

July 31, 1962

R. C. ABERLE

3,046,772

WASHING MACHINE DRIVE SYSTEM

Filed Feb. 29, 1960

4 Sheets-Sheet 2

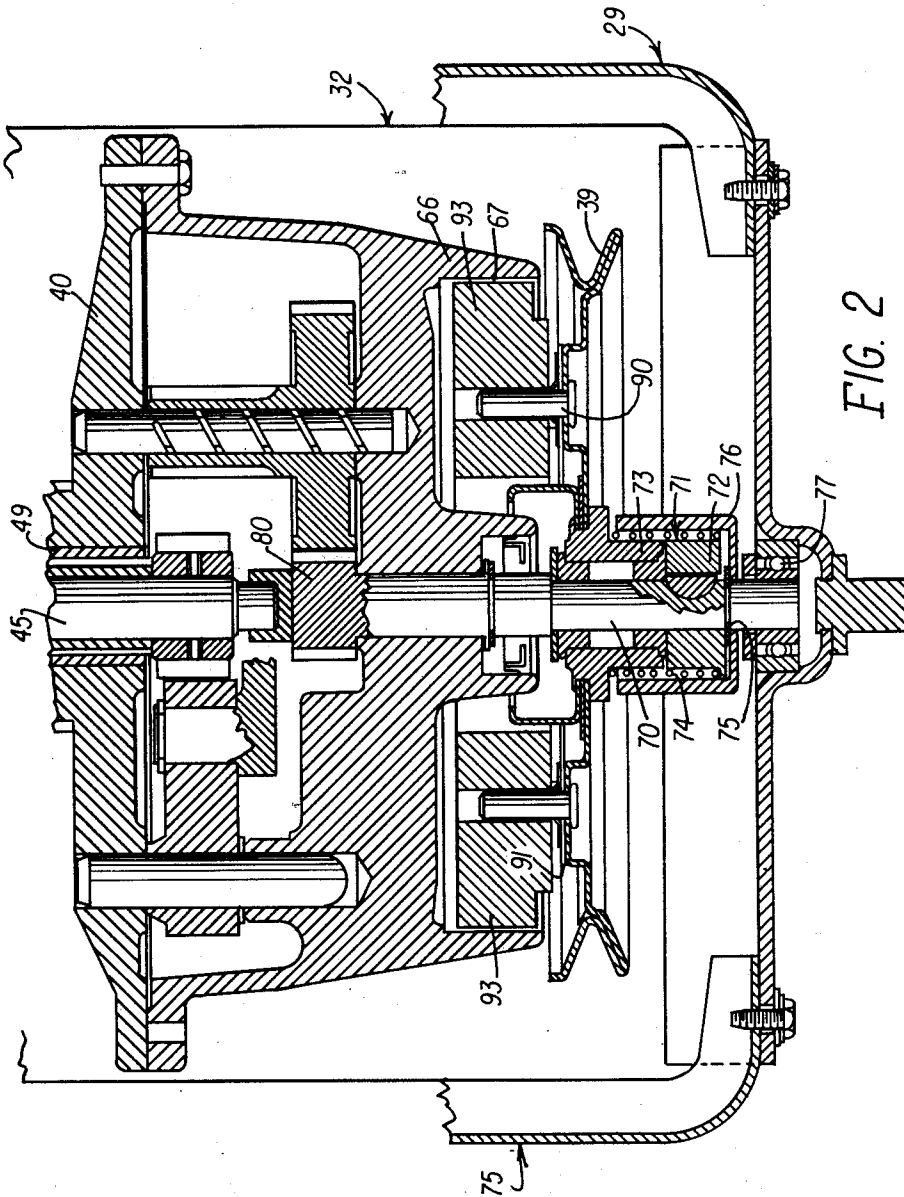


FIG. 2

INVENTOR.

Robert C. Aberle

BY

Andrew B. Hubbard

Attys

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R. C. ABERLE

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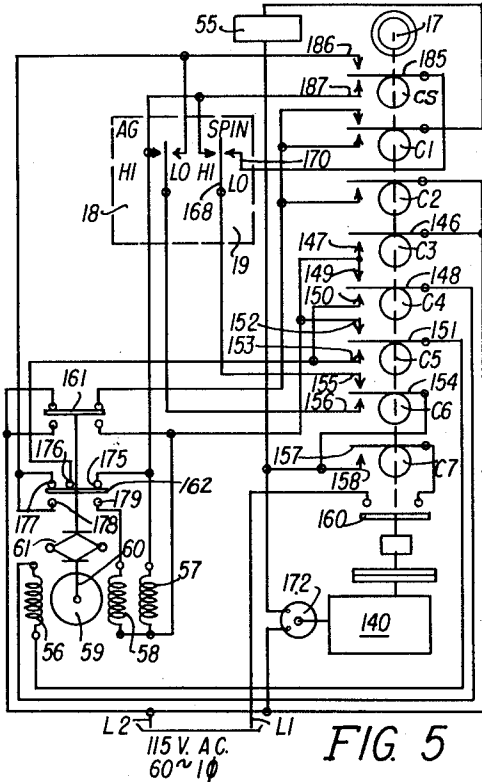


