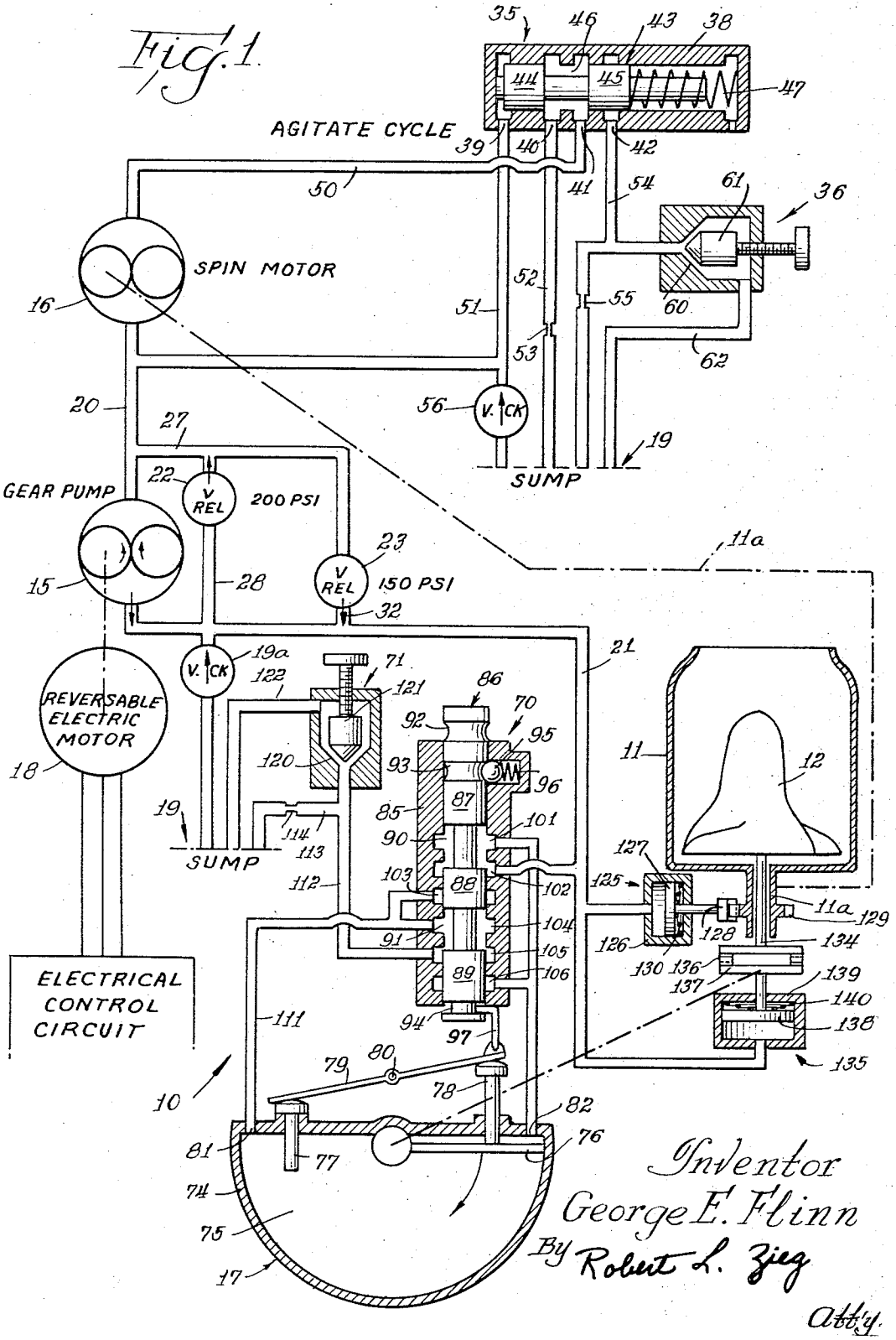
July 11, 1967 G. E. FLINN 3,330,138

CLOTHES WASHING MACHINE AND HYDRAULIC TRANSMISSION

Filed Dec. 13, 1965 3 Sheets-Sheet 1

Fig. 1.



