Feb. 4, 1969 K. O. SISSON 3,425,559

DOMESTIC CLOTHES WASHER HAVING IMPROVED SPEED CONTROL MEANS

Filed June 10, 1966 Sheet 1 of 2

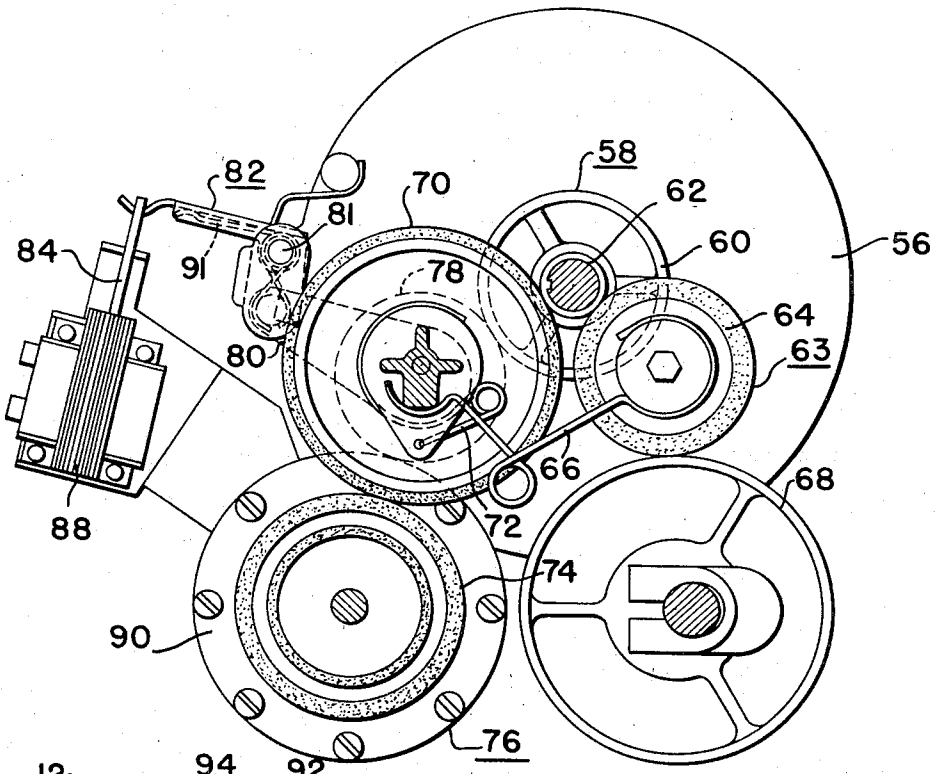


Fig. 2

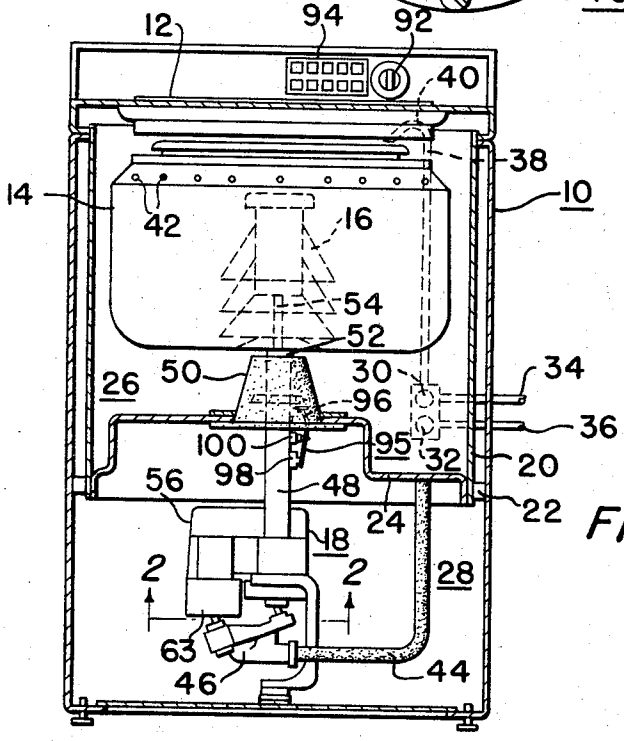


Fig. 1

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Sheet 2 of 2

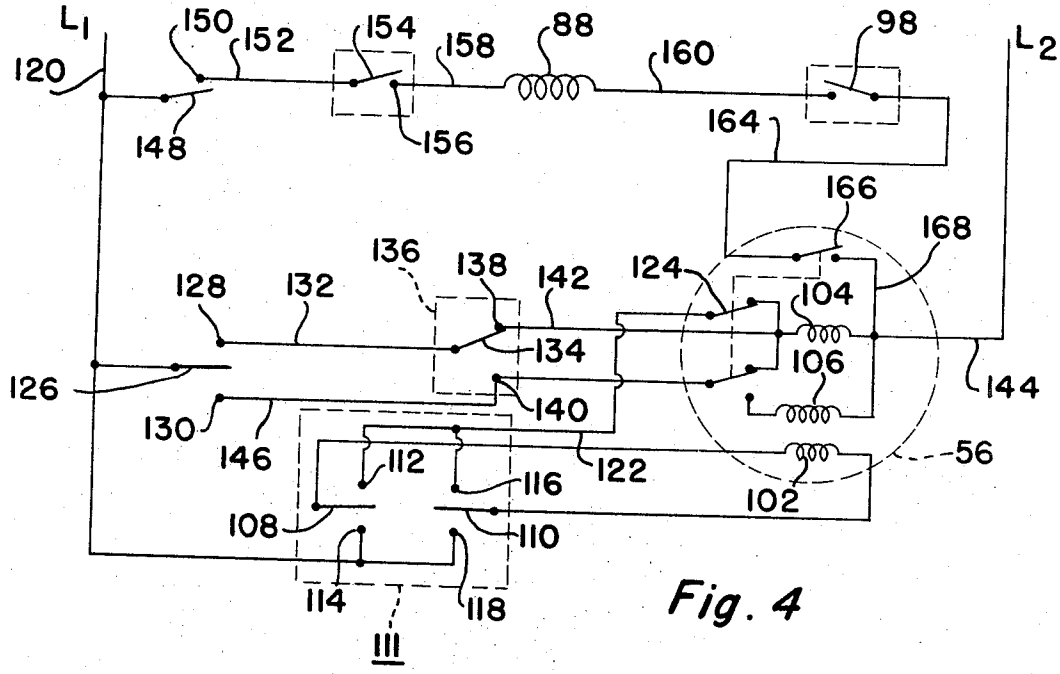


Fig. 4

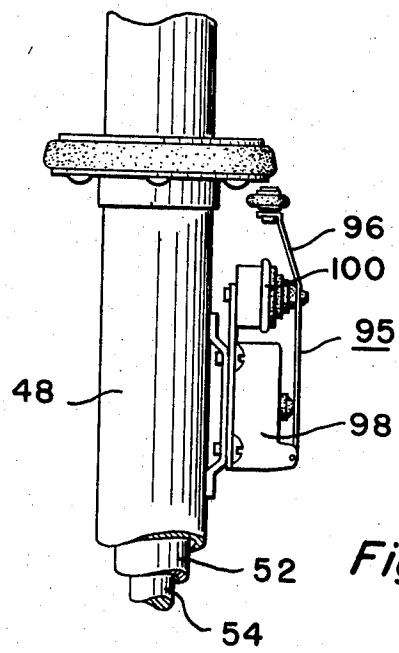


Fig. 3

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United States Patent Office 3,425,559 Patented Feb. 4, 1969

3,425,559

DOMESTIC CLOTHES WASHER HAVING IMPROVED SPEED CONTROL MEANS

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Filed June 10, 1966, Ser. No. 556,603
U.S. Cl. 210—138 4 Claims
Int. Cl. B01d 43/00

ABSTRACT OF THE DISCLOSURE

A domestic washer having a spin tub supported by an inverted hat on a support. A drive shaft housing supported on the hat carries a drive motor and a friction roller drive mechanism for operating the tub at high and low centrifuging speeds. A solenoid on the motor actuates a linkage to disengage a high spin roller in the drive mechanism to produce low spin speed tub operation. An electrical control system conditions the solenoid to produce low spin speed tub operation (1) during initial energization of the motor and (2) during periods where a bump switch on the shaft housing engages the hat because of excessive machine vibration.

