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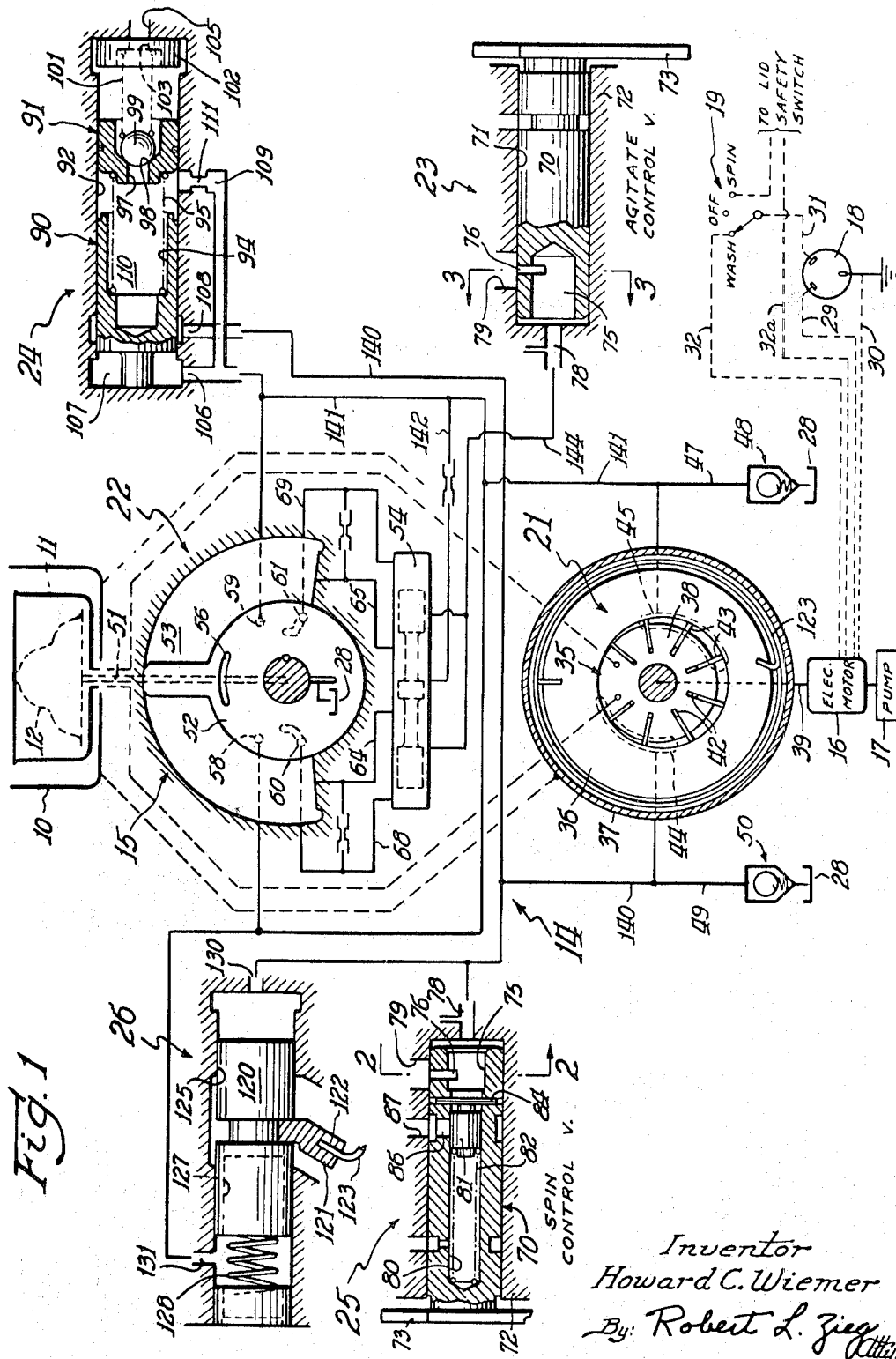
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3,533,251