FIG. 5

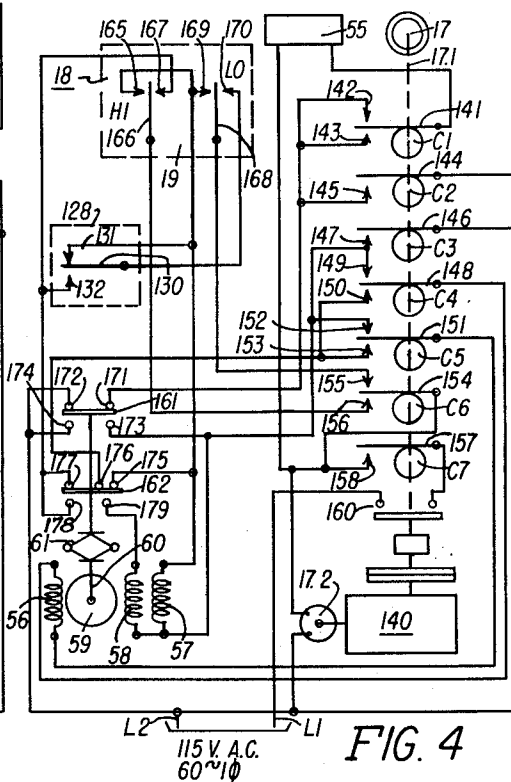


FIG. 4

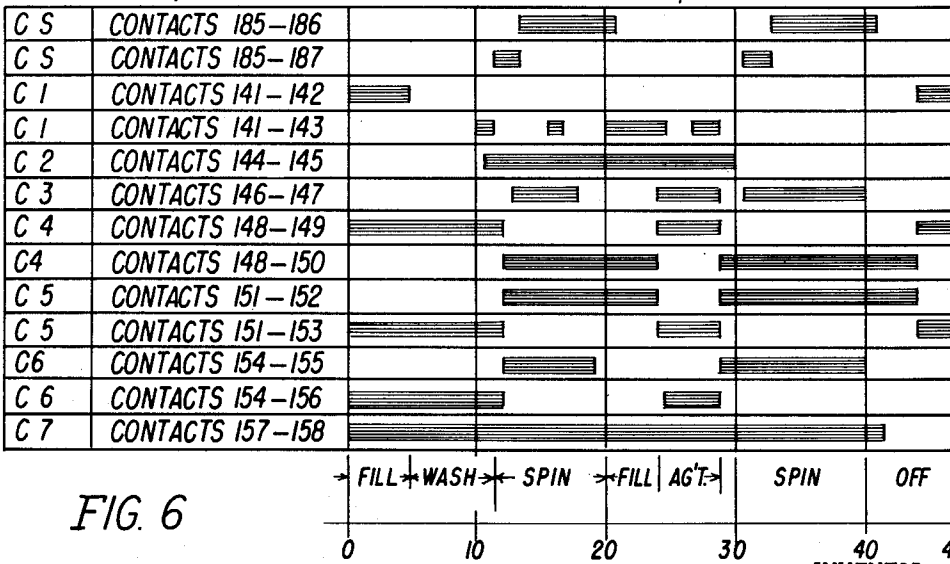


FIG. 6

Robert C. Aberle

BY

Andrew B. Hubbard

Attys

July 31, 1962

R. C. ABERLE

3,046,772

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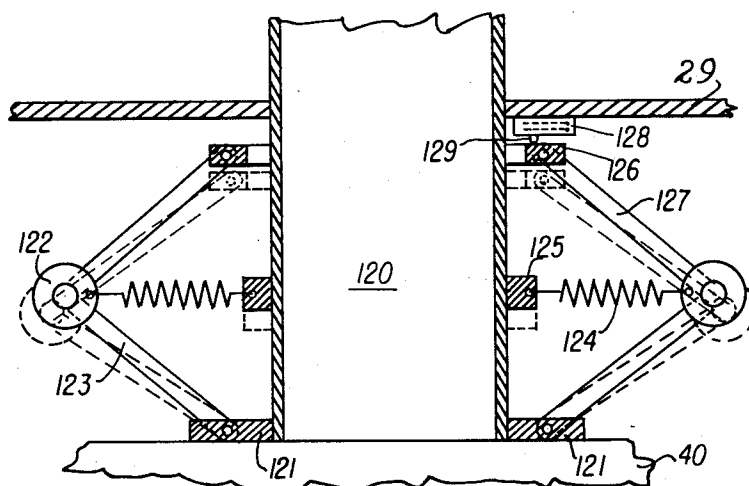


FIG. 7

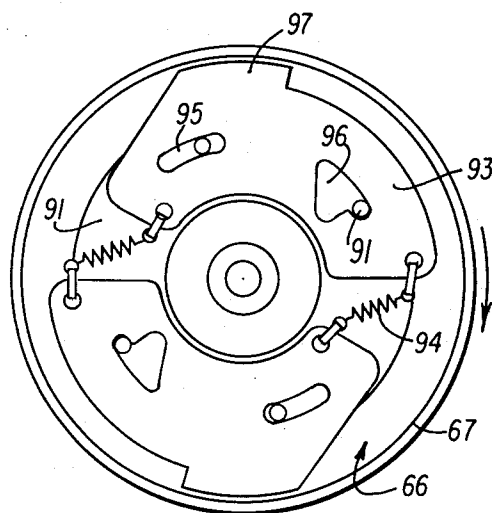


FIG. 8

INVENTOR.

Robert C. Aberle.

BY

Andrew B. Hubbard

Attys.

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3,046,772

WASHING MACHINE DRIVE SYSTEM

Robert C. Aberle, Lombard, Ill., assignor to General Electric Company, a corporation of New York

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8 Claims. (Cl. 68-12)

The present invention relates to automatic clothes washing machines and more particularly to improved control circuitry and mechanisms therefor.

In machines of this type which must provide the proper washing and extracting actions for the various assorted types of fabrics laundered in domestic usage, it is desirable that the machines be capable of two different speeds of operation. In particular, it is desirable that there be provided two-speed independent selection of both wash speed and spin extraction speed for both horizontal and vertical axis machines. In vertical axis machines, it is preferable that the agitator be oscillatory at two different speeds and that the spin basket be rotatable at two speeds independently of the agitator speed selection. The higher or normal speed operation of the agitator provides a strong washing action whereas the slower speed operation produces a more delicate washing action. Similarly the high speed rotation of the spin basket provides a strong centrifugal or drying action whereas the slower rotation of the basket provides a more delicate drying action. These two actions or speeds of the agitator and the spin basket are desirable because the same actions are not suitable for all types of fabrics. For example, the strong washing and drying actions required to wash and dry a load of heavy fabrics such as cotton materials are likely to cause rapid wearing or even tearing if applied to a load of delicate synthetic fabrics such as Orlon, nylon and the like. For such delicate fabrics the gentle actions provided by the slow speed agitation and the slow speed spin are much more suitable. On the other hand, these gentle actions would not produce satisfactory results if applied to the load of heavy fabrics. Further, various combinations of wash and spin speeds are required for highly soiled clothes of the delicate type or lightly soiled heavy fabrics. To provide a machine which will adequately launder all fabrics in the usual clothes conditions, separate control of wash and spin speeds are necessary in the modern laundry machine.

Therefore, the present invention has as its object to provide in a washing machine of the two speed selective type as outlined above, mechanism which will allow the spin basket to be accelerated at the highest rate regardless of the operating rate selected by the user.

It is a further object of the invention to provide in a washing machine of the two speed selective type which utilizes a two speed motor to provide the drive variability, circuitry for accelerating the wash basket at the high speed of the motor until the basket has been accelerated to approximately the lower of the possible operating speeds of the basket, at which time the pre-selected speed will assume control of the operating speed of the spin basket.

Other objects, features and advantages of the present invention will be apparent from the detailed description of the preferred embodiments thereof read in connection with the following drawings in which:

FIG. 1 shows a partially sectioned front perspective view of a clothes washing machine utilizing the invention;

FIG. 2 is a side elevational section of the transmission mechanism employed;

FIG. 3 is an exploded view of the transmission mechanism of FIG. 2;

FIG. 4 is a schematic diagram of the circuit of the first embodiment utilizing a centrifugal switch mechanism;

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FIG. 5 is a schematic diagram of the second embodiment utilizing a timing mechanism;

FIG. 6 is a cam closure diagram to illustrate the closures necessary in the circuits of FIGS. 4 and 5;

FIG. 7 is a schematic view of a centrifugal switch mechanism which may be utilized for the first embodiment as the tub speed responsive device; and

FIG. 8 is a top view of the spin clutch shoes as mounted on the transmission pulley.