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CLOTHES WASHING MACHINE AND HYDRAULIC TRANSMISSION

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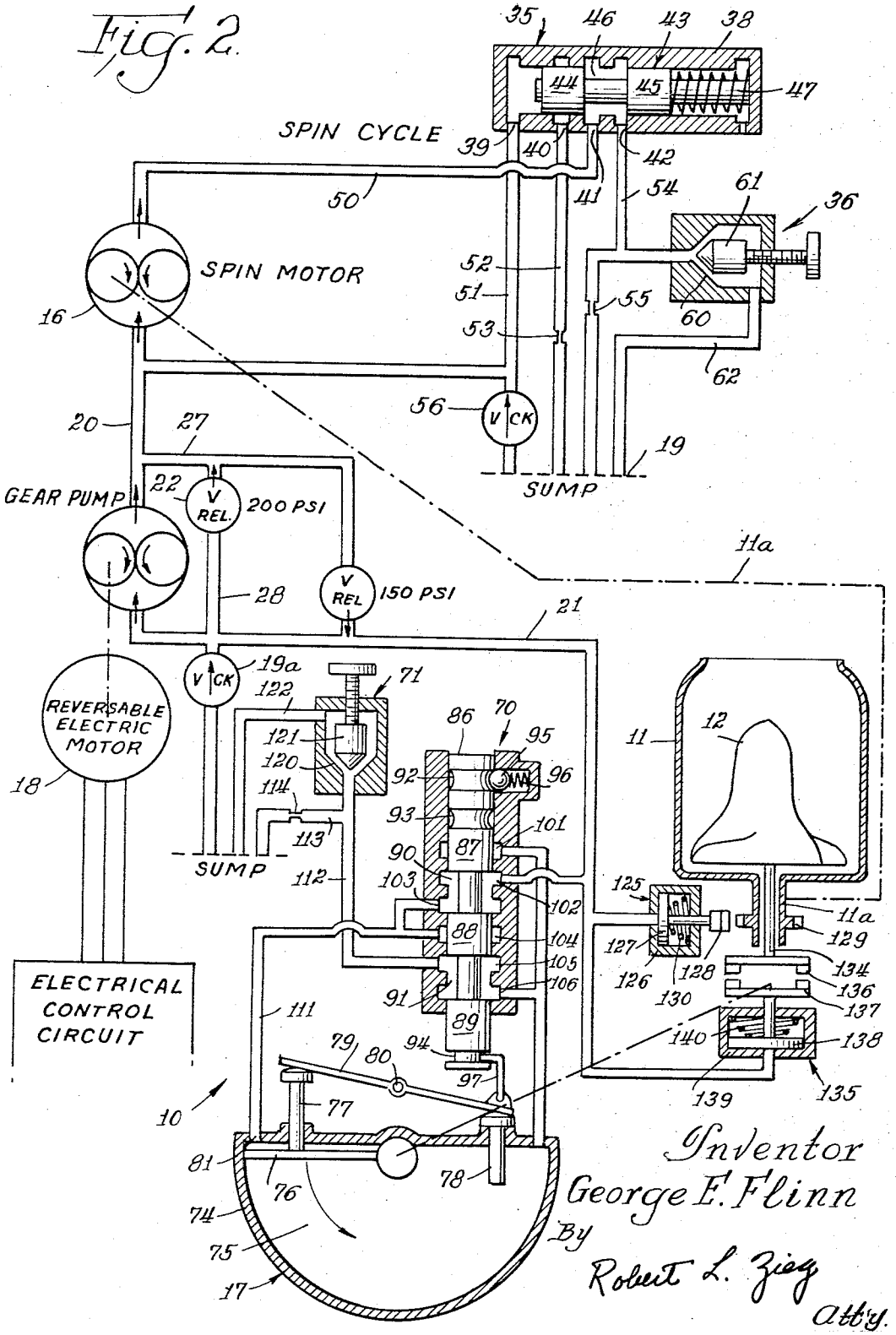
Fig. 2.