BRAKE ACTUATOR FOR HYDRAULIC TRANSMISSION

Filed Oct. 31, 1968

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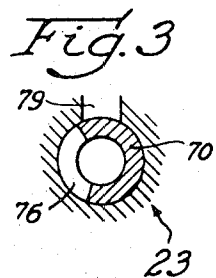
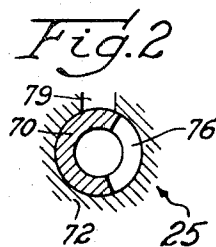
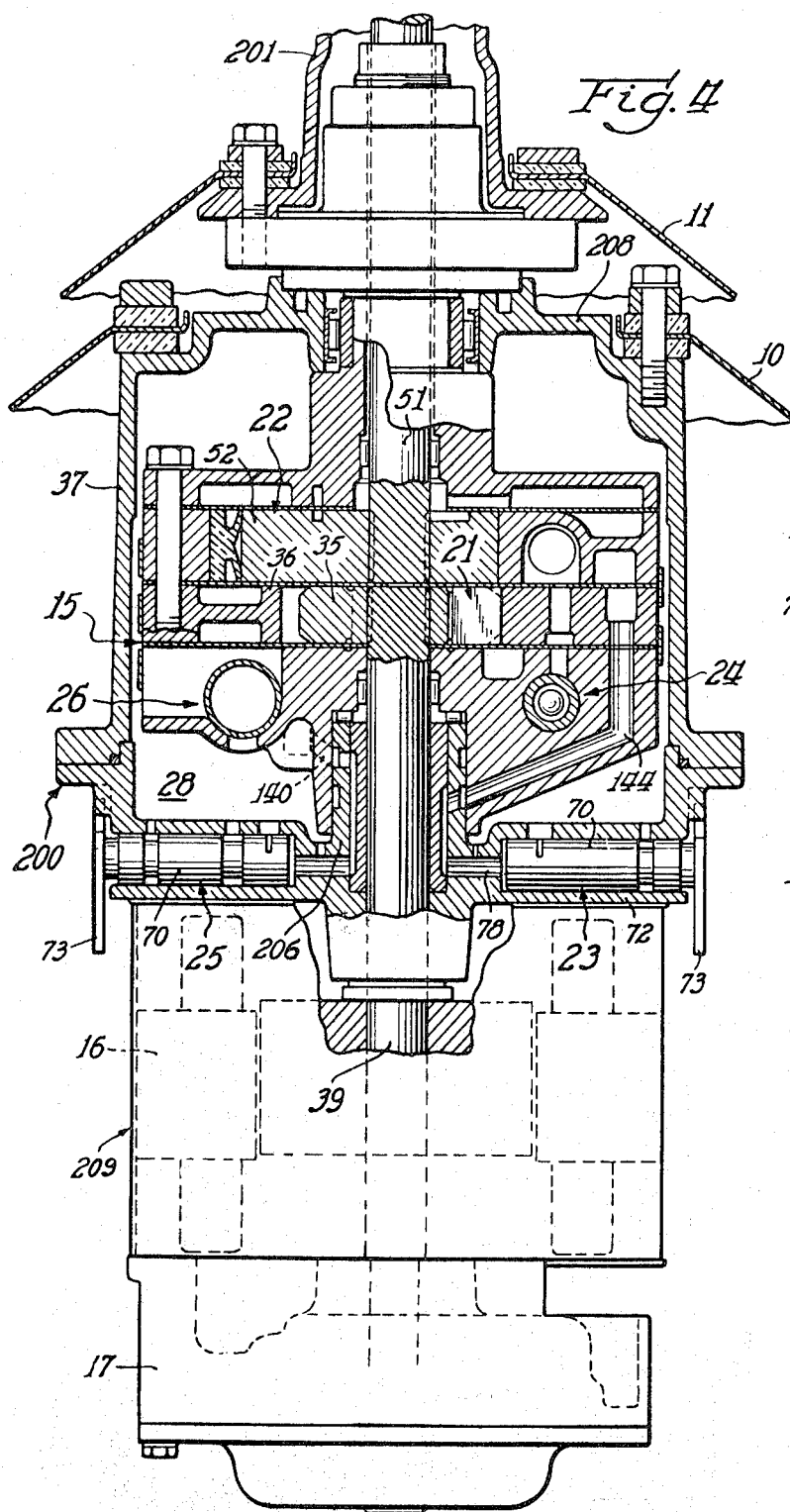
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2 Sheets-Sheet 2



