fluid from the pump 59 to the primary motor cylinder port 22. By setting the valve to neutral position relative to the primary and secondary motors (see Fig. 6), that is to a position where the primary and secondary motors communicate fully with the fluid system, the valve 60 is arrested and the fluid advances through port 61, passage 66 and port 63 to conduit 53, thus back to the reservoir 70. In this position of the valve 60, the passages 65 and 67 are effectively closed off from operating relation with the pump and primary and secondary motors.

In the line 52 between the pump 59 and the distributing valve 60, I usually provide a relief valve 80 for bleeding off fluid and relieving excess pressure in the fluid system. This valve 80 (see Figure 7) preferably is a metering valve, having a casing 81 with central bore 83 which receives fluid from the conduit 52. For this purpose, conduit 52 conveniently communicates with a passage 82 in plate 95. This passage in turn communicates with the internally threaded hole 101 in plate 100. The main body of the casing 81 conveniently is provided with a threaded end portion or stem 86 which is threadedly received in the hole in plate 100. The valve stem is held in place by an internal locknut, which is exerted against the seat by a spring 87. In addition, it may be noted that the valve is biased in the upward direction to clear the valve from the valve seat when the pressure of the fluid is diminished, thus facilitating the discharge of fluid through passages 82 to the fluid supply reservoir 70.

The fluid inlet opening 82 in plate 95 leads into the threaded opening 101 in plate 100 which in turn opens into central bore 83 of the valve 80. Within bore 83 is positioned the longitudinally slideable plunger 84. The valve plunger is substantially conical in form, and the conical portion increases in diameter as it progresses along the bore 83. Still further back, the plunger conveniently is substantially cylindrical in shape in conformity with bore 83. Along this zone of the bore, there is lateral opening 88 through casing 81, thus to afford an outlet for fluid admitted through inlet 82 and thence to the bore.

Under normal pressure conditions, the fluid outlet opening 85 is closed by the substantially cylindrical portion of the plunger 84. This position of the plunger is maintained as by a ball 88 and helical spring 89 disposed in an enlargement of the cylindrical bore 83 behind the inner end of the plunger, forcing the plunger against plate 102 defining one wall of inlet opening 82. The ball advantageously is sufficiently large to be guided by the bore wall. It acts as a pressure element to apply the force of the spring to the inner end of the plunger. Also, the ball advantageously affords a bearing surface for the adjacent end of the spring for transmitting the force thereof and conveniently compensates for any eccentricity of alignment of the different diameter bore zones of bore 83. The other end of the spring preferably is seated against an adjustable support such as the inverted seat 83a, which is held in place by the screws 83d securing threads on the outer surface for engaging corresponding threads extending longitudinally along the wall of the bore 83. Thus, the plug 89 may be advanced or retracted, as with the aid of a screw driver notch 91 in the outer end surface thereof, to vary the compression of spring 89 and the force on ball 88 which in turn alters the width of blocking the fluid escape opening from end to end of the casing. On the outside, the casing preferably is round in transverse section except for flat sides 99 to allow wrench grip.

The metering valve 80 (see Figs. 4, 5 and 6) is connected with fluid reservoir 70 by conduit 56. Thus, whenever pressure of fluid in the line 52 becomes so great as to force the valve plunger 84 backward against the action of the ball 88 and spring 89 (see Fig. 7), away from the inlet and outlet openings, an admission passage develops between the conical portion of the meter valve in tandem along the bore 83, this bore preferably being substantially straight in axial direction from end to end of the casing. On the outside, the casing preferably is round in transverse section except for flat sides 99 to allow wrench grip.

The metering valve 80 (see Figs. 4, 5 and 6) is connected with fluid reservoir 70 by conduit 56. Thus, whenever pressure of fluid in the line 52 becomes so great as to force the valve plunger 84 backward against the action of the ball 88 and spring 89 (see Fig. 7), away from the inlet and outlet openings, an admission passage develops between the conical portion of the meter valve in tandem along the bore 83, this bore preferably being substantially straight in axial direction from end to end of the casing. On the outside, the casing preferably is round in transverse section except for flat sides 99 to allow wrench grip.

Thus, it will be seen that in this invention there is provided a fluid power system and apparatus for use in the same, in which the various objects noted herein together with many thoroughly practical advantages are successfully achieved. In this connection, it will be noted that the several fluid motors and apparatus for controlling their sequence of operation co-function with reliability and highly satisfactory results. Also, it will be...
seen that a fluid power system embodying the sequence-controlled motors has many practical advantages, as from the standpoint of being simple to construct and operate, by virtue of having the motors themselves initiate automatic function for controlling the sequence of motor operation.

As many possible embodiments may be made of my invention and as many changes or alterations may be made in the embodiment hereinbefore set forth, it will be understood that all matter described herein is to be interpreted as illustrative and not as a limitation.

I claim:

1. A motor assembly comprising two fluid motors having pistons and corresponding rods, the piston of one of said motors being slidable in a bore longitudinally through the piston of another of said motors and the rods of said pistons being substantially parallel and operative in substantially the same directions of stroke for one set of movements and then for a reverse set of movements, and detent means in driven relation to the piston rod of one of said motors and effective with respect to one of said acts of movement for arresting the rod of said one motor by abutting the rod of said other motor until freed by the movement of such other rod and effective with respect to said set of reverse movements for arresting the operation of the other motor by disposition in the path of operation thereof, until driven aside by operation of the one motor.

2. A motor assembly comprising primary and secondary fluid motors for operation in a set of forward directions and then in a set of reverse directions, and detent means effective with respect to one of said sets of operating directions for arresting said secondary motor, until freeing the same as an incident to operation of the secondary motor; and a fluid distributing valve for directing fluid from said source of pressure to said motors to drive the same in one of the sets of directions and then in the reverse set of directions.

3. A fluid power system comprising a source of fluid pressure; a motor assembly including primary and secondary fluid motors for operation in a set of forward directions and then in a set of reverse directions, and detent means effective with respect to one of said sets of operating directions for arresting said secondary motor, until freeing the same as an incident to operation of said primary motor, and effective with respect to said set of reverse directions for arresting the primary motor and freeing the same as an incident to operation of the secondary motor; a fluid distributing valve for directing fluid from the source of pressure to said motors to drive the same in one of the sets of directions and then in the reverse set of directions; and a fluid pressure relief valve connected between said source and distributing valve for returning fluid to said source.

4. A motor assembly comprising at least two fluid motors having pistons and corresponding rods, the piston of one of said motors being slidable in a bore longitudinally through the piston of another of said motors and having opposite faces for exposure to the same fluid pressure as the adjacent piston faces, and the corresponding rods of said pistons extending through openings in the casing wall and sealed relative to the same for reciprocation with their pistons; and detent means in driven connection with the piston rod of said secondary motor for arresting the rod of said primary motor by abutting the rod of said primary motor until freed by forward movement of the same; and effective for arresting movement of the rod of the primary motor in reverse direction by disposition in the path thereof, until driven aside by operation of said secondary motor.

5. A fluid power system including a source of fluid pressure; a motor assembly comprising primary and secondary fluid motors for operation in a set of forward directions and then in a set of reverse directions, and detent means effective with respect to one of said sets of operating directions for arresting said secondary motor, until freeing the same as an incident to operation of the secondary motor; a fluid distributing valve for directing fluid from said source of pressure to said motors to drive the same in one of the sets of directions and then in the reverse set of directions; and a fluid pressure relief valve connected between said source and distributing valve for returning fluid to said source.

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