This invention relates to domestic appliances and more particularly to a domestic clothes washer having an electric motor driven plural speed drive mechanism including drive mechanism output speed control means therein which are associated with improved circuit means for varying the energization of the speed control means in accordance with predetermined operating conditions of the domestic appliance.

Many domestic appliances such as clothes washers, now have electric motor driven multi-speed drive mechanisms therein operable to produce plural centrifuging or spinning operations in the domestic washers or likewise plural clothes agitation or washing operation in such domestic appliances.

In such drive means, typically an electric motor with predetermined drive torque characteristics is utilized to drive an article containing spin tub through a plural speed drive mechanism or transmission at one of a plurality of selected spin speeds. In such cases, at the start of a high spin speed of operation as the plural speed drive mechanism is accelerated to produce a high speed spin phase of operation of the spin tub of the clothes washer, the tub is generally filled with water and clothing, thus producing a substantial initial load to be overcome by the electric drive motor. Such loading can produce undesirable wear in the components of the drive system or cause the motor to stall at the start of the high spin phase of operation.

Another problem in domestic washers and like domestic appliances having a high spin speed of operation is manifested by an undesirable gyration of the spin tub of the domestic washer produced by an article distribution in the spin tube that is capable of producing an extreme unbalanced loading on the spin tub at the high spin speeds of operation. In such machines, various control systems have been proposed to modify the speed output from a plural speed transmission or the like to regulate the spin tub speed to compensate for the undesirable unbalanced load producing clothes distribution.

An object of the present invention is to improve domestic appliances having plural speed drive means including an electric motor and a mechanism or transmission with speed control means therein for varying the output speed from the transmission by provision of improved high speed electric circuit means including switch means responsive to the speed of the drive motor and operative

at the start of a spin phase of operation to condition the high speed means of the transmission to cause the drive mechanism to operate at a low speed until the motor reaches a predetermined percentage of its operating speed to prevent stalling of the motor at the start of a high spin phase of operation of the machine.

A further object of the present invention is to improve domestic washers and like centrifuging machines of the type having a plural speed drive means including an electric motor and a speed varying drive mechanism driven by the electric motor and wherein the drive mechanism includes a speed control element operative to condition the drive mechanism for low and high spin speed operations of a spin tub by the provision of improved high spin speed circuit means in association with a speed control element including vibration responsive means operative during critical speed of operation of the spin tub and upon the occurrence of an undesirable unbalanced loading in the spin tub of the domestic appliance for conditioning the high speed control element to cause the drive mechanism to operate at a low spin speed output whereby components in the drive mechanism are subjected to less wear and the spin tub is operated without undesirable gyratory movements.

A still further object of the present invention is to improve centrifuging devices of the type including a rotatable spin tub driven by plural speed drive means having an electric motor and a plural speed drive mechanism or transmission driven by the motor wherein the transmission includes a high speed control element to condition the drive mechanism for a low or high speed of operation of the spin tub by the provision of an improved high speed control circuit in association with the high speed control element that includes a motor speed responsive switch that is controlled by speed of operation of the electric drive motor and operative to maintain the output speed from the drive transmission at a low speed until the electric motor attains a predetermined percentage of its operating speed whereby the motor will not be stalled at the start of a spin cycle of operation.