The invention as set out herein has been applied to a washing machine in which the basket may be rotated at either the "normal fabrics" extraction speed of 600 r.p.m., or the "delicate fabrics" extraction speed of 400 r.p.m. Because of operating advantages well known in the art, it is usual for such washing machines to utilize a speed responsive arrangement such as a centrifugal clutch for transmitting power from the drive mechanism to the rotatable basket. It is also common practice to use a two-speed electric motor to provide the basic operating speeds. In a four-pole, six-pole motor, for example, a circuit establishing four-pole operation will produce 1,725 r.p.m. motor speed, whereas six-pole operation results in 1,140 r.p.m. With centrifugal clutch transmissions, the time required to accelerate the basket to its lower operating speed is unduly long when the low speed of the motor is utilized and this excess time adds unnecessarily to the cycle length. In a preferred embodiment of my invention, the acceleration speed is produced by a control circuit which always uses the high-speed winding of the motor to effect the acceleration, regardless of the fact that the operator may have preselected low speed extraction, and then automatically changes to the low speed windings when the desired low extraction speed is approached. Two alternative methods are shown which allow this high speed acceleration to be used for all basket accelerations. In the first of these methods, a centrifugal switch is mounted to the spin basket or transmission housing. This switch insures that only the high speed of the motor will be used for acceleration of the basket by activating the high speed and inactivating the selective control during the acceleration of the basket. The switch will change this condition only when the basket has reached a predetermined minimum speed. Thereafter, the speed control function is restored to the speed selective device. The second method utilizes a predetermined time period of high speed acceleration after which the speed selective device would gain control of the rotative speed of the basket to accomplish the same result as the first embodiment. Both embodiments have been illustrated as applied to vertical axis machines although the principle is clearly applicable to horizontal axis laundering and drying machines.

Referring now to FIG. 1 of the drawings, the clothes washing machine 10 there illustrated, is of the generally known spin basket type. More particularly, the machine 10 comprises a substantially rectangular base 11 that is supported upon independently adjustable feet (not shown) arranged to engage the floor or other supporting surface. A housing or outer casing 13 is removably carried by the base 11 and includes a wrap around element including front and side walls and defining both a rear opening and a top opening; a rear wall (not shown) is permanently affixed to the base 11 covering the rear opening, and a top wall 15 is removably carried by the top of the housing in order to close the top opening mentioned. The sides of the top wall 15 are substantially flush with the side walls of housing 13 to form an upright substantially rectangular prism. At the rear of the top wall 15 is mounted a vertically extending backplasher 16 which serves as a control bearing panel. The inner surface of this backplasher contains the control knobs and

switch buttons for initiating a cycle of the proper length and type. More specifically, there is shown a timer control knob 17 which is rotatable manually to set the desired length of the operative cycle. Further, there are provided two switching arrangements, respectively 18 and 19, which selectively establish the control circuits for effecting desired operational speeds of the washing and extraction cycles, as later explained. The first switch 18 includes a first switch-operating button 18.1 designated high speed and a second button 18.2 designated low speed; and these buttons control the intensity of the agitation cycle. These buttons are of the interlocked type such that only one of the buttons can be depressed at any given time and the other will automatically restore. The second switch, designated 19, is used to control the spin operation and includes a high-speed selection button 19.1 and a low-speed selection button 19.2; these buttons also are of the interlocked type.

A substantially centrally disposed top opening 20 is provided in top wall 15 in order to render the interior of the housing 13 accessible from the exterior. A conventional door (not shown) is provided for the purposes of selectively closing the top opening 20; the door being hinged at one of its sides to the top wall 15 and movable thereabout from a closed position to an open position allowing access to the interior of the casing 13 for loading or unloading the machine.

A supporting structure 22 carries an upstanding rectangular collection chamber or drain tub 23 arranged in the upper portion of housing 13. The chamber 23 at its uppermost section is provided with an inwardly directed flange 24 that terminates in a top opening disposed below the top wall. The bottom wall 26 of chamber 23 is spaced above base 11 to define a machinery compartment 27 arranged in the lower portion of housing 13. The base 11 carries additional supporting structure 28 upon which the principal drive mechanism for the machine is mounted. A further support structure 29 which serves as the foundation for the transmission is also mounted to base 11. This support structure 29 comprises a horizontal base plate 30 affixed to base 11 and vertical side walls 31 extending therefrom to form an open-ended mounting space for the transmission mechanism 32. The upper plate of the transmission support structure 29 contains a central opening above which is mounted a hollow tube shaped, bearing retaining structure 33, the function of which will be explained more fully later. Secured to the side wall 31 is a curved channel member 35 to which is bolted or affixed in any known manner the main drive motor 36. Motor 36 is positioned in inverted fashion with its output shaft (not shown) depending from the motor structure. Secured about the motor shaft is a drain pump (also not shown) of any generally known type. The pump may preferably have its impeller fastened to the motor shaft so that the pump may expel waste water on rotation of the motor. Further, the motor shaft has mounted to it a pulley (not shown) which carries a flexible V belt 38. This V belt is also laced about pulley 39 of the transmission mechanism 32, to impart driving effect thereto. The transmission mechanism 32 is mounted in parallel relationship to the motor 36 and has extending upwardly above its topmost surface 40 a central agitator shaft 45 which in its upward extent protrudes through the bearing retainer structure and into the collection chamber 23.

An upstanding spin basket 46 is centrally positioned within collection chamber 23 and is mounted for rotation about a substantially vertical axis. The spin basket is generally imperforate and has an open face adjacent the top access opening of the casing 13 to allow access to the tub interior. About the periphery of the basket adjacent the open face, there is secured an annular balance ring 46.1 of high density material providing a comparatively large moment of inertia for the basket. The spin basket 46 is provided with an upwardly and out-

wardly flared sidewall that terminates as mentioned below the access opening. Near its upper periphery basket 46 contains a horizontally aligned series of apertures or slots 47 for centrifugally ejecting water from the basket. At the center of the spin tub there is positioned a vertical agitator 48 which is mounted coaxially on the agitator shaft 45 and is oscillated thereby. Also mounted coaxially about shaft 45 is a tubular spinner shaft 49 whose upper end terminates a few inches above the spin basket lower surface. This spinner shaft is used to impart rotative motion to the spin basket and to further this end, the spin shaft is firmly secured to the spin basket 46 at hub 49.1. Exteriorly of the cylindrical body of the agitator 48 are positioned a plurality of radially extending agitator vanes 50. The agitator is further provided with an outwardly and downwardly flared skirt 51 to which the vanes 50 are joined at their lower ends.