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3,533,251 BRAKE ACTUATOR FOR HYDRAULIC TRANSMISSION

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9 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulically actuated piston mechanism for control of a friction device mounted between a fixed part of a transmission and the drive to the clothes basket of a washing machine mechanism, the washing machine having spin and agitate cycles, and the piston being spring actuated in a brake engaging direction so as to stop rotation of the clothes basket at the end of the spin cycle. The piston including a land responsive to fluid pressure during the agitate cycle to augment the force of the spring to hold the clothes basket stationary during the agitate cycle and a second land responsive to fluid pressure during the spin cycle to move the piston in a direction to release the brake mechanism to free the clothes basket for rotation.

SUMMARY OF THE INVENTION

This invention relates to hydraulic transmission mechanisms and more particularly to hydraulic transmission mechanisms for washing machines which include a brake mechanism for stopping rotation of the clothes basket of the washing machine.

Previously known hydraulic transmissions incorporating brake mechanisms for washing machine installations as, for example, copending application Ser. No. 671,675, filed Sept. 9, 1967, now Pat. No. 3,443,405, of common assignee, include an actuator for the brake mechanism which is released by fluid pressure during the spin cycle to allow spinning of the clothes basket and urged into an engaging position by a spring at the completion of the spin cycle to stop rotation of the clothes basket. In known structures of this type a separate positive lock mechanism which may be hydraulically actuated is usually provided, for example, a hydraulically actuated pin mechanism to hold the clothes basket stationary during the agitate cycle.

The present invention provides an improved brake actuator which utilizes a land responsive to fluid pressure during the agitate cycle to augment the force of the spring to apply the brake mechanism with increased force and thereby hold the clothes basket stationary. Thus the present invention eliminates the need for a positive lock mechanism on the clothes basket and conveniently utilizes available hydraulic pressure to insure that the clothes basket will not move during the agitate cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a control system for a hydraulic transmission for a clothes washer embodying the principles of the invention;

FIG. 2 is a view taken along the lines 2—2 of FIG. 1;

FIG. 3 is a view taken along the lines 3—3 of FIG. 1; and

FIG. 4 is a cross-sectional view of the transmission in actual washing machine installation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a washing machine is schematically illustrated comprising a tub 10 adapted to hold a laundering fluid, a clothes container 11 and an oscillatable agita-

tor 12. A hydraulic transmission 14 is schematically illustrated for independently driving the clothes basket 11 for effecting a centrifugal drying operation, herein referred to as the spin cycle, or the oscillatory agitator 12, herein referred to as the agitate cycle, of the automatic clothes washer. The transmission 14 includes a transmission inner housing generally designated as 15 within which most of the elements of the transmission are mounted. An electric motor 16 is provided having a water pump 17 driven thereby for recirculating water in the clothes container 11 of the automatic washer and a source of power 18 is illustrated for operating the motor 16. A cycle selector switch 19 is schematically illustrated in simplified form although in a washer installation this function would be performed by a timer switch mechanism of known construction.

The important elements of the hydraulic transmission are as follows: a constant volume reversible fluid pump 21, an oscillatory agitator motor 22, a rotary control valve 23 for the agitator motor, a by-pass/relief valve 24 for the agitator motor, rotary control valve 25 to selectively restrict the output of the pump 21 and a spin brake actuator 26.

A fluid sump 28 is provided which is schematically illustrated for convenience at various places in the illustration of the invention, although in the actual construction, one fluid sump 28 is provided into which all the exhaust connections for various elements of the transmission exhaust fluid pressure. Electric leads 29 and 30 interconnect the source of power 18 with the motor 16, the lead 30 being a ground line. Lead 31 connects the source of power 18 to switch mechanism 19. Switch mechanism 19 is connected to the motor by a lead 32 or a lead 32a.