Yet another object of the present invention is to improve the operation of domestic clothese washers of the type including a plural speed output drive mechanism having mechanical components therein selectively positioned to effect a high speed output from the mechanism and a low speed output from the mechanism and wherein the operative position of the components is determined by electrically energizable speed control means that are cyclically controlled by means including a timer motor for producing predetermined spin phases of operation in the domestic washer during which time a spin tub of the washer is driven at a high centrifuging speed by the drive mechanism and wherein upon the occurrence of a predetermined unbalanced loading in the spin tub, means associated with the speed control means are rendered operative to condition the speed control means to produce a low speed output from the drive mechanism so as to compensate for the unbalanced loading in the spin tub.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a fragmentary, sectional view of a clothes washing machine including the present invention;

FIGURE 2 is an enlarged view in horizontal section taken substantially along the line 2—2 of FIGURE 1;

FIGURE 3 is an elevational view of a movement sensing assembly in the control system of the present invention; and

FIGURE 4 is a schematic wiring diagram for control-

ling an automatic washing machine in accordance with the concepts of the present invention.

Referring now to FIGURE 1, a clothes washer **10** is illustrated having a clothes loading door or lid **12** that provides access to an open top of a rotatably mounted spin basket **14** in which is located a clothes agitator **16** for surging cleaning solvent containing liquid through articles contained within the spin basket **14**. In the illustrated arrangement the spin basket **14** and clothes agitation **16** are operatively associated with a plural output speed drive system **18** which is selectively operable either to rotate the spin basket **14** during a centrifuging operation or spin phase of operation of the clothes washer or vertically reciprocate the agitator **16** within the spin basket **14** during a washing cycle of operation.

Surrounding the spin tub **14** and spaced therefrom is a water container **20** mounted on the outer casing of the clothes washer **10** by suitable means shown as brackets **22**. A partition or bottom bulkhead **24** closes the lower end of the water container **20** to separate a water receiving space **26** between the container **20** and the spin basket **14** from a machinery compartment **28** in which is located the drive system **18**.

In the illustrated arrangement, water is supplied to the interior of the clothes washer **10** through a hot water solenoid actuated valve **30** and a cold water solenoid actuated valve **32** which are connected, respectively, to a hot water inlet **34** and a cold water inlet **36**. A mixing conduit **38** directs the tub water fill, the temperature of which is determined by the water valves **30**, **32** to a water chute **40** overlying the top opening of the spin basket **14**. The spin basket **14** is provided with a plurality of outlets **42** adjacent the upper rim thereof through which water is centrifuged from the interior of the spin basket **14** during a high speed spin phase of operation of the clothes washer. A drain conduit **44** selectively removes the water collected in the water receiving space **26** through a pump mechanism **46** operatively positioned on the lower end of the drive system **18**.

Referring now more specifically to the drive system **18** a shaft housing **48** is seen that is supported on a resilient hat shaped member **50** secured to the bottom bulkhead **24**. Within the shaft housing **48** is located a spin shaft **52** which is secured to the base of the spin basket **14** and coaxially and inwardly of the shaft **52** is directed a vertically reciprocal agitate shaft **54** which is secured to the clothes agitator **16**. The shaft housing **48** in turn supports a reversible electric motor **56** which in the illustrated embodiment of the invention is a one-third horsepower, single phase, two-speed, 1725/1140 r.p.m., 4/6 pole unit that has a power drive shaft **58** directed therefrom with a large diameter end portion **60** and a small diameter portion **62** thereon, as best seen in FIGURE 2.