Further, the machine 10 includes a water supply system of the generally known type, the details of which have not been included in the drawings to simplify the disclosure. The water system selectively provides hot and cold water for filling the tub under the control of water solenoids shown only representatively herein as solenoid 55. Suitable plumbing for removing water from the collection chamber through the use of the motor driven pump must also be provided in any generally known fashion.

Turning more specifically to the drive mechanisms which form the core of the present invention, there is provided as previously mentioned, a main drive motor 36. The motor comprises a reversible induction motor of the split phase, four pole, six pole type and includes a stator (not shown) carrying a four pole start winding 56, a four pole or high speed run winding 57 and a six pole or low speed run winding 58 as well as a rotor 59 carrying a squirrel cage winding and provided with the operating shaft shown diagrammatically as 60. There is also provided a motor speed responsive switch shown representatively as 61 affixed to the motor shaft 60 as will be explained more fully in a subsequent section of this description. The main motor has a rating of about $\frac{1}{4}$ horsepower and an operating speed at full load of about 1,725 r.p.m. when operating as a four pole motor and an operating speed at full load of about 1,140 r.p.m. when arranged as a six-pole motor. In the arrangement shown, agitator 48 is oscillated at about 72 cycles per minute through the medium of transmission mechanism 32 when the main motor is running as a four-pole motor at its high speed, on the other hand agitator 48 is oscillated at about 48 cycles per minute when the main motor is running as a six pole motor at its low speed. The spin basket 46 will be rotated at approximately 600 r.p.m. when the motor is running at its high speed and when the motor is rotating at its low speed, the spin basket will rotate at its lower speed of approximately 400 r.p.m.

Referring now to FIGS. 2 and 3, there is shown in detail a transmission mechanism 32 of the type which has its operative axis coaxial to the agitator and rotative axis of the machine and as a result is called a coaxial transmission. For ease in understanding, the transmission mechanism may be considered as having four sections: the outer casing and support structure, agitator clutch mechanism 63, spin clutch mechanism 64, and agitating gear train 65. Analyzing these sections individually, the support and casing structure may be considered to include the transmission support structure 29 and the bearing retainer 33 previously discussed. Further, there is secured rotatively within support 29, a transmission casing or housing 66 which provides a foundation structure within which the transmission in the main is housed. Casing 66 comprises an open topped bowl-shaped structure with a downwardly directed cylindrical sidewall 67 extending from the base of the bowl. The open top is closed by circular cover plate 40 which has a central circular opening for the tubular shaft 49. As mentioned, there is

provided a pulley 39 which mounts beneath the casing 66 and is freely rotatable thereon. By way of V belt 38, the pulley 39 receives and transmits the primary driving motion to the transmission mechanism.

The agitator clutch mechanism 63 is operatively positioned below the pulley 39 within casing sidewall 67. This clutch mechanism includes a vertically extending shaft 70 which protrudes through the pulley rotative axis and is freely rotatable therein. The shaft has keyed to it a clutch hub 71 which comprises a circular base plate section 72 from which arises a perpendicular cylindrical section 73 disposed about and keyed to the shaft 70. Outwardly of clutch hub 71 is circumposed closely a cylindrical helically wound clutch spring 74 which is confined in the vertical direction by the body of pulley 39 above, and the base plate 72 of the clutch hub below. Disposed below the circular base 72 is a spring clip retaining ring 75 which is mounted to the shaft locking the clutch hub in place vertically. Seated below and about the retaining ring is a cup-shaped grease retainer 76 which is mounted above the lower bearing and support assembly 77 to serve the purpose which its name implies.

In this assembly as described, the keying of the clutch hub to the shaft 70 serves to render the clutch hub co-rotative with the shaft. Shaft 70, although mounted coaxially through the pulley is freely rotatable therein and extends upwardly into the central cavity of transmission casing 66 and at its upper end shaft 70 has secured thereto gear train drive pinion 80. For the agitate cycle when the pulley begins to spin in a clockwise direction, the clutch spring tightens on the clutch hub and couples together the pulley, the clutch hub and the shaft. The combined rotation of these elements rotates the clutch shaft 70 which in turn will operate gear train 65 to oscillate the agitator shaft 45 about the vertical axis in a known fashion. When the pulley is rotated in the counterclockwise direction for spin of the basket, clutch spring tends to unwind about shaft 70, shaft 70 will not rotate and the agitator remains quiescent.

To provide for rotation of the spin basket there is provided spin clutch mechanism 64 which mounts directly beneath the central base portion of the casing 66 within side wall 67. The mechanism includes four pin members 90 depending from pulley 39 and arranged in a concentric circle about the axis of the pulley. An annular shim plate 91 which rests against the body of pulley 39 includes holes 92 for receiving the clutch pins thereby allowing the shim plate to contact the pulley body. The clutch pins also extend through the two clutch shoes 93, each of which receives two clutch pins. The shoes are resiliently connected together by means of clutch retaining springs 94. In the manner shown in FIG. 8, each of the clutch shoes has a suitable arcuate slot 95 for receiving one of the clutch pins and each also has a heart shaped aperture 96 for receiving the other clutch pin. Each clutch shoe also has an arcuate emboss 97 extending radially outwardly of the shoe proper. As can be seen best in FIG. 2, embosses 97 normally remain spaced away from annular depending wall 67 which acts as the clutch drum.

The operation of the spin clutch is as follows: When the motor rotates in a clockwise direction, the pulley rotates in a clockwise direction also. This in turn rotates the clutch pins and the clutch shoes. In this rotational direction (shown as counterclockwise in FIG. 8) the shoes are not thrown radially outward and they do not contact the adjacent sidewall 67 of the transmission casing and no rotational force can be transmitted to the casing and in turn to the spin tub.

When the pulley 39 is rotated in a counterclockwise direction to initiate a centrifugal extraction cycle, centrifugal forces impel the clutch shoes 93 into frictional driving engagement with the clutch drum wall 67. The washing basket has a heavy load of water and clothes, and, therefore, substantial inertia, whereupon it is obvious that the pulley must be brought as quickly as pos-

sible to a speed at which the clutch shoes will exert the necessary driving effort. In previous two speed motor driving mechanisms, if the control circuit had been pre-selected for low-speed extraction, an unduly long time was required to accelerate the basket to its desired extraction speed. The present invention provides a control system which makes the rate of acceleration of the tub independent of the operational speed selected by the operator.