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CLOTHES WASHING MACHINE AND HYDRAULIC TRANSMISSION

Filed Dec. 13, 1965 3 Sheets-Sheet 3

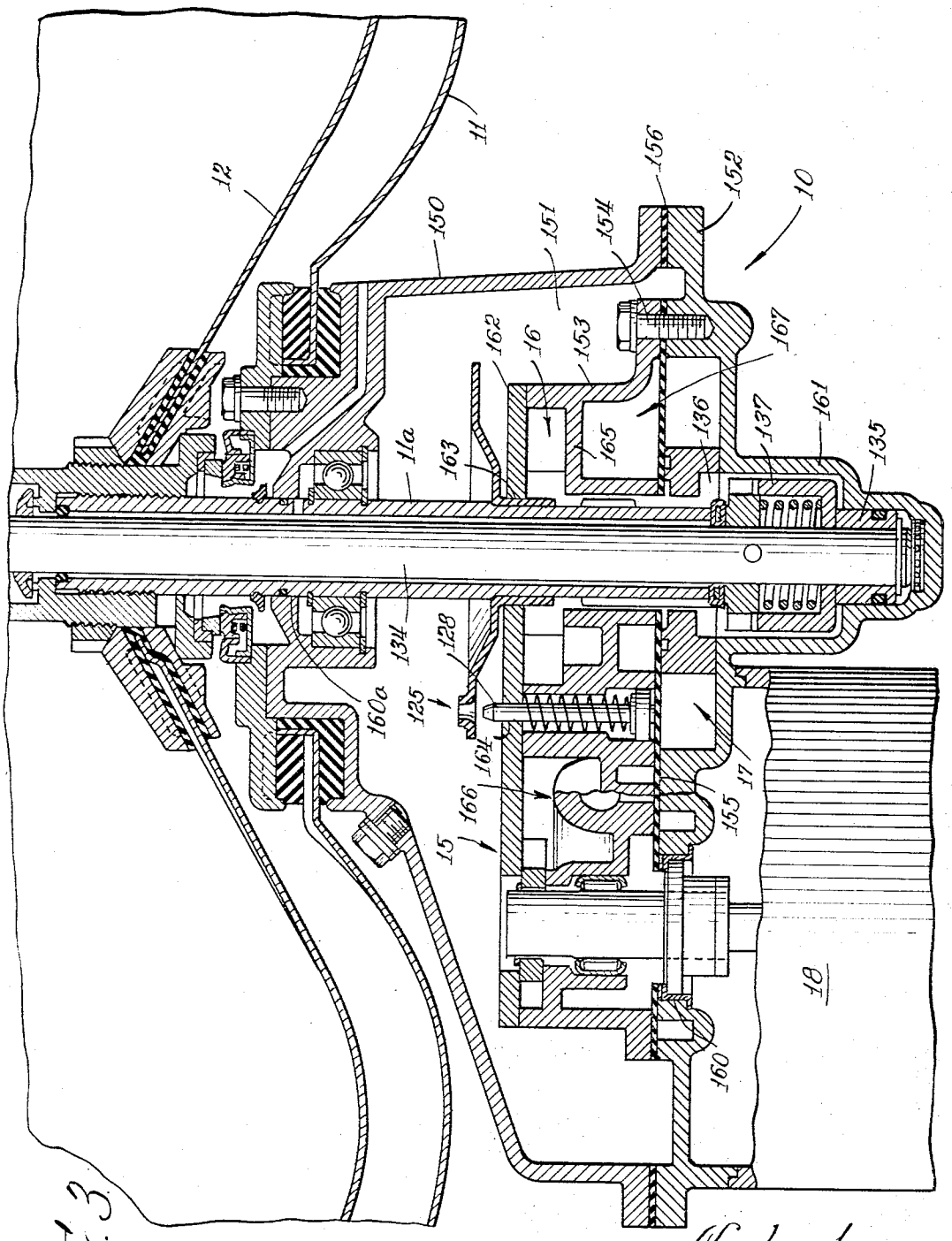

Fig. 3

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CLOTHES WASHING MACHINE AND HYDRAULIC TRANSMISSION

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Filed Dec. 13, 1965, Ser. No. 513,262
10 Claims. (Cl. 68—23)

This invention relates to a hydraulic transmission. More particularly this invention relates to a hydraulic transmission particularly adapted for use in an automatic clothes washer although use in other machines would be contemplated.

It is an object of this invention to provide an improved transmission for the clothes basket and agitator drive of an automatic clothes washer comprising a fluid pump operable in two directions of rotation in combination with a control system adapted to deliver fluid to a fluid motor to spin the clothes basked when the pump is operated in one direction and operative to deliver fluid pressure to a fluid motor adapted to oscillate the agitator of the washer when the pump is operated in the reverse direction of rotation. In accordance with the invention an improved form of control for a hydraulic transmission for a washer is presented in that the speed of the spinning of the clothes basket is controlled by a manually adjustable means to control the exhaust fluid from the spin motor and the speed of agitation of the agitator of the clothes washer is controlled by a manually operated means controlling the exhaust fluid pressure from the agitator fluid motor.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects and such other objects as will appear from the following description of the preferred embodiment of the invention illustrated with reference to the accompanying drawings, wherein:

FIGURE 1 is a schematic view of a hydraulic transmission for a clothes washer during the "agitate" cycle embodying the principles of the invention;

FIGURE 2 is a schematic view showing the hydraulic transmission during the "spin" cycle; and

FIGURE 3 is a cross section through the transmission in an automatic washer installation.