The drive shaft **58** operates a plural output speed drive transmission or mechanism **63** including an agitate friction drive roller **64** which is maintained by means including a spring **66** in a self-energizing frictional engagement with the small diameter portion **62** of the shaft **58** and the outer surface of an agitate drum assembly **68** of the drive mechanism **63**. On the opposite side of the shaft **58** is located a large diameter low-speed spin friction drive roller **70** that is held in a self-energizing frictional drive relationship by means including a spring **72** with the small diameter portion **62** of the drive shaft **58** and a small diameter end **74** of a spin drum assembly **76**. In addition, and as shown in dotted lines in FIGURE 2, there is a high-speed spin roller **78** that is operatively connected to a carriage or bracket **80** and pivotal about a pin **81** secured to the bottom of motor **56**. A linkage **82** connects the bracket **80** to an armature **84** of a speed control solenoid **88**. When the speed control solenoid **88** is energized, the armature **84** pulls the linkage **82** to cause the bracket **80** to pivot roller **78** about pin **81** so as to be maintained in a self-energizing frictional drive relationship with the large diameter end **60** of the drive shaft **58** and the outer surface **90** of a large diameter end of the spin drum assembly **76** whereby the spin shaft **52** is driven at a high speed for operating the spin tub **14** at a high spin speed during centrifuging of water therefrom. When the solenoid **88** is de-energized a spring **91** causes the linkage **82** to be moved away from solenoid **88** and roller **78** to be moved to a position where it no longer is in a driving relationship with spin drum assembly **76**.

During agitation, the drive motor **56** is conditioned to drive the shaft **58** clockwise as seen in FIGURE 2, and the agitate roller **64** will be dragged into frictional engagement between the shaft **58** and the agitate drum assembly **68** so as to produce a vertical reciprocation of the shaft **54** and agitator **16** to carry out a wash cycle of operation in the machine **10**. Upon conditioning of the motor **56** to cause the shaft **58** to rotate in a counterclockwise direction, as seen in FIGURE 2, and assuming that the speed control solenoid **88** is de-energized, the high speed spin roller **78** is located out of driving engagement with the shaft **58** and the low speed spin roller **70** will be dragged into driving engagement with the shaft **58** and the spin drum assembly **76** to effect a low-speed spin output from the mechanism **63**. However, when the speed control solenoid **88** is energized, the high speed spin roller **78** will be located in driving engagement with the shaft **58** and the spin drum assembly **76** to produce a high speed output from the drive mechanism **63** with the low speed roller **78** being overridden.

The above-described system is merely representative of a plural speed drive means having a driven transmission therein under the control of a speed control element. For purposes of the present invention the above description of the drive system **18** should suffice. However, for a more complete disclosure of the friction rollers and other components of this type of multi-speed drive system, reference may be had to copending application of Brackman et al., Ser. No. 375,158, filed Oct. 18, 1965, and now abandoned. Furthermore, in mechanism **18** the spin drum assembly **76** has a slipping clutch incorporated therein of the type set forth in a copending application of Fosler et al., Ser. No. 430,264, filed Feb. 4, 1965, now Patent No. 3,314,257.

The illustrated domestic washing machine **10** further includes a timer control dial **92** on its control panel positionable to select one of a plurality of cycles of operation in the washer **10**. Furthermore, the washer **10** on its control panel includes a plurality of selector buttons **94** positionable to condition switches in the control circuitry of the machine **10** to cause the operation of the machine during the timer control sequence of operation thereof to be adapted to particular types of fabrics being washed in the machine or the like. A typical control arrangement of this type is also set forth in the above-mentioned copending Brackman et al. application.

In the illustrated arrangement the spin basket **14** is resiliently supported on the hat **50** for movement with respect to the bottom bulkhead **24** causing tilting movement of the shaft housing **48** with respect thereto. When such movement exceeds a predetermined maximum during operation of the spin tub through critical speed or because of unbalanced loading in the spin basket **14**, movement sensing means **95** on the spin shaft **48** are moved into engagement with the inner surface of the support hat **50** to cause an actuator arm **96** thereof to be shifted in a direction to open a normally closed microswitch component **98** to condition a high speed control circuit for the washer **10** including the speed solenoid **88** to reduce the output speed from the drive mechanism **63**. The output speed from the drive mechanism **18** is maintained at a lower speed output through a delay assembly **100** of the sensing mechanism **95** for reasons to be discussed. In FIGURE 3, the primary components of the movement sensing means **95** are set forth. For a more detailed disclosure of the unbalance sensing and time delay apparatus, reference may be had to another co-

pending application of Fosler, Ser. No. 555,178, filed June 3, 1966.