In the first embodiment of the invention, I employ a spin basket speed responsive switch mechanism 120 to establish the drive motor circuit; this mechanism by virtue of its functionary nature may with its allied circuitry hereinafter be referred to as a basket acceleration control means. Mechanism 120, as shown in detail in FIG. 7, comprises a centrifugally operated mechanism of the well-known fly ball type. The mechanism is mounted concentrically about the spin basket tubular shaft 49 in the area just above transmission cover plate 40. The lower member 121 of the switch is firmly secured to the transmission cover 40 in any known manner in order to be rotatable therewith. As shown in FIG. 7 there are provided two fly ball mechanisms, each displaced from one another 180° about the central shaft of the machine. Each of the fly balls 122 is movably secured into lower securing member 121 by means of a connecting rod 123. Each of the fly balls is resiliently connected by means of bias spring 124 to opposite sides of an annular member 125 which slideably surrounds the shaft. Each of the fly balls is further resiliently secured to an upper contacting annulus 126 by means of a rod member 127. Annulus 126 is also supported slideably on shaft 49 to normally remain adjacent transmission support 29. The speed responsive device, as described, is held in its normal position by the action of bias spring 124 which tensilely draws and holds the fly balls inwardly toward shaft 49 and as a result maintains annulus 126 in its uppermost position.

Further, there is mounted stationarily to the underside of the top plate of transmission support 29, a snap acting limit switch 128. The switch has an operating button 129 actuatably adjacent annulus 126. The relationship of the switch to the annulus is such that when the transmission casing is at rest, the annulus depresses button 129 maintaining armature spring 130 in contact with stationary contact 131 indicating the normal position of the switch. When the transmission casing is rotated at a speed sufficiently great enough to cause the fly balls 122 to be impelled outwardly, annulus 126 is driven downwardly away from operating button 129. When this occurs, armature contact 130 breaks the circuit to contact 131 and closes a path to stationary contact 132. The level at which this switch actuation occurs may be set by varying the tensile forces on bias spring 124. In the preferred form of the present invention, the transmission casing speed at which switch 128 is actuated from its normal to its off-normal state should be approximately the lower operating speed of the casing and basket which is 400 r.p.m. Conversely when the casing and basket speed falls substantially below 400 r.p.m., as occurs following de-energization of motor 36, the speed responsive device returns to normal and switch 128 also will restore to its normal state with armature 130 closed to stationary contact 131.

The circuit employing this first embodiment is shown schematically in FIG. 4. There I use a conventional control knob 17 which may be rotated in a plane parallel to the control panel backplasher 16 and may also be depressed axially. Knob 17 on either of these movements actuates cam shaft 17.1 in a like manner. There is also provided a timer motor 17.2 which through suitable transmission mechanism 140 drives shaft 17.1 in a step by step fashion at the rate of 6° of revolution per minute to return the shaft to its normal position after manual rotation. Cam shaft 17.1 bears seven circular

cams all of which rotate with the cam shaft. These cams are numbered sequentially C1-C7 and each has actuatably adjacent thereto an armature spring movable between one or more stationary contacts to open and close electrical circuits. Each of these cams has one or more embossed portions to make and break these circuits in the pattern shown in the cam closure diagram of FIG. 6. Thus, there is shown a cam C1 having an armature contact 141 movable between an upper contact 142 and a lower contact 143 and which may remain intermediately between these contacts in an open circuit condition. Cam C2 has an armature spring 144 which makes and breaks circuit to single stationary contact 145. Cam C3 has as its armature spring 146 which can make or break to its single stationary contact 147. Cam C4 has its armature contact 148 movable between two stationary contacts 149 and 150. Cam C5 has an armature spring 151 movable between stationary contacts 152 and 153. Cam C6 has as its armature 154 movable between stationary contacts 155 and 156 or intermediately therebetween. Cam C7 has armature 157 which is closed to contact 158 for the entire operative cycle of the machine to maintain a closed energizing path for the timer motor 17.2.

The other components of the circuit include a line switch 160 which supplies the circuit of FIG. 4 with a source of 115 volt, 60 cycle, single phase current at conductor lead L1. The other side of the source is connected to conductor lead L2. Further, the circuit contains a reversible four-pole, six pole induction motor 36 having a four-pole start winding 56, a four-pole run winding 57 and a six-pole run winding 58. Provided also is the motor speed responsive switch 61 having two movable armatures 161 and 162 which are actuated by the motor shaft when the motor reaches a predetermined speed and which may be set to the level of the motor low running speed. This motor responsive switch 61 may be of the generally known centrifugal type and may be supplied as one of the internal components of the motor. Also in the circuit of FIG. 4, there is included the basket or transmission speed responsive switch 128 which, as mentioned, has its armature 130 normally closed to stationary contact 131. A second stationary contact 132 is contacted by the armature 130 only when the transmission and the basket reach the predetermined transmission casing speed.

The circuit also includes a speed selective device with an agitate speed selection switch 18 and a spin speed selection switch 19 each manually actuatable independently of the other. Within the agitate switch 18 there is provided an armature contactor 166 which may be closed to either one of the two stationary contactors 165 or 167. The circuit is closed to contact 165 when high agitate speed is required and to contact 167 when low agitate speed is desired by the operator. The spin switch 19 has as armature contact 168 which may be closed to either one of two stationary contactors 169 for high speed or 170 for low spin speed. These switches are individually push button controlled, as previously noted. The actual switch operating mechanism is unimportant; any known type of single pole, double throw switch may be used. A single water solenoid 55 is shown, although in normal practice there are separate hot and cold solenoids with selective controls, as well known in the art. Dual controls have been omitted to simplify the disclosure of the invention.

The operation of the embodiment of FIG. 4 is as follows the operator preselects the desired agitate speed at switch 18 and the desired spin speed at switch 19 and further depresses knob 17 and rotates the knob to the start position. Depression of knob 17 closes the line switch 160 closing the supply circuit through its contacts which then remain closed for the duration of the operative cycle. Rotation of the knob and the consequent rotation of cam shaft 17.1 places the cams in the position represented by the left border of the cam closure chart of FIG. 6. As

may be seen in FIG. 6, rotation of knob 17 to the start position causes cams C1 and C4 to close their armature contacts to their upper stationary contacts and causes cams C5, C6 and C7 to close their armature contacts to their lower stationary contacts. These cam closures complete a number of circuits including an energizing circuit for the timer motor 17.2 which may be followed from conductor L1 through the closed contacts of switch 160, closed contacts 157 and 158 to timer motor 17.2 and the other side of the line at conductor L2. As mentioned, cam C7 retains contacts 157 and 158 closed for the entire operative cycle of the machine and as a result timer motor 17.2 remains energized over this circuit for the duration of the laundering cycle. A circuit to the water solenoid is closed over a path which extends from conductor L1 through the closed contacts of switch 160, closed contacts 157-158, solenoid 55, closed contacts 141-142, closed contacts 171-172 of the motor speed responsive switch 61 to conductor L2. The machine then receives an inflow of water for a predetermined timed period governed by the rotation of timer motor 17.2 and its output camshaft 17.1.