The hydraulic pump 21 includes a pumping element 35 and a rotatable pump housing element 36 operative within a fixed case section 37.

Any of a number of well-known types of hydraulic pumps could adequately perform the functions of the hydraulic pump 21, as for example, the crescent type or the gerotor type, but for reasons that will later be described, it is found that the vane type pump will perform best in the present transmission. For this reason, the hydraulic pump 21 is illustrated as a vane pump.

The pumping element 35 consists of a rotor 38 connectible to a rotatable drive member 39 of the electric motor 16. The rotor 38 contains a series of radial slots 42. A plurality of vanes 43 are provided, each vane adapted to slide within a slot 42.

The rotatable pump housing element 36 consists of an annular disc mounted eccentric to the rotor 38 and is shown drivingly connected to the clothes container 11. A pair of arcuate ports 44 and 45 are formed in the pump housing element 36 for communicating fluid from the sump 28 to pump 21 and, after the fluid is pressurized, from the pump 21. The ports 44 and 45 will either be inlet ports or exhaust ports depending upon the direction of rotation of the electric motor 16 and thereby the direction of rotation of the rotor 38.

A fluid conduit 47 is provided to communicate fluid operated in a direction so as to activate the spin circuit. A check valve 48 allows fluid flow only in a direction from the sump 28 into pump 21. Fluid conduit 49 is provided to communicate fluid from sump 28 to port 44 when the electric motor 16 is operated in a direction to activate the agitate circuit. Check valve 50 allows fluid flow only in a direction from the sump 28 into pump 21. Check valves 48 and 50 are spring biased open, the purpose of which will later be described.

The oscillatory agitator motor 22 includes a vane 52 mounted in a chamber 53 and has associated therewith a reversing valve 54. The vane 52 drives a shaft 51 which in turn is drivingly connected to agitator 12. Provided in

the vane 52 is a slot 56 which at times communicates with a pair of ports 58, 59 and 60, 61 provided in the housing 15 adjacent the vane 52. Chamber 53 is connected to reversing valve 54 by conduits 64 and 65. Reversing valve 54 is also connected to the ports 60 and 61 by conduits 68 and 69, respectively.

The spin rotary control valve 25 and the agitator rotary control valve 23 each includes rotary valve spools 70 mounted in a bore 71 in a case section 72. Each of the rotary control valves 23 and 25 further includes a lever 73 actuatable to rotate the valve spool 70. Provided within the spool 70 of the valves 23 and 25 is a central bore 75 which is intersected by generally rectangular slots 76 provided in the valve spool 70. The control valves further each includes an inlet port 78 communicating with the bores 75 and an outlet port 79 communicating with the slots 76 and the sump 28. Control valve 25 further includes an elongated bore section 80 connected to the bore 75 which has a relief piston 81 slidably mounted therein. A spring 82 is provided in the bore section 80 urging piston 81 to the right against a stop pin 84. Rotary valve spool 70 for valve 25 has an additional port 86 therein communicating with an exhaust port 87 provided in the case section 72.

The bypass/relief valve 24 includes a piston 90 slidable within a bore 92 in the housing 15. A valve member 91 is provided which is fixed in position in bore 92. The piston 90 has a counter-bored section 94 receiving a spring 95 which also engages the valve member 91. Valve member 91 has a central bore 97 therethrough and has a valve seat 98 formed therein engaged by a ball 99. A spring 101 urges ball 99 against seat 98 and engages a disc 102 having a central bore 103 which is mounted in the end of the bore 92. Bore 92 has a port 105 connected to the sump 28 and further has a port 106 communicating with a chamber 107 at the left end of the valve as viewed in FIG. 1. Also provided is a port 108 and a port 109 connected to a chamber 110 between piston 90 and valve member 91 and a restriction 111 is provided in the port 109. A conduit interconnects ports 106 and 109 which will later be described.