As shown in the wiring diagram of FIGURE 4, the drive motor **56** includes a phase winding **102**, a high speed, four-pole main run winding **104**, and a low-speed, six-pole main winding **106**. In the illustrated arrangement the phase winding **102** has the opposite ends thereof connected to movable switch blades **108**, **110** of a timer motor operated phase control switch **111**. The blade **108** is selectively movable between contacts **112**, **114** and the blade **110** is selectively movable into engagement with contacts **116**, **118** to reverse the polarity across the phase winding **102** so as to determine the direction of rotation of the output shaft **58** of the motor **56**.

More particularly, the energization circuit for the phase winding **102** runs from wire L_1 through a conductor **120** which is electrically connected to one side of the phase switch **111**; the opposite side of the phase switch is electrically connected to a conductor **122** which in turn is electrically connected to a centrifugal start switch **124** that maintains the phase winding **102** in series with the four-pole main winding **104** until the output of the motor **56** reaches a predetermined percentage of its running speed at which time the phase winding **102** is dropped from the motor circuit.

The running windings of the motor **56** are energized through a circuit from wire L_1 through conductor **120**, a timer operated speed selector switch including a switch blade **126** that is selectively movable into engagement with a high speed contact **128** and a low speed contact **130**. The high speed contact is electrically connected by a conductor **132** to the movable switch blade **134** of a manually operable speed selector switch **136** having a high speed contact **138** and a low speed contact **140**. The high speed contact **138** is electrically connected by a conductor **142** to one side of the four-pole run winding **104** which has an opposite side thereof connected by a conductor **144** to wire L_2. In the illustrated arrangement the timer controlled speed selector switch blade **126** may be positioned during certain phases of the cycle of operation of the machine **10** to engage the low-speed contact **130** thereby to complete an energization circuit through a conductor **146** and the centrifugal switch **124** when the motor is up to speed thence through the six-pole, low-speed main winding **106** which is electrically connected by the conductor **144** to wire L_2.

Additionally, the electric circuit of FIGURE 4 includes a high-speed control circuit for conditioning the speed control solenoid **88** of the prime mover for the spin basket **14** either to operate the drive mechanism **63** at a high speed or a low speed output as discussed above. The speed control circuit includes a timer controlled switch having a movable switch blade **148** selectively positionable against a contact **150** that is electrically connected by a conductor **152** to one side of a manually operable spin speed switch having a normally closed movable switch blade **154** in engagement with a contact **156** that in turn is electrically connected by a conductor **158** to one side of the drive mechanism output speed control solenoid **88** which has the opposite side thereof electrically connected by a conductor **160** to one side of the microswitch component **98** of the movement sensing means **95** which has the opposite side thereof electrically connected by conductor **164** in serial relationship with a centrifugal switch **166** that is opened when the motor **56** initially starts and movable into a closed position once the motor **56** has reached a predetermined percentage of its normal operating speed. The centrifugal switch **166** of the high speed control circuit has the opposite side thereof electrically connected by a conductor **168** to conductor **144** thence to wire L_2.

The motor **56**, by virtue of the above-illustrated control circuit, can be rotated in opposite directions and run at high and low speeds depending upon whether the four-pole main winding **104** or the six-pole main winding **106** are electrically connected across wires L_1, L_2. Furthermore, during initial acceleration of the drive motor **56** the phase winding **102** and four-pole main winding **104** are utilized to accelerate the motor **56** against relatively high torque conditions existing in the prime moving system at the start of motor energization.

Normal operation of the machine includes first loading the spin basket **14** with materials to be washed therein and filling the basket **14** with a desired fluid level for a particular washing operation selected by the option control buttons **94**. Following a washing operation during which time the agitator **16** is driven so as to surge water and cleaning solvent through the articles, the motor **56** is de-energized by the timer controlled switch **126** and the direction of rotation thereof is reversed by the phase switch to initiate a spin or extraction phase of operation wherein the spin basket **14** is rotated at high spin speeds so as to centrifugally extract fluid through the ports **42** of the spin basket **14** into the water container **20**.