Referring to FIGURE 1 the hydraulic transmission **10** is schematically illustrated for driving the clothes basket **11** and the agitator **12** of an automatic clothes washer. The hydraulic transmission has the following major components: (1) a positive displacement gear-type pump **15**, (2) a positive displacement fluid motor of the gear-type **16** which is adapted to drive a hollow shaft **11***a* (shown schematically in FIGURE 1) connected to the clothes basket of the automatic washer for driving same and (3) an agitating fluid motor **17** adapted to be connected to drive the agitator **12** with an oscillating type of motion.

A reversible electric motor **18** is connected to the pump **15** and thereby adapted to drive the pump **15** in either direction of rotation. The arrows around one of the gears of the pump **15** show the direction of rotation of one of the gear elements for either the spin cycle of the washer in which fluid pressure will be supplied to the fluid circuit for the fluid motor **16** or the agitate cycle of the washer for which fluid pressure will be supplied to the fluid circuit for the agitate fluid motor **17**. A fluid sump **19** is provided to contain the fluid for transmission **10**.

A fluid conduit **20** connects the pump **15** with the spin motor **16** and a fluid conduit **21** connects the fluid pump **15** with the agitate fluid motor **17**. Conduit **21** is connected to the sump **19** by a check valve **19***a* which allows fluid flow only in the direction from sump **19** into conduit **21**. Over pressure relief valves **22** and **23** are provided for the pump **15**.

Relief valve **22** is connected by a conduit **27** to fluid conduit **20**. Relief valve **22** is also connected to a fluid conduit **21** by a conduit **28**.

Relief valve **23** is connected to fluid conduit **21** by conduit **32** and to fluid conduit **20** by conduit **27**.

Within the fluid circuit for the spin cycle of the clothes washer along with the fluid motor **16** for spinning the clothes basket there is provided a stop valve **35** and a manually operable variable restriction exhaust valve **36**.

Stop valve **35** includes a valve body **38** having ports **39**, **40**, **41** and **42**. A valve spool **43** is slidable in body **38** which has lands **44** and **45** thereon separated by groove **46**. A spring **47** urges the valve spool **43** to the left as viewed in FIGURE 1.

Exhaust fluid pressure from fluid motor **16** is connected to be delivered to port **41** of valve **35** by conduit **50**. Port **39** is connected to the fluid supply conduit **20** to the fluid motor **16** by conduit **51**. Port **40** of the valve **25** is connected to the sump by conduit **52** including restriction **53**. Port **42** of valve **35** is connected to the manually operable exhaust valve **36** by conduit **54**. Conduit **54** is connected to the sump through a restriction **55**. Conduit **51** is connected to the sump by check valve **56** which allows fluid flow only in the direction from the sump into conduit **51**.

Exhaust valve **36** is schematically represented and constitutes a manually adjustable valve of the needle valve type including a tapered opening **60** which can be variably restricted by a needle **61** which is manually adjustable to allow adjustment of the flow from conduit **54**. Fluid passing through valve **36** is returned to the sump **19** through a conduit **62**.

The fluid circuit for the agitate cycle of the automatic washer includes, in addition to the agitate fluid motor **17** and the pressure supply conduit **21**, a direction valve **70** and a manually operable variable restriction exhaust valve **71**.

The agitate fluid motor **17** includes a body **74** having a chamber **75** having a vane **76** therein which will be oscillated by the action of the fluid pressure supplied to the chamber **75**. The vane **76** is connected in a wash machine installation to drive the agitator **12** of the washing machine.

The motor **17** also includes a pair of pins **77** and **78** slidably mounted in a body **74** which engage with a rockable arm **79** which is pivoted at **80**. The chamber **75** has ports **81** and **82** therein at opposite sides thereof through which fluid pressure may be supplied from the direction valve **70**.

The direction valve **70** includes a valve body **85** having a spool **86** slidable therein. The valve spool **86** has lands **87**, **88** and **89** thereon. Lands **87** and **88** are separated by a groove **90**. Lands **88** and **89** are separated by a groove **91**. The valve spool **86** also includes grooves **92**, **93** and **94**. A ball detent mechanism is provided constituting a ball **95** urged by spring **96** into engagement with either the groove **92** or **93** depending upon the position of the valve spool **86**. The spool groove **94** is engaged by an end portion **97** on the rocking arm **79**.