At the conclusion of the timed water fill period, cam C3 closes its contact 146 and 147 initiating the agitate cycle. At this stage it should be noted that the operator had two alternatives—that of agitating the machine at high speed or at low speed. This selective control has been performed by the prior manipulation of switch 18 to the desired agitate intensity. First, we will assume that the operator had desired a gentle agitation and to accomplish this end had closed armature 166 to stationary contactor 167. This contact closure in combination with the cams which already have their armatures in the closed circuit positions energizes the motor start winding and the motor high speed run winding to start the acceleration of the motor. The circuit for energizing the motor start winding may be traced from conductor L1 through the closed contacts of line switch 160, closed contacts 157 and 158, closed contacts 154 and 156 of cam C6, closed contacts 166 and 167 of the selective agitate switch, contacts 177 and 176 of the motor speed responsive switch, contacts 153 and 151 of cam C5, start winding 56 of the drive motor, closed contacts 148 and 149 and contacts 147 and 146 to conductor L2. The high speed winding operate path may be traced from conductor L1 through contacts of line switch 160, closed contacts 157-158, closed contacts 154-156 of cam C6, closed contacts 166-167 of the agitate selective switch, closed contacts 177-175 of the motor speed responsive switch to winding 57 of the motor and through closed contacts 147-146 to conductor L2. The motor then accelerates until the motor speed responsive switch armatures 161 and 162 are both actuated by the motor reaching its lower running speed. In so doing, the circuits to both the start winding and high speed run windings are opened and an operating circuit is completed to the low speed run winding. This circuit extends from conductor L1 and closed contacts of switch 160 through closed contacts of 157-158, closed contacts 154-156 at cam C6, closed contacts 166-167 of the agitate selection switch, the motor speed responsive switch contacts 178-179, the winding 58 of the motor and closed contacts 147-146 at cam C3 to conductor L2. The motor then continues to operate the agitator at its low speed through the medium of previously described transmission mechanism. The agitate washing cycle continues for the timed interval in this manner.

If the operator had desired a high speed agitation, and as a result had closed the armature 166 of the agitate selection switch to stationary contact 165, the start winding of the motor and the high speed run winding of the motor again would be energized. The start winding in this case is energized over a path which extends from conductor L1 through the closed contacts of switch 160, closed contacts 157 and 158 of cam C7, closed contacts 154-156 at cam C6, closed contacts 166-165 at the agi-

tator selection switch, contacts 175—176 of the motor speed responsive switch, closed contacts 153 and 151 at cam C5, start winding 56, closed contacts 148—149 of cam C4, closed contacts 147—146 of cam C3 to conductor L2. In this case also, the motor accelerates to the point at which its speed responsive switch 61 switches both armatures 161 and 162 to their operating positions de-energizing the start winding and retaining the motor high speed winding operated. This operating path extends from conductor L1 through closed contacts of switch 160, closed contacts 157—158 of cam C7, contacts 154—156 of cam C6, contacts 166—165 of the agitate selection switch, high speed winding 57, and closed contacts 147 and 146 to conductor L2. It can be seen that this high speed winding operating circuit does not include contacts of the speed responsive switch 61 and as a result is not affected by the action of the speed responsive switch. As a result the high speed winding will continue to rotate the motor after the motor has accelerated past the motor speed responsive level. The machine continues through its agitation period at the selected speed and thereafter must expel the wash water which remains in the wash basket and collection chamber. This, of course, is accomplished by spinning the basket at high speed to eject the wash water to the collection chamber and draining the ejected water from the collection chamber by means of the drain pump. To effect this portion of the cycle as can be seen in FIG. 6, cam C2, C3 and C4 close their armature contacts to their lower contacts and cams C5 and C6 close to their upper contacts; cam C7 remains closed. Through these cam closures the motor start winding and the high speed run winding are both energized to accelerate the motor. For the extraction cycle also, the operator may optionally have selected either the high or low spin speed. Both the start and high speed run windings are used to accelerate the motor consequent to either high or low spin speed selection.

Assuming the operator has selected high speed spin, a circuit will be closed to the start winding as follows: conductor L1, through the closed contacts of switch 160 and closed contacts 157—158 of cam C7, closed contacts 154—155 of cam C6, closed contacts 169—168 of the spin selection switch, closed contacts 175—176 of the speed responsive switch, contacts 150—148 of cam C4, start winding 56, closed contacts 151—152 of cam C5 and contacts 147—146 of cam C3 to conductor L2. It should be noted that for spin energization of the start winding, the direction of current flow through the start winding is directly opposite that employed for agitation. This reversed direction of energization causes the motor to accelerate in the counterclockwise direction which in turn rotates the spin basket and the pump impeller. The high speed run winding of the motor is energized at this time over a path from conductor L1, through the closed contacts of switch 160, closed contacts 157 and 158 of cam C7, closed contacts 154 and 155 of cam C6, closed contacts 169—168 of the spin selection switch, the high speed winding 57 and closed contacts 147—146 of cam C3 to conductor L2. This energization path again does not include the contacts of the speed responsive switches 61 and 128 and as a result, the high speed run winding will continue to rotate the motor after the circuit to the start winding has been opened by the action of the armatures 161 and 162 of the speed responsive switch 61. When the high speed spin has been selected, the basket continues to spin for the timed extraction interval ejecting water from the basket to the collection chamber from which the exhaust pump expels the water to the drain.

When the operator has selected the low speed at spin selection switch 19, contacts 168 and 170 close and the first embodiment of the present invention comes into play. As previously described, the start winding and the high speed winding are energized to accelerate the motor. The operating circuit for the start winding extends from conductor L1 through the closed contacts of switch 160,

closed contacts 157—158 of cam C7, closed contacts 154—155 of cam C6, contacts 168—170 of the spin selection switch, contacts 130—131 of the basket speed responsive switch 128, closed contacts 175—176 of the motor speed responsive device, contacts 150 and 148 of cam C4, start winding 56, contacts 151—152 of cam C5 and closed contacts 147—146 of cam C3 to conductor L2. The high speed winding is energized over a path from conductor L1 through the closed contacts of switch 160, closed contacts 157 and 158 of cam C7, contacts 154—155 of cam C6, closed contacts 168—170 of the spin selector switch, contacts 130—131 of the basket speed responsive switch 128, high speed winding 57 to closed contacts 147 and 146 and conductor L2. The motor accelerates over these windings until the predetermined motor speed is reached at which time the motor speed responsive switch 61 changes state switching its armatures 161 and 162. When this occurs, the start winding is de-energized as contacts 175—176 open and the motor continues to accelerate utilizing the high speed winding.