One aspect of the present invention is that at the beginning of such a spin phase of operation of the machine **10** the centrifugal switch **166** will maintain the high speed control circuit de-energized whereby during the initial part of the spin phase of operation the output speed of the spin shaft **52** will be determined by the drive between the shaft **58** of the motor **56**, the low speed spin roller **70** and the spin drum assembly **76**. This particular drive path establishes a low-speed drive of the spin shaft **52** until the motor **56** attains a predetermined percentage of its operating speed at which time the switch **166** will close so as to energize the high spin speed solenoid **88** causing the high speed spin roller **78** to be driven into driving engagement with the drive shaft **58** and spin drum assembly **76** thereby producing an acceleration of the spin shaft **52** and an increase in the spin speed of the spin basket **14** so as to improve the extraction of liquid therefrom. By virtue of the inclusion of centrifugal switch **166** in the high spin speed control circuit, it is found that the motor **56** will operate without stalling at the start of a high spin cycle of operation.

A further feature of the above-described high-speed control circuit through the spin solenoid **88** is the presence of switch **98** therein to sense when articles in the spin basket **14** are distributed so as to produce a large unbalanced load thereon during the high-speed spin phases of operation. As the spin tub **14** is driven through its critical speed even without unbalanced loadings, there is a momentary substantial tilting movement of the spin basket **14** on its resilient support member **50**. Upon the occurrence of such a condition, more specifically, and as set forth in the copending Fosler application, the actuator arm **96** of movement sensing means **95** is directed into engagement with the spin hat **50** so as to condition the microswitch **98** thereof to be opened whereby the spin solenoid **88** is de-energized. In accordance with certain principles of the present invention, the spin solenoid **88** is maintained de-energized for a predetermined delay period during which time the spin tub is driven at a lower speed as established by the drive train through the low-speed spin roller **70**. Following the delay which is established by delay assembly **100**, more specifically set forth in the copending Fosler application, the switch **98** will be closed to re-energize the spin speed solenoid **88** so as to cause the drive from the motor pinion **58** to pass through the high-speed spin roller thence through the spin drum assembly **76** to increase the output speed of the spin shaft **52** causing an increase in the extraction velocities of the spin basket **14**. Undesirable unbalanced loading in the spin basket **14** will cause movements of the spin tub to condition switch **98** to cause the spin tub to be held at the low spin speed during the spin cycle. Downshifting of speed during the start of a spin cycle also reduces slippage in the spin drum assembly clutch and thus serves to reduce wear in the operative components of the drive mechanism therein. The downshifting of the output speed followed by the

predetermined delay as established by the sensing means **95** will produce a maximum amount of fluid extraction for a given unbalanced loading condition throughout the spin phases of a particular washing machine cycle of operation. Thus, the cycle of operation of the machine **10** can be completed and within the cycle, as much extraction as is possible under the conditions that exist therein is accomplished. Furthermore, the machine operation will advance from a wash spin cycle into subsequent cycles of operation such as a rinse cycle wherein the unbalanced loading may be overcome whereby a final spin cycle can be carried out at high spin speeds.