The improved brake actuator 26 includes a piston 120 which carries a collar 121. The collar 121 has an end 122 of a brake band 123 secured therein. The piston 120 is slidable in a bore 125 provided in the housing 15. The piston 120 is counter-bored at 127 to receive spring 128 which engages the end of bore 125 and urges the piston 120 to the right as viewed in FIG. 1. Pressure ports 130 and 131 are provided for the brake actuator 26.

A fluid conduit 140 interconnects the port 44 of pump 21, port 78 of valve 25, port 130 of brake actuator 26, and port 108 of bypass/relief valve 24. A fluid conduit 141 interconnects port 45 of pump 21, ports 58 and 59 of agitator motor 22, port 131 of brake actuator 26, and ports 106 and 109 of the bypass/relief valve. A branch conduit 142 is provided connecting conduit 141 to the reversing valve 54. A conduit 144 connects port 78 of the agitator control valve 23 to each end of the reversing valve 54.

The operation of the improved transmission is as follows: when the wash cycle is selected by selector valve 19, pumping element 35 of pump 21 will be rotated in a counterclockwise direction by electric motor 16. The pump will draw fluid through port 44 from the sump 28 and through the open check valve 50. Pressure thus will be supplied by the pump 21 from port 45 into conduits 141 and 47. Until the pump builds up a certain pressure the spring in check valve 48 will keep the check valve open so that the pump does not have to start rotation against the load. After pressure in conduit 47 closes check valve 48, pressure in conduit 141 will be communicated to ports 58 and 59 of agitator motor 22 and will also be supplied to the center of reversing valve 54 by conduit 142. Depending upon the position

of the reversing valve 54, pressure will be supplied from conduit 142 to either conduit 64 or 65 to pressurize chamber 53 on one side of the vane 52. Fluid on the other side of the vane in chamber 53 is drained by means of the other conduit 64, 65 through reversing valve 54, conduit 144, and valve 23 to sump 28. When the vane reaches the end of its stroke, the slot 56 will interconnect, for example, pressure port 59 with port 61 to communicate pressure through conduit 69 to reversing valve 54 to change its position and pressurize the other side of the vane 52, in a manner more completely described in Pat. No. 3,373,660, issued Mar. 19, 1968 of common assignee.

The pressure in conduit 141 will also be communicated through ports 106, 109 to chambers 107, 110 of bypass/relief valve 24. In the event the pressure in conduit 141 exceeds some predetermined maximum, ball 99 will move from seat 98 to relieve the pressure. In case of a rapid pressure surge, since the restriction 111 impedes the flow into the chamber 110, the pressure in chamber 107 will momentarily exceed the pressure in chamber 110. Piston 90 will then move to the right to allow the surge pressure in conduit 141 to flow into port 108 and conduit 140 to return to the inlet port 44 of the pump.

During the agitate cycle of the machine the brake actuator 26 receives fluid pressure through port 131 to move the brake actuator piston 120 to the right to hold the brake band 123 expanded to engage the fixed case section 37 and thus hold the clothes basket 11 stationary. The spring 128 at the completion of the spin cycle, as will be described, moves the piston 120 to the right to expand the brake band 123 and stop the spinning of the basket as is more completely described in copending application S.N. 671,675, filed Sept. 29, 1967 mentioned above. However, the improved structure of the present invention utilizes the additional pressure through port 131 on piston 120 to engage the brake band with increased force to hold the clothes basket 11 stationary and thus eliminate the need for a pressure actuated positive stop pin mechanism to hold the clothes basket, as is previously known.

As described above, pressure is exhausted from reversing valve 54 into conduit 144 and port 78 into the bore 75 of rotary control valve 23. The spool 70 of valve 23 may be rotated such that an orifice of desired size is provided between the slot 76 and exhaust port 79. This orifice will control the flow of escape fluid from the unpressurized portion of chamber 53 of the agitator motor 22. Thus the speed of the agitator motor 22 can be conveniently controlled merely by adjusting the size of the orifice defined by the slot 76 and exhaust port 79 and thereby provide an infinitely variable control of the speed of agitator motor 22.