The valve body further includes ports **101**, **102**, **103**, **104**, **105** and **106**. Port **102** is connected to conduit **21**. Ports **101** and **106** are interconnected with port **82** of the agitate motor **17** by a conduit **110**. Ports **103** and **104** are interconnected with the port **81** of the agitate motor **17** by a conduit **111**. Port **105** is connected to the exhaust valve **71** by means of a conduit **112**. Conduit **112** is connected to the sump **19** through a conduit **113** having a restriction **114** therein.

Exhaust valve **71** is schematically illustrated and constitutes a manually adjustable valve of the needle valve type including a tapered opening **120** which can be variably restricted by a needle **121** which is manually adjustable to vary the flow from conduit **112**. Fluid passing through valve **71** is returned to sump **19** by a conduit **122**.

A basket brake **125** which comprises a cylinder **126** is connected to fluid conduit **21** having a piston **127** therein. A spring **130** urges piston **127** to the left as viewed in FIGURE 1. Piston **127** has a pawl or projection **128** thereon engageable in one of a plurality of matching notches in a disc **129** provided on the clothes basket **11** so that when fluid pressure exists in conduit **21** piston **127** will engage the pawl **128** to hold the basket **11** stationary.

Also connected to the fluid conduit **21** is a fluid pressure actuated clutch **135**. Positive clutch teeth **136** are provided on a shaft **134** drivingly connected to agitator **12**. Mating positive clutch teeth **137** are provided on a fluid piston **138** which is mounted in a fluid cylinder **139**. Fluid cylinder **139** receives fluid pressure from conduit **21**. A spring **140** urges piston **138** toward a disengaged position of clutch teeth **137–136**. The teeth **136** and **137** are engageable to provide a driving connection between agitator **12** and the oscillating vane **76** of the agitator motor **17**. Vane **76** is drivingly connected to piston **138** as schematically illustrated.

The operation of the hydraulic transmission as described is as follows: when the fluid pump is rotated by the motor **18** in the direction indicated by the arrow noted "spin," fluid pressure will be drawn from the sump through check valve **19***a* into conduit **21** and squeezed out between the teeth of the pump **15** into conduit **20** to the fluid circuit for spin motor **16**. Fluid pressure is thus supplied to the fluid motor **16** which is connected to drive the clothes basket **11** of the automatic washer through shaft **11***a* and the machine will begin the "spin" cycle as illustrated in FIGURE 2. The pressure in conduit **20** is imposed on over pressure relief **23** which would, for example, be set open at 150 p.s.i. so that if the fluid pressure in the conduit **20** exceeded 150 p.s.i. the relief valve **23** would open to relieve the fluid pressure and allow pressure to flow into conduit **21** which is now acting as the fluid pressure inlet supply passage for pump **15**.

Thus as fluid pressure is supplied to the fluid motor **16** of positive displacement the gears of the fluid motor will rotate and rotate the clothes basket at a high r.p.m. to spin the water from the clothes.

Exhaust fluid pressure from the fluid motor **16** flows through conduit **50** and port **41** into the groove **46** of the valve **35**. Since fluid pressure from the pump is imposed through conduit **51** and port **39** on the left end of the valve spool **43**, the valve spool **43** will be moved to the right against the force of spring **47** to the position illustrated in FIGURE 2 in which groove **46** interconnects ports **41** and **42** of the valve **35**. Thus exhaust fluid pressure from the fluid motor **16** at port **41** will flow through groove **46** and port **42** into conduit **54** to the manually adjustable exhaust valve **36**. During the spin cycle by manual adjustment of the exhaust valve **36** the fluid exhaust from the fluid motor **16** can be variably restricted and thus the speed of the spinning of the clothes basket may be regulated by manual adjustment of valve **36**.

As previously explained, over pressure development which may injure parts of the transmission is prevented by over pressure relief valve **23**.

Referring to FIGURE 1, when the electric motor is stopped and then reversed to go into the agitate cycle as would be the case in an automatic washer through the operation of an electric timer switch mechanism, conduit **20** then becomes the fluid supply conduit or inlet conduit for pump **15** as it rotates in the direction indicated by the arrow labeled "agitate." Conduit **20** will now draw fluid from the sump through check valve **56** to supply pump **15**. When the fluid pressure is thus no longer supplied into conduit **20** pressure will no longer exist in port **39**

and be imposed on the valve spool **43**. Valve spool **43** will be moved to the left by the spring **47** to the position illustrated in FIGURE 1 and the connection between ports **41** and **42** are interrupted. Thus the exhaust pressure from spin motor **50** is blocked and can only escape through port **40**, conduit **52** and through restriction **53** to the sump.