The improved high-speed control circuitry of the present invention accomplishes the reduction of wear in the drive components of the prime mover which is representatively shown as being a friction roller drive mechanism and a maximum extraction of fluid during spin phases of operation of the machine by an expedient that requires only a minor modification of the drive motor **56** constituted by the provision of the second centrifugal switch **166** therein and the addition of a tub movement sensing means for periodically conditioning a high-speed component in the prime mover system of the washer **10**. Thus, the control circuitry for the washer **10** can retain a conventional timer mechanism, a standard drive train such as the friction roller system illustrated and a standard two-speed reversible electric motor for driving the remainder of the prime mover system.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a centrifuging machine the combination of a rotatable container, a base member, means for supporting said rotatable container on said base member for movement relative thereto, prime mover means including a spin drive shaft connected to said container and high and low speed transmission means selectively operating said spin drive shaft for rotating said container at a high speed and a low speed, said prime mover means including an electric motor having an output shaft engageable with both said high and low speed transmission means during a centrifuging operation, means for energizing said electric motor to produce output shaft rotation at a predetermined set speed during the centrifuging operation, said prime mover means including electrically energizable speed control means connected to said high speed transmission means for engaging said output shaft therewith to change the speed of rotation of said rotatable container between said high speed and low speed conditions of operation thereof, and switch means responsive to the speed of operation of said electric motor for maintaining said electrically energizable speed control means inoperative during initial acceleration of said electric motor means to disengage said spin drive shaft and said high speed transmission means, said low speed transmission and said spin drive shaft operating said container at its low speed operation when said high speed transmission is so disengaged to prevent stalling of said electric motor during the accelerative phases of operation thereof.

2. In a centrifugal machine, the combination of a rotatable container for extracting fluid from a material, prime mover means for driving said rotatable container including a self-energizing low spin speed roller and a self-energizing high spin speed roller for selectively driving said rotatable container at a low centrifuging speed and a high centrifuging speed, said prime mover means further including an electrically energizable motor having an output shaft engaging both of said rollers, means for selectively energizing said electric motor during a predetermined spin phase of operation of said centrifugal machine to drive said output shaft at a set speed during said spin phase, speed control means for said prime mover means including means for conditioning said prime mover means to drive said rotatable container at either said low speed or said high spin speed during operation of said output shaft at said set speed, said speed control means including an electrically energizable solenoid, carriage means connected to said high spin speed roller for movably supporting said high spin speed roller for selective driving engagement with said output shaft, link means connecting said solenoid and carriage means, circuit means for conditioning said high speed electrically energizable solenoid during the spin phase of operation of said motor to position said rollers to cause said container to be driven at a low speed during an initial part of the spin phase of operation of the machine.

3. In a centrifuging machine, the combination of a rotatable container, fixed support means, means for resiliently supporting said rotatable container for gyratory movement with respect to said fixed support means and about a vertical axis, prime mover means for rotating said rotatable container including first means for driving said container at a low speed and second means for rotating said container at a high speed, said prime mover means including an electric motor having an output shaft driven at a set speed during a centrifuging operation, said output shaft selectively operating both of said low and high speed drive means of said prime mover means, high speed electric control means selectively operable to condition said second means in said prime moving means to be operated by said output shaft to drive said rotatable container at a high speed during the centrifuging operation, and means including switch means responsive to the speed of operation of said electric motor for rendering said high speed control means ineffective during initial acceleration of said container, said first low speed drive means of said prime mover means being operated by said output shaft during such initial container acceleration to positively rotate said container while operating said drive motor in a low torque range.

4. In the combination of claim **3**, said high speed control means including timer control means for connecting said high speed control means for energization during a spin phase of operation of said motor means, said high speed control means further including an electrically energizable solenoid connected to said second means for rotating said container, centrifugal switch means connected in serial power supply relationship with said solenoid and said timer control means, said centrifugal switch means being responsive to the speed of rotation of said electric motor to condition said electrically energizable solenoid during acceleration of the motor to condition said second means for rotating said container to produce the low torque start operation of said motor.

References Cited

UNITED STATES PATENTS

Re. 15,115	5/1921	Mackintosh	210—145
2,432,272	12/1947	Bariffi	210—145 X
2,461,764	2/1949	Olcott	210—145
2,780,086	2/1957	Dunlap	210—144 X
2,911,812	11/1959	Metzger	210—144 X
3,268,791	8/1966	Burns et al.	210—144 X
3,273,361	9/1966	Smith	210—144 X
3,308,954	3/1967	Powder	210—144 X
3,322,278	5/1967	Ishoy et al.	210—144 X

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U.S. Cl. X.R.

210—144, 145; 68—12, 23