Once the selector switch 19 is moved to select the spin cycle, electric motor 16 will rotate pumping element 35 of pump 21 clockwise thus drawing fluid from sump 28 through check valve 48 of conduit 47 into port 45. Pressure will be supplied then from port 44 to conduit 140 and conduit 49. As in the agitate cycle, check valve 50 will initially be open and will be closed by pressure in conduit 45 to allow the pump to begin rotation without being under load. The pressure in conduit 140 will be supplied through port 130 to act on piston 120 of brake actuator 26 to move the piston to the left against the force of spring 128 to release engagement of brake band 123 with fixed case section 37 thus releasing the clothes basket 11 for rotation.

Pressure in conduit 140 will also be supplied through port 78 to bore 75 of rotary control valve 25. In a manner similar to operation of control valve 23, spool 79 of valve 25 may be rotated to define an orifice between slot 76 and port 79 of the valve 25. Thus the output of fluid pressure from pump 21 into conduit 140 may be variably restricted. As is more fully described in copending application S.N. 671,675 previously mentioned, since the outer element of

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the pump 21 is connected to basket 11, restriction of the output fluid pressure to the sump through port 79 will tend to lock up the pump 21 and cause a reaction that the basket 11 will be rotated. The speed of rotation of the basket 11 may thus be infinitely varied by adjustment of the size of the orifice defined by slot 76 and port 79 of valve 25. If the pressure in conduit 140 exceeds some predetermined maximum, relief piston 81 will be moved against the force of spring 82 to open conduit 140 to the sump through port 87 of valve 25 to relieve excessive pressures.

As will be apparent, the rotary control valves 23 and 25 simplify previously used reciprocating valves to define an orifice size. The rotary valves 23, 25 are easily machined and provide precise control of orifice size. Further, the rotary valves can be conveniently mounted in a stationary part of the transmission to simplify the orifice control structure over that which is required when valves are installed in a rotary part in the transmission.

Referring to FIG. 4, the structural relationships of the components of the improved transmission are shown in an assembly for installation in a washing machine. A stationary case 200 including the case section 37 previously mentioned above is provided which has journaled in it at one end a drive shaft member 39 of electric motor 16 and has journaled in the other end an agitator drive shaft 51 and a hollow shaft 201 connected to drive clothes basket 11. A general numeral 15 has previously been given for the housing structure which comprises in general the rotating part of the transmission mechanism. This rotating housing 15 is connected to the hollow shaft 201 and thus to the basket 11.

Case 200 includes a case section 72 having a pilot portion 206 thereon in which drive member 39 is rotatably journaled. The control valves 23 and 25 are mounted in case section 72 of stationary case 200 on opposite sides of drive member 39 so that they may be conveniently controlled. Pilot portion 206 has rotary fluid communication with the rotating housing 15 to support the housing and to provide the necessary communication between the outlet ports of the pump 21 and the control valves 23 and 25.

As shown in FIG. 4 proceeding from the left to right the housing 15 includes a section including a brake actuator 26 and bypass/relief valve 24, a section containing pump 21, and a section containing agitator motor 22.

The case 200 also has an end section 208 in which shafts 51 and 201 are journaled. Case sections 37, 72 and 208 together define a fluid tight reservoir 28 and container for the transmission. Casing 200 further includes a motor section 209 containing electric motor 16 and water pump 17.

As will be apparent from the illustrations of FIG. 4, the improved components of the present invention provide an extremely compact transmission mechanism in that the electric motor 16, water pump 17, pump 21 and agitator motor 22 are all mounted within a common housing and are coaxial. Rotary connections have been provided between the housing 15 and the stationary housing 200 so that the rotary control valves can be mounted in a stationary location and yet control operation of the parts contained in the housing 15. Further, the stationary case 200 not only provides a housing for the hydraulic transmission and its sump but also further provides a mounting for the electric motor and water pump which is isolated from the transmission and sump.

Various features of the invention have been particularly shown and described; however, it should be obvious to one skilled in the art that modifications may be made therein without departing from the scope of the invention.

What is claimed is:

1. In a fabric treating machine having a fabric container, an agitator associated with said container, a transmission to selectively drive the fabric container or the

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agitator, a source of fluid pressure, a brake mechanism operatively connected to said fabric container, actuating means being selectively actuatable to release said brake mechanism for drive of said fabric container, means exerting a predetermined force on said actuating means to actuate said brake mechanism to stop rotation of said fabric container, said actuating means including fluid pressure responsive means connectible to said source of pressure to engage said brake mechanism with additional force to hold said fabric container stationary when said agitator is driven.

2. A fabric treating machine as claimed in claim 1 wherein said means includes a hydraulic actuated piston connected to said brake mechanism.

3. A fabric treating machine as claimed in claim 2 wherein said means includes resilient means adapted to move said piston to engage said brake mechanism and said fluid responsive means is adapted to selectively augment the action of said resilient means to hold said fabric container stationary.

4. A fabric treating machine as claimed in claim 3, said means further including a fluid pressure responsive means to selectively move said piston against the force of said resilient means to release said brake mechanism.

5. A fabric treating machine having a fabric container, an agitator associated with said container and a transmission to selectively drive the fabric container or the agitator, a source of fluid pressure for the transmission, said machine having a spin cycle of operation in which said fabric container is driven and an agitate cycle of operation in which said agitator is driven, a brake mechanism operatively connected to said fabric container, actuating means selectively actuatable to release said brake mechanism at the beginning of said spin cycle to permit drive of said fabric container, means exerting a predetermined force on said actuating means to actuate said brake mechanism to stop rotation of said fabric container at the completion of said spin cycle, said actuating means including fluid pressure responsive means connectible to said source of pressure to actuate said brake mechanism with additional force to hold said fabric container stationary during said agitate cycle.

6. A fabric treating machine as claimed in claim 5 wherein said actuating means includes a hydraulic actuated piston connected to said brake mechanism.

7. A fabric treating machine as claimed in claim 6 wherein said brake mechanism comprises a friction band, said transmission being mounted within a stationary housing, said friction band being expandable by said piston to engage said stationary housing to stop rotation of said fabric container.

8. A fabric treating machine including a fabric container, a motor having a rotatable drive member, a hydraulic pump comprising a pumping element and a pump housing element which are relatively rotatable, a fixed case enclosing said pump, one of said elements connected to said drive member and the other of said elements connected to said container, means including a rotary valve for selectively restricting the flow of fluid from said pump to induce rotation of said container by said pump element attached thereto whereby the rotational speed of said container is responsive to said restricting means, speed control means associated with said restricting means operative to vary the position of said restricting means thereby varying the speed of rotation of said container, brake means connected to said pump element connected to said fabric container and adapted to contact said fixed case to decelerate rotation of said pump element and thereby said container, actuating means attached to said brake means to position said brake means out of contact with said fixed case when said container is rotated and means urging said brake means into contact with said fixed case with a predetermined force when said motor is deactivated, and said brake means including fluid pressure responsive means augmenting said urging means to thereby hold

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said container stationary while said motor is rotating said drive member.

9. A hydraulic drive arrangement for a clothes cleaning machine having a clothes basket and an agitator in said basket, the drive arrangement comprising: a pump enclosed within a fixed case including a pumping element and a pump housing element which are relatively rotatable, one of said elements being connected to said basket, a motor having a drive member connectible to the other of said pump elements, a hydraulic motor connected to said agitator, valve means controlling operation of said hydraulic motor to actuate said agitator, rotary valve means for selectively restricting the flow of fluid from said pump to compel rotation of said pump element attached to said basket and thereby said basket whereby the rotational speed of said basket is responsive to said restricting means, speed control means associated with said restricting means operative to vary the position of said restricting means thereby varying the speed of rotation of said basket, brake means associated with said pump element connected to said fabric container and adapted to contact said fixed case to decelerate rotation of said pump

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element and thereby said container, actuating means attached to said brake means operative to position said brake means out of contact with said fixed case when said container is rotated, said actuating means including urging means adapted to urge said brake means into contact with said fixed case with a predetermined force when said motor is deactivated, and said actuating means having a fluid responsive means augmenting the force of said urging means to hold said basket stationary when said hydraulic motor to actuate said agitator is in operation.

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U.S. Cl. X.R.

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