Since the exhaust fluid pressure in conduit **50** from fluid motor **16** is now blocked from flowing to sump **19** except through restriction **53**, the valve **35** acts as a stop valve or brake by substantially restricting the exhaust from the fluid motor **16** and bringing the clothes basket to a stop quickly so that the automatic washer can continue into the next cycle. The valve spool **43** of valve **35** will stay in its position to the left until once more the pump is rotated in the direction labeled "spin."

When the fluid pump is operated in the direction shown in FIGURE 1, fluid pressure will be supplied into conduit **21** to the fluid circuit for agitate motor **17**. Conduit **21** is connected by conduit **28** to over pressure relief valve **22** and if the fluid pressure in **21** exceeds a predetermined value, for example 200 p.s.i., the relief valve **22** will open and thereby connect conduit **28** to conduit **27**. Thus the pressure will be bled off into the inlet conduit **20** for the pump **15**, thereby relieving the pressure until it is below the predetermined maximum.

Fluid pressure in conduit **21** is introduced into cylinder **139** moving piston **138** up to engage clutch teeth **136** and **137** and thus directly connect the vane **76** of the agitator motor to drive the motor **12**. Fluid pressure in conduit **21** will also be introduced into cylinder **126** to move piston **127** to the right to engage pawl teeth **128** with one of the notches in disc **129** to provide a positive brake on the clothes basket to hold it stationary while the agitator is oscillating. Fluid pressure in conduit **21** is also supplied to port **102** of direction valve **70**.

In the position of valve **70** as illustrated in FIGURE 2, fluid pressure in port **102** will flow through groove **90** into port **103**, conduit **111** and port **81** into fluid chamber **75** of agitate motor **17**. At this time port **82** of fluid chamber **75** is connected through conduit **110**, port **106**, port **105**, conduit **112**, and exhaust valve **71** to the sump thus exhausting pressure ahead of the vane **76** through port **82**. Thus vane **76** will move counterclockwise to the position as illustrated in FIGURE 1 due to the fluid pressure being introduced from port **81**.

When vane **76** moves clockwise far enough to engage pin **78**, pin **78** will move up pivoting arm **79** around pivot **90** and moving the valve spool **86** to its upper position illustrated in FIGURE 1 with the detent ball **95** engaged in groove **93**. In this upper position of the valve spool **86** fluid pressure will now be supplied from port **102** through groove **90** then port **101** into conduit **110** and port **82** to fluid pressure chamber **75** to act on vane **76**. Port **81** of the agitate motor **17** will now be connected by means of conduit **111**, port **104**, groove **91**, port **105**, conduit **112**, and exhaust valve **71** to the sump. Thus port **81** now becomes the exhaust port of the agitate motor **17** and **82** is the pressure port.

Pressure supplied from port **82** will now act on vane **76** to move the vane clockwise. The vane **76** will move clockwise until it again engages pin **77** to rock arm **79** and move valve spool **86** to its lower position to repeat the above cycle.

As described, the fluid motor **17** acts to oscillate the agitator of the wash machine by fluid pressure oscillation of vane **76**. The speed of agitation as in the case of the spin motor is controlled by means of manual adjustment of exhaust valve **71**. In either position of the valve spool **86**, conduit **112** is connected to exhaust fluid pressure from one side or the other of fluid chamber **75** of the agitate motor **17**. By adjusting the position of needle valve **121** in the tapered opening **120**, the exhaust from the agitate motor may be variably restricted and thus the speed of oscillation of the agitator controlled.

When the agitate cycle ends and the electric motor

is reversed the fluid pressure in fluid conduit **21** will be interrupted and fluid conduit **21** will again become the supply conduit for pump **15**. Thus piston **127** of the brake **125** will be moved to a disengaged position by the spring **130** and the agitator clutch will be disengaged by spring **140**.

Referring to FIGURE 3 the transmission is illustrated as installed in an automatic washer environment. The location of the major elements of the transmission such as pump **15**, motor **16** and agitate motor **17** is indicated in FIGURE 3.

A main or low pressure housing **150** is provided for the transmission having a large cavity **151** therein which can be termed a low pressure cavity. The low pressure cavity **151** is enclosed by an end plate **152** which is secured to the housing **150** by suitable means such as bolts (not illustrated). Within the low pressure cavity **151**, a high pressure housing **153** is provided which contains the transmission components of the washer. The housing **153** is secured to end plate **152** by bolts **154**. A gasket **155** is provided between housing **153** and end plate **152** to provide a fluid seal for the housing **153**. A gasket **156** is provided between housing **150** and end plate **152** to provide a fluid seal therebetween.