The motor continues to accelerate until the transmission reaches the operating level of switch 128, which as mentioned may be the lower running speed of the basket, i.e. 400 r.p.m. At that time annulus 126 is drawn away from operating button 129 opening the operating circuit to the high speed winding at contacts 130—131 and closing a circuit at contacts 130—132 to the motor low speed winding. The low speed winding is energized over a path which extends from conductor L1, through the closed contacts of switch 160, closed contacts 157—158 of cam C7, contacts 154—155 of cam C6, contacts 168—170 of the spin selective switch, contacts 130—132 of the basket speed responsive switch, contacts 178—179 of the motor speed responsive device, low speed winding 58 and contacts 147—146 of cam C3 to conductor L2. The spin cycle continues at the lower, more gentle-to-the-clothes speed for the duration of the timed extraction interval.

The cyclic operation continues at the selected speed and when the timed water extraction period is ended as indicated by the change in cam closures, the machine moves into the rinse cycle. This cycle for the purpose of this invention is a duplicate of the operations which occur for the washing cycle in that there is a water fill followed by an agitation for which the agitate speed has been selected at switch 18, which in turn is followed by a spin out extraction of the accumulated water. In this final spin, the selective operation of the first embodiment of the invention occurs as previously described for the wash water extraction operation.

The second embodiment of the invention utilizes an extra cam CS mounted on cam shaft 17.1. This cam actuates an armature contact 185 movable between an upper stationary contact 186 and a lower stationary contact 187 or may remain intermediate therebetween. This cam CS, its contacts 185, 186 and 187 in addition to the circuitry allied therewith may for purpose of simplicity also be termed a basket acceleration control means. These cam driven contacts replace the contacts of the basket speed responsive switch 128 and this switch may be eliminated for this embodiment. Cam CS functions for a timed period during spin operations and maintains the motor high speed winding operative. This timed period which may range from 45 seconds to one minute is sufficient to allow the basket to reach its lower running speed of 400 r.p.m. At the conclusion of the timed period, cam CS restores and allows the speed control to be governed by the selection at switch 19.

Excepting the replacement of the basket responsive switch contacts by the timed cam functioning, the operation of the circuit of FIG. 5 is identical to that of FIG. 4. Thus, there is no need to repeat the majority of the operations utilizing the embodiment of FIG. 5. The only operation which is different and needs explanation is that of a spin operation where a low speed spin has

been selected. In this second embodiment, when the low speed spin has been selected, the motor start winding 56 and the high speed run windings are both energized to accelerate the motor in the spin direction. At this time cams C2, C3, C4 have closed their armature contacts to their lower stationary contacts and cams C5 and C6 have closed their armatures to their upper contacts. Again cam C7 remains closed for the entire cycle of operation maintaining the timer motor in continuous operation to provide a fully timed laundering cycle. Cam CS at this time has closed its armature to its lower contact as shown in the cam closure chart. The energizing path for the motor start winding may be traced from conductor L1 through the closed contacts of switch 160, closed contacts 157 and 158 of cam C7, closed contacts 154—155 of cam C6, closed contacts 168—170 of the spin selection control switch, contacts 185 and 187 of cam CS, contacts 175—176 of the motor speed responsive switch, contacts 150—148 of cam C4, start winding 56, and contacts 147—146 of cam C3 to conductor L2. The motor high speed winding starting path may be followed from conductor L1, through the closed contacts of switch 160, closed contacts 157—158 of cam C7, contacts 154—155 of cam C6, contacts 168—170 of the spin selection switch, contacts 185—187 of cam CS, high speed winding 57, contacts 147—146 of cam C3 to conductor L2. The motor accelerates until the motor speed reaches the level at which armatures 161 and 162 actuate. Actuation of armature 162 opens the start circuit at contacts 175—176 and the motor start winding is thereby de-energized. The motor continues to accelerate on the high speed winding which, as can readily be seen, does not include contacts of the motor speed responsive switch 61 in its operating path. The motor continues its high speed acceleration for a period timed by the rotation of cam shaft 17.1 and cam CS. At the conclusion of this timed period which in practice has been found optimally to range from 45 seconds to one minute in duration, cam CS actuates its armature 185 from its lower contact 187 to its upper contact 186. Opening of the circuit between armature contact 185 and lower stationary contact 187 opens the high speed winding circuit. Closure of contacts 185 and 186 closes a circuit to the low speed winding as follows: conductor L1, through the closed contacts of switch 160, contacts 157—158 of cam C7, contacts 154—155 of cam C6, contacts 168—170 of the spin selection switch, contacts 185—186 of cam CS, contacts 178—179 of motor speed responsive switch, low speed winding 58, and contacts 147—146 of cam C3 to conductor L2. The cycle then continues, utilizing low speed spin until the termination of the timed period. The remainder of the cycle then is completed in the usual manner.

Summarizing, there have been shown two methods of accelerating a rotatable laundry basket to its operating speed where the lower of two operating speeds has been selected. In both of these methods, the low speed selection is overridden for a period which in one method is timed and in the other is controlled by the basket speed. At the conclusion of the period using either method, the override is removed and the selective control governs the operative laundry basket speed.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a clothes washing machine adapted to proceed through a predetermined cycle of operations for washing and drying clothes, a rotatable wash basket, a clothes agitator disposed within said basket, drive means including a two-speed drive motor for operating said agitator at either of two predetermined speeds for washing the clothes and for rotating said basket at either of two pre-

determined speeds for extracting water from the clothes, manually operable control means including a first controller for selecting the agitator speed independently of the basket rotative speed and a second controller for selecting the operative basket rotative speed independently of the agitator speed, means for starting the acceleration of said motor at the higher of said two motor speeds independently of the selection at said second controller and for continuing said acceleration at the higher of said two motor speeds until said motor has reached the lower of said two motor speeds, speed responsive transmission means accelerated by said motor at said higher speed, said transmission means responsive to acceleration past a predetermined speed for thereafter transmitting rotational force to said basket and thereby to accelerate said basket at said higher motor speed, further means for continuing the acceleration of said basket at a higher of said two motor speeds by overriding the selection at said second controller and means operative after said basket has been accelerated to a predetermined level to remove said selection override and render said second controller effective to control the rotative speed of said wash basket.

2. In a clothes washing machine adapted to proceed through a predetermined cycle of operations for washing and drying clothes, a rotatable wash basket, a clothes agitator disposed within said basket, drive means including a two-speed drive motor for operating said agitator at either of two predetermined speeds for washing the clothes and for rotating said basket at either of two predetermined speeds for extracting water from the clothes, manually operable control means including a first manually operable controller for preselecting the agitator speed independently of the basket speed and a second controller for preselecting the operative basket speed independently of the agitator speed, and means for controlling the acceleration of said motor at the higher of said two motor speeds independently of the selection at said second controller, basket acceleration control means, switch means responsive to said motor reaching the lower of said two motor speeds for transferring basket speed control to said basket acceleration control means, said basket acceleration control means thereafter operative for continuing the acceleration of said basket at a higher of said two predetermined extracting speeds by overriding the speed selection at said second controller, said basket acceleration control means responsive to said basket having been accelerated to substantially the lower of said basket speeds for removing said override and for rendering said second controller effective thereafter to control the rotative speed of said basket.

3. In a clothes washing machine adapted to proceed through a predetermined cycle of operations for washing and drying clothes, a rotatable wash basket, a clothes agitator disposed within said basket, drive means for operating said agitator at either of two predetermined speeds for washing the clothes and for rotating said basket at either of two predetermined speeds for extracting water from the clothes, said drive means comprising a motor rotative at either of two speeds and a centrifugally responsive transmission mechanism, said transmission mechanism co-rotative with said basket during extraction, manually operable control means including a first manually operable controller for selecting the agitator speed independently of the selected basket speed and a second controller for selecting the operative basket speed independently of the selected agitator speed, and means for controlling the acceleration of said motor at the higher of said two motor speeds independently of the selection at said second controller, basket acceleration control means, switch means responsive to said motor reaching the lower of said two motor speeds for transferring basket speed control to said basket acceleration control means, and means for continuing the acceleration of said basket at a higher of said two predetermined extracting speeds independently of the speed selection at said controller,

said basket acceleration control means centrifugally actuable in response to said transmission and said basket combinedly having been accelerated to a predetermined level to render said second controller operative to govern said rotative speed in accordance with the basket speed selected.

4. In a clothes laundering machine adapted to proceed through a predetermined cycle of operations which may include washing and drying operations; a rotatable clothes receiving basket, drive means including a two speed motor and transmission mechanism for rotating said basket at either of two predetermined speeds, control means including a manually operable controller for selecting the operative basket speed, basket speed control means including first and second switch means, means for accelerating said motor at the higher of said two predetermined motor speeds independently of the selected basket speed, a clutch mechanism, said first switch means operative after said motor has been accelerated to the lower of said motor speeds for causing said clutch mechanism thereafter to be accelerated at the higher of said two motor speeds independently of the selection at said manually operable controller, said clutch mechanism responsive to acceleration to a predetermined level for thereafter accelerating said basket at the higher of said two motor speeds, and said second switch means actuable when said basket has been accelerated to substantially the lower of said two basket speeds, said manually operable controller effective on the actuation of said second switch means for thereafter governing the basket rotative speed in accordance with said selection.

5. In a clothes washing machine of the type having a basket within which clothes are washed, said basket being arranged for rotation to centrifugally extract washing liquid from the basket and the clothes therein, the combination of mechanism for accelerating said basket from a rest position to rotation at an extraction speed, said mechanism including a motor having a power circuit for operating the same at either a first speed or a substantially slower second speed; preselector switch means in said circuit to preselect the first or the second motor speed; and other switch means in said circuit to maintain the motor at its first speed for a period sufficient to accelerate said basket to a speed substantially the basket speed effected by said motor second speed and thereafter restoring the motor circuit for continued operation at the preselected speed.

6. In a clothes washing machine adapted to proceed through a cycle of operations for washing and spin drying clothes, a wash basket, an oscillatable agitator within said basket for agitating and washing clothes, a transmission mechanism driven by said motor on rotation of said motor during certain periods of a cycle of operation, said transmission mechanism actuable on achieving a predetermined speed for accelerating and rotating said basket, said motor of the two-speed type for rotating said basket at either of two selected speeds during said certain periods, a manually operable controller for selecting the operative basket speed, means responsive to selection at said controller for energizing said drive motor, a first motor energizing path independent of the selection at said controller for accelerating said motor to its lower running speed, a second motor energizing path for operating said motor at the higher of said two speeds, means centrifugally actuable by said motor reaching its lower running speed for transferring said motor circuit from said first to said second path independently of the selection, means for accelerating said transmission mechanism, said transmission mechanism responsive to acceleration to its actuating speed for thereafter accelerating said basket, and

means responsive to said basket having been accelerated for a predetermined timed period for switching said motor energizing circuit from the second path to the basket speed selected at said second controller.

7. In a clothes washing machine adapted to proceed through a cycle of operations for washing and spin drying clothes, a wash basket, an oscillatable agitator within said basket for agitating and washing clothes, a clutch mechanism driven by said motor on rotation of said motor during certain periods in a cycle of operation, said motor of the two-speed type for rotating said basket at either of two selected speeds during said certain cycles, a manually operable controller for selecting the basket rotative speed, means responsive to selection at said controller for energizing said drive motor for basket rotation during said certain periods, a first motor energizing path independent of the selection at said controller for accelerating said motor to its lower running speed, a second motor energizing path for accelerating said motor at the higher of said two speeds independently of the selection, means centrifugally actuable by said motor reaching its lower running speed for transferring said motor from said first to said second path, means for accelerating said clutch mechanism toward the actuate speed of said clutch mechanism, said clutch mechanism centrifugally responsive to the clutch actuate speed having been reached for thereafter accelerating said basket, and means responsive to said basket having been accelerated to a predetermined speed for switching said motor energizing circuit from the second path to the basket speed selected at said second controller.

8. In a clothes washing machine adapted to proceed through a predetermined cycle of operations for washing and spin drying clothes; a rotatable wash basket, a clothes agitator disposed within said basket, drive means for operating said agitator at either of two predetermined speeds for washing the clothes and for rotating said basket at either of two predetermined speeds for spin drying the clothes, said drive means comprising a motor rotative at either of two speeds and a centrifugal clutch mechanism driven thereby for accelerating and rotating said basket, control means including a first controller for selecting the agitator speed independently of the selected basket speed and a second controller for selecting the rotative spin dry speed independently of the selected agitator speed, means for controlling the acceleration of said motor at the higher of said two motor speeds independently of the selection at said second controller, spin acceleration control means, switch means responsive to said motor reaching the lower of said two motor speeds for transferring motor speed control to said spin control means, said clutch mechanism responsive to acceleration by said motor by said spin control means to a predetermined actuation level for thereafter accelerating said basket, said spin control means operative after said clutch mechanism has reached its actuation level for continuing the acceleration of said basket at the higher of said two predetermined spin speeds independently of the speed selection at said second controller, said spin control means actuable in response to said basket having been accelerated to a predetermined speed to render said second controller operative to govern said basket rotative speed in accordance with the basket speed selected.

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