End plate **152** has a bore **160** therein to accommodate the driving shaft between motor **18** and pump **15**. Housing **150** has a bore **160***a* therein to accommodate hollow shaft **11***a* and agitator drive shaft **134**. The end plate further has an outwardly extending portion **161** which houses the clutch mechanism **135** operative to drivingly engage the agitator motor **17** with agitator shaft **134**. The upper side of housing **153** as viewed in FIGURE 3 may be of unitary construction as a part of housing **153** or may be an end plate **162** suitably secured to housing **153** for example by bolts (not illustrated). End plate **162** is provided with bores **163** and **164**. Bore **163** accommodates the hollow shaft **11***a* to drive the clothes basket **11** and the agitator drive shaft **134**. Bore **164** has a projection **128** of the brake mechanism **125** slidable therein.

Housing **153** is a casting which would include wall sections therein such as indicated at **165** to accommodate the components of the transmission. Indicated at **166** and located on the back side of the transmission as illustrated in FIGURE 3 provision is made for the control valves of the transmission.

Housing **153**, end plate **162** and end plate **152** including the gasket **155** encloses a cavity which can be referred to as a high pressure cavity, generally indicated by the numeral **167**. It can be seen that the high pressure fluid within the transmission will be contained by the housing **153**, end plates **162** and **152** and gasket **155**. Any oil which would leak from any of the transmission components within the housing **153** would leak into the low pressure cavity **151**. The fluid within the low pressure cavity thus serves as a sump for the transmission and due to the seal between housing **150** and end plate **152** including gasket **156**, the oil in the low pressure cavity **151** is prevented from leaking out.

Thus a housing structure has been provided in which expensive sealing structures within housing **153** for main components of the transmission are not required since any oil leaking therefrom will be contained within a low pressure cavity which envelops the transmission.

In hydraulic transmissions of the known type, as may be used for example in an automatic washing machine, any oil leaks from the main transmission components would not be caught by an outer housing having a low pressure cavity and thus would be quite unacceptable if such a leak developed, in that oil would leak out onto the floor where the washing machine is located. The housing structure illustrated in FIGURE 3 thus is advantageous in that oil will not leak out of the wash machine onto the floor or surrounding area. Further, due to the use of a structure which would contain oil surrounding the transmission components, the transmission operates more quietly than is the case with known housing structures.

From the above it will be apparent that a new and improved transmission has been provided which is adaptable to drive the agitator and clothes basket of an automatic washer. Applicant has provided a single reversible pump rotatable in one direction to supply fluid to an agitate motor circuit and rotatable in the other direction to supply fluid to a spin motor circuit, thus eliminating the need for a special valve to control the direction of flow.

Further, the present invention provides a simple and economical means of controlling the speed of the spin motor and an agitate motor for a washing machine. With the use of manual valves **36** and **71** the speed of either the spinning of the clothes basket or the speed of the agitation of the agitator **12** may be manually controlled between broad limits. The present invention is advantageously adaptable to an automatic washing machine to provide an infinitely variable speed of agitation and an infinitely variable speed of the clothes basket during the spin cycle. Safely provisions have been included in the circuits using over pressure relief valves **22** and **23** to prevent build up of harmful pressures in the system.

The present invention also includes a spring urged stop valve **35** which will serve to automatically stop the clothes basket after the spin cycle by using the spin fluid motor itself as a brake on the clothes basket.

Economies will result due to the use of a single pump operable in either direction of rotation to operate in one direction the spin motor and in the other direction an agitator motor. Due to the use of a positive displacement pump and a positive displacement motor with control means of a variable restricted exhaust expensive variable volume pumps or variable volume motors are unnecessary. Further, the clutch to connect the agitator to the agitator motor is automatically engaged when pressure is induced in the agitate circuit as is the fluid actuated brake for holding the clothes basket stationary.

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

I claim:

1. In a hydraulic transmission having selectively operable output members comprising a first output element and a second output element, a sump for hydraulic fluid, a fluid pump connected to said sump, said pump being connected to supply fluid pressure to a first fluid circuit to drive said first output member when said pump is rotated in one direction of rotation and to supply fluid pressure to a second fluid circuit to drive said second output member when said pump is rotated in a reverse direction, said first fluid circuit including a first hydraulic motor connected to said first output member and hydraulically connected to said pump, an exhaust conduit for said first motor, a first selectively operable valve in said exhaust conduit adapted to variably restrict exhaust pressure from said motor to thereby control the speed of drive of said first output member, said second fluid circuit including a second fluid motor connected to drive said second output member and hydraulically connected to said pump, an exhaust conduit for said second fluid motor, a second selectively operable valve in said exhaust conduit for said second motor adapted to variably restrict exhaust fluid pressure from said second motor and thereby control the speed of drive of said second output member.

2. A hydraulic transmission as claimed in claim **1** including additional valve means in said exhaust conduit between said first hydraulic motor and said selectively operable valve adapted to at times interrupt the connection between said motor and said selectively operable valve.

3. A hydraulic transmission as claimed in claim **2**

wherein said additional valve means is adapted to interrupt the connection between said first hydraulic motor and said selectively operable valve when said pump is supplying fluid pressure to said second hydraulic motor whereby said first hydraulic motor will serve as a hydraulic brake for said first output element.

4. A hydraulic transmission as claimed in claim 3 wherein said additional valve means includes a valve spool connected to said first circuit whereby fluid pressure in said first circuit urges said valve spool to a position hydraulically connecting said exhaust conduit to said first selectively operable valve and spring means urging said spool to a position interrupting said hydraulic connection when no fluid pressure exists in said first circuit.

5. In a hydraulic transmission having selectively operable output members comprising a first output member and a second member, a sump having hydraulic fluid therein, a reversible fluid pump connected to said sump, said pump being connected to supply fluid pressure to a first fluid circuit to rotate said first output member when said pump is rotated in one direction and to supply fluid pressure to a second fluid circuit to oscillate said second output member when said pump is rotated in the reverse direction, said first fluid circuit including a rotary hydraulic motor connected to said first output member and hydraulically connected to said pump, an exhaust conduit for said rotary motor, a first selectively operable valve in said exhaust conduit adapted to variably restrict exhaust pressure from said rotary motor to thereby control the speed of rotation of said first output member, said second fluid circuit including an oscillating fluid motor connected to oscillate said second output member and hydraulically connected to said pump, an exhaust conduit for said oscillating fluid motor, and a second selectively operable valve in said exhaust conduit adapted to variably restrict exhaust fluid pressure from said oscillating fluid motor and thereby control the speed of oscillation of said second output member.

6. A hydraulic transmission as claimed in claim 5 including additional valve means in said exhaust conduit for said rotary hydraulic motor adapted to at times interrupt the connection between said rotary motor and said first selectively operable valve.

7. A hydraulical transmission as claimed in claim 6 wherein said additional valve means will interrupt said connection when said pump is supplying fluid pressure to said oscillating fluid motor whereby said rotary hydraulic motor will serve as a hydraulic brake for said first output member.

8. A hydraulic transmission as claimed in claim 7 wherein said additional valve means includes a valve spool connected to said first circuit whereby fluid pressure in said first circuit urges said valve spool to a position hydraulically connecting said exhaust conduit to said first selectively operable valve and spring means urging said spool to a position interrupting said hydraulic connection when no fluid pressure exists in said first circuit.

9. In a hydraulic transmission for an automatic washer having a clothes tub and an agitator, a sump having hydraulic fluid therein, a reversible fluid pump connected to said sump, said pump being connected to supply fluid pressure to a first fluid circuit to rotate said clothes tub when said pump is rotated in one direction and to supply fluid pressure to a second fluid circuit to oscillate said agitator when said pump is rotated in the reverse direction, said first fluid circuit including a rotary hydraulic motor connected to said clothes tub and hydraulically motor connected to said pump, an exhaust conduit for said rotary motor, a first selectively operable valve in said exhaust conduit adapted to variably restrict exhaust pressure from said rotary motor to thereby control the speed of rotation of said clothes tub, said second fluid circuit including an oscillating fluid motor connected to oscillate said agitator and hydraulically connected to said pump, an exhaust conduit for said oscillating fluid motor, and a second selectively operable valve in said exhaust conduit adapted to variably restrict exhaust fluid pressure from said oscillating fluid motor and thereby control the speed of oscillation of said agitator.

10. A hydraulic transmission as claimed in claim 9 including additional valve means in said exhaust conduit between said rotary hydraulic motor and said first selectively operable valve, said additional valve means being adapted to interrupt the connection between said rotary hydraulic motor and said first selectively operable valve when said pump is supplying fluid pressure to said second fluid circuit to oscillate said agitator motor will serve as a hydraulic brake for said clothes tub.

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WILLIAM I. PRICE, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,330,138 July 11, 1967

George E. Flinn

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 18, after "second" insert -- output --.
Column 8, line 16, cancel "motor".

Signed and sealed this 14th day of October 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents