

March 28, 1961

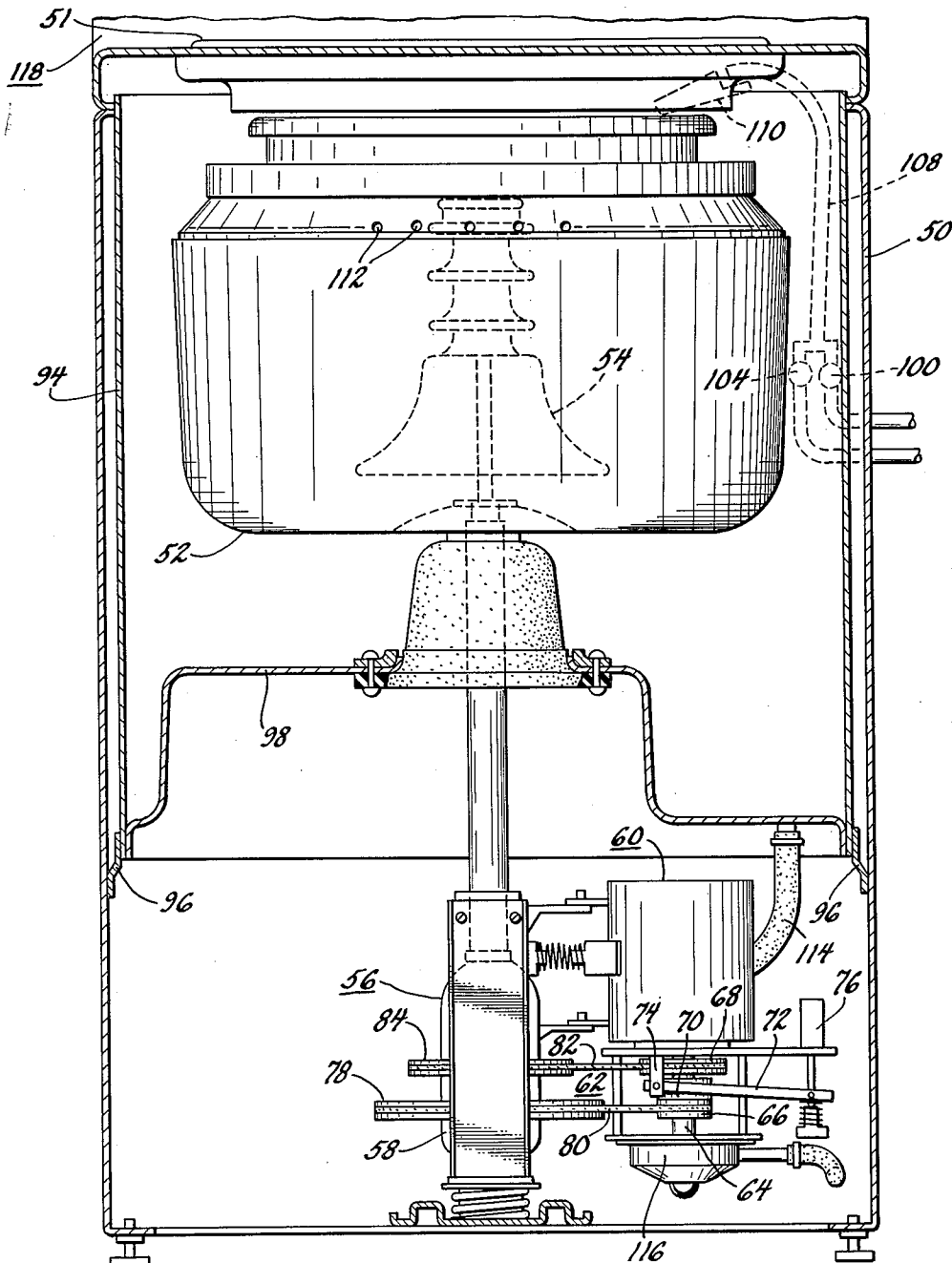
K. O. SISSON ET AL

2,976,710

AUTOMATIC CLOTHES WASHING MACHINE

Filed July 14, 1958

4 Sheets-Sheet 1



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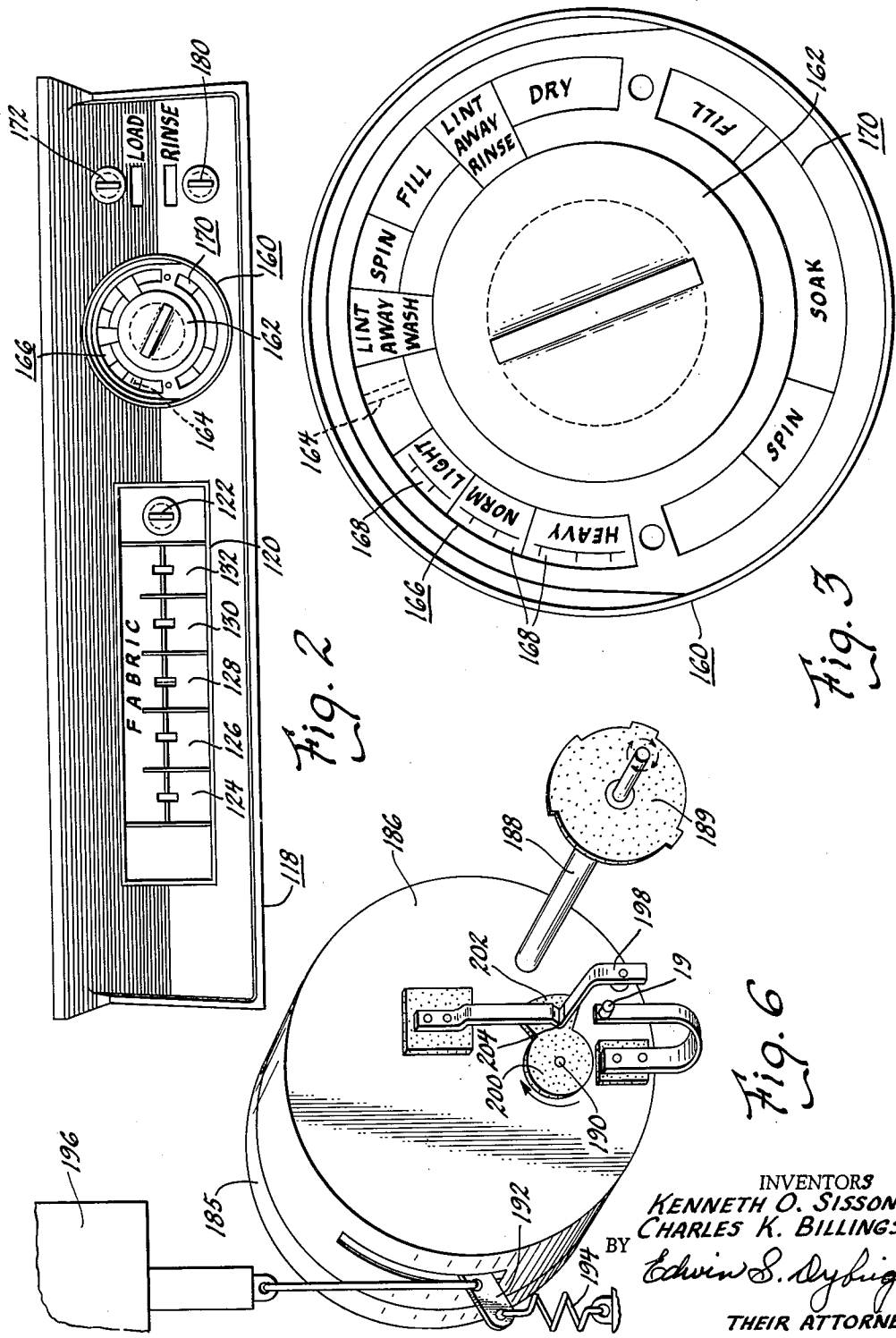
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

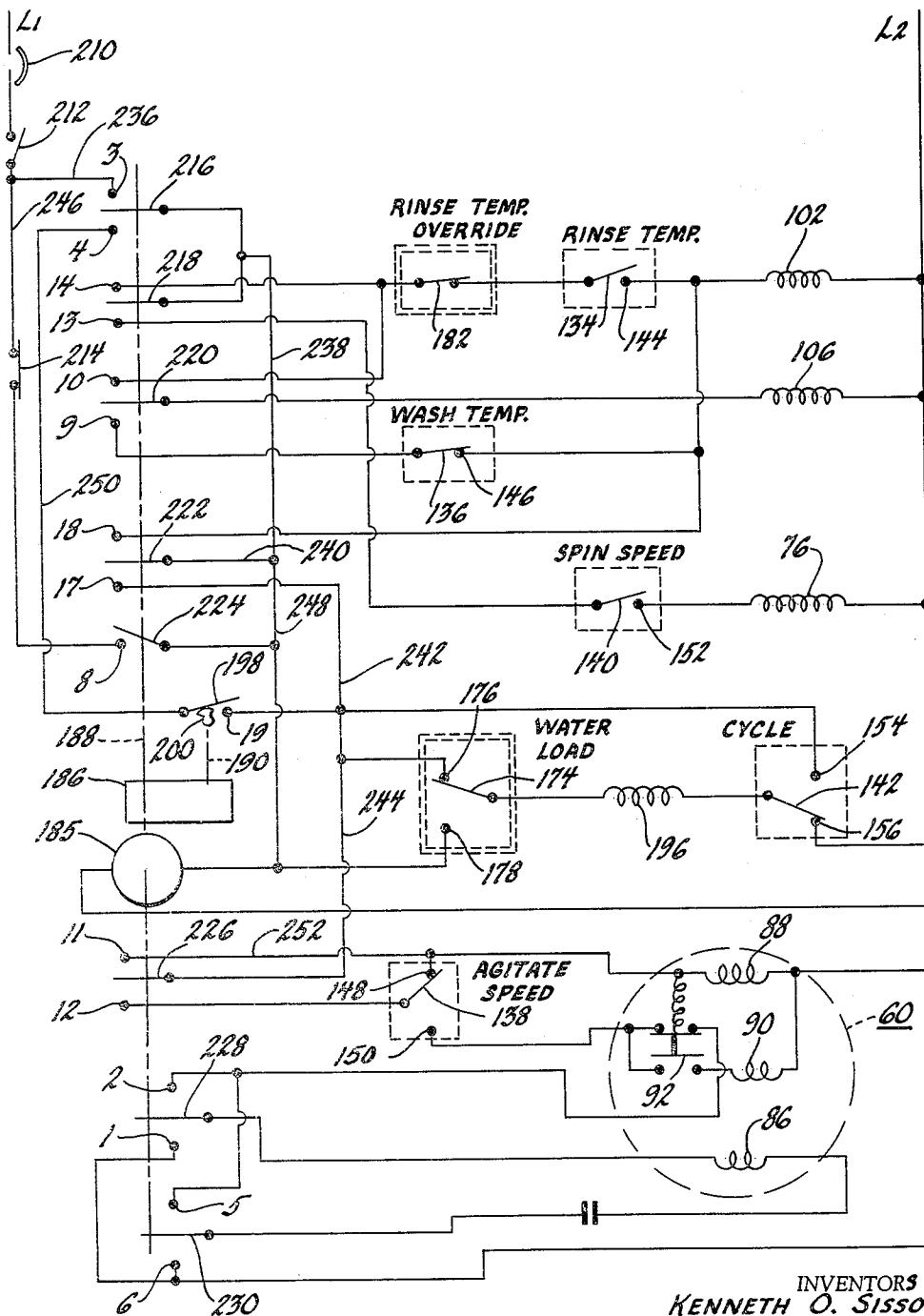


Fig. 4

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4 Sheets-Sheet 4

Timer Cycle Chart
Advances

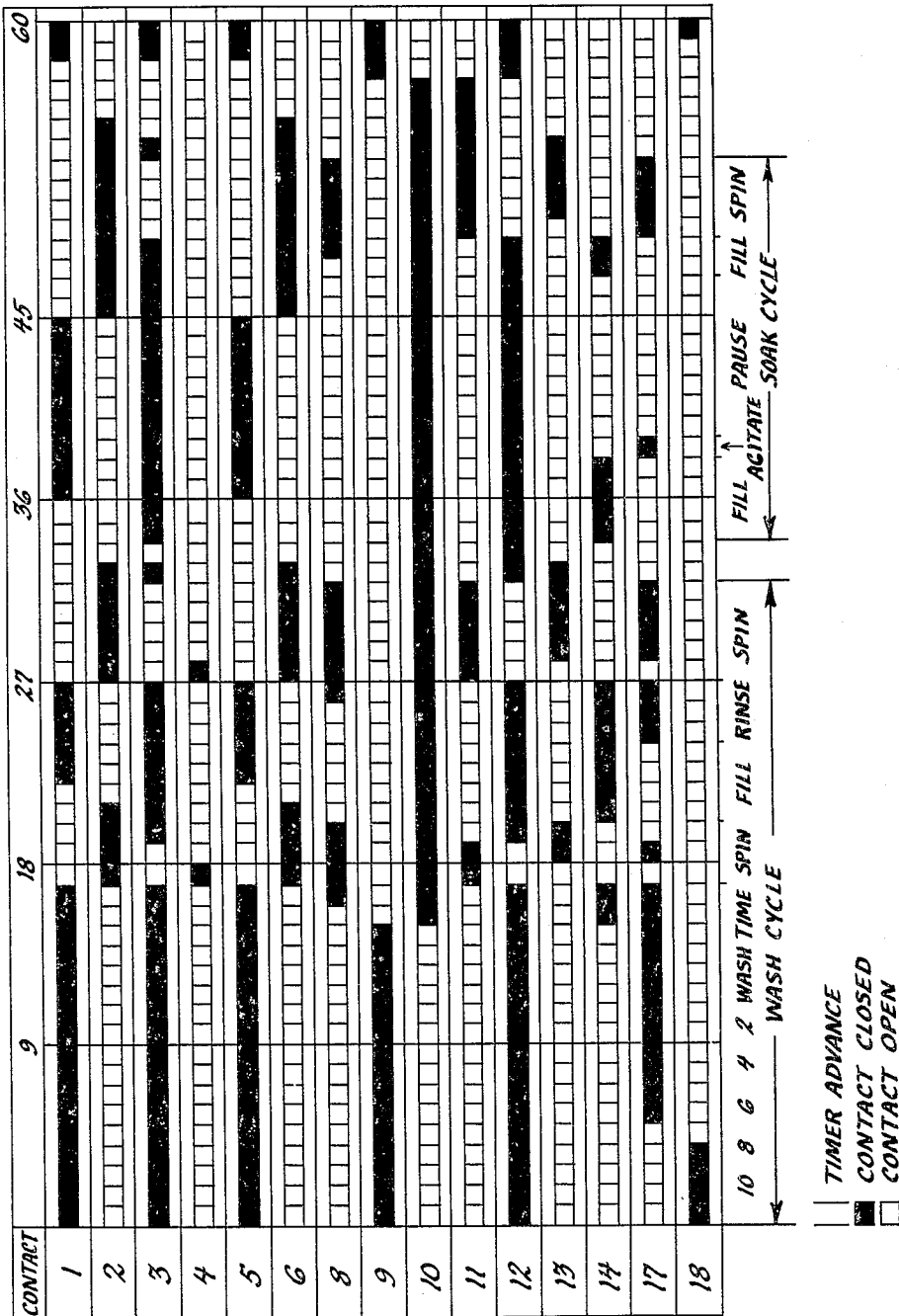


Fig. 5

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1

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AUTOMATIC CLOTHES WASHING MACHINE

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Filed July 14, 1958, Ser. No. 748,412

14 Claims. (Cl. 68—12)

This invention relates to a domestic appliance and more particularly to an improved operational cycle for a clothes washing machine.

With the advanced development of various man-made fabrics it has become necessary for the clothes washing art to keep pace therewith by providing a larger degree of operational flexibility for domestic clothes washers to accommodate both the conventional and the man-made fabrics. This desire for machine flexibility has been further accented by the differently sized wash loads and the desire of the operator for selectable temperature rinses. In addition to these variables, clothes to be washed are in various states of soil or dirtiness and therefore need differing lengths of wash or agitation periods. To effect a maximum in user control in the domestic clothes washing art, an improved and more flexible operating cycle has been set forth herein.

Another problem which arises in an automatic clothes washing cycle arises due to the delay which ensues as the timer sequentially advances the washing cycle from agitation into a spinning or centrifuging process. Sediment and dirt which is dislodged from the fabrics being washed remains suspended in the washing solution so long as the solution is agitated. But on the conclusion thereof, the heavier sediment tends to gravitate from the solution and to redeposit on the fabric surfaces before the timer control advances the washer mechanism to initiate the centrifuging process. The optimum would be to proceed immediately from agitate into spin or centrifuging. However, where the operational sequence is programmed on a conventional intermittently pulsed timer, the time period of one timer advance or pulse is necessary between the conclusion of one operation and the initiation of another. Others have utilized various sediment trap designs to eliminate the redeposit of this material on the washed fabrics. This invention proposes to minimize such deposit and remove lint and scum before it has a change to settle at the conclusion of the agitation cycle.

Accordingly, it is an object of this invention to initiate a spin or centrifuging operation in a time period less than the interval of one timer advance.

It is a more particular object to provide a washing machine control circuit wherein a continuously opening and closing switch is placed in control of the washer motor circuit during the interposed timer interval between agitate and spin.

A still more particular object of this invention is the inclusion of a timing means having an intermittently rotated cam shaft for sequentially advancing the clothes washing cycle and a continuously rotated cam shaft for interrupting the motor circuit immediately preceding a spin or centrifuging operation, thereby to effect the initiation of said centrifuging in a lesser time interval than one pulse or timer advance of the said intermittently rotated cam shaft.

It is also an object of this invention to provide a domestic clothes washing cycle wherein a two-speed timer

2

mechanism is adapted to give user control of wash and rinse water-fills and the duration of other cycle operations, each independently one from the other.

It is also an object of this invention to provide a fabric selector switch wherein a predetermined washing program is prescribed by the selection of a particular fabric, and whereby a cooling period is provided for wash-and-wear fabrics prior to their centrifuging.

Another object of this invention is the provision of a user rinse temperature selector switch which may be manually and independently operated to override the rinse temperatures programmed by the said fabric selector switch.

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

In the drawings:

Figure 1 is a fragmentary sectional view of a clothes washing machine suitable for use with this invention;

Figure 2 is an elevational view of a washing machine control panel adapted for use with this invention;

Figure 3 is a detailed view of the timer dial illustrated generally in Figure 2;

Figure 4 is a schematic wiring diagram operable in accordance with the concepts of this invention;

Figure 5 is a timer cycle chart showing the open or closed condition of the timer contacts in Figure 4; and

Figure 6 is a perspective view of a timer mechanism adapted for two-speed operation and equipped with a continuously rotating cam for periodically interrupting a motor circuit at selected points in a clothes washing cycle.

In accordance with this invention and with reference to Fig. 1, a clothes washer 50 having a clothes loading door 51 is adapted to include a rotatably mounted spin basket 52 and an agitator 54 therein. An agitating and spinning mechanism, shown generally at 56, is utilized to vertically reciprocate the agitator 54 when a rotatable housing portion 58 is rotated in one direction, and to rotate the spin tub 52 in a centrifuging operation when the housing 58 is rotated in a reverse manner. This agitating and spinning mechanism 56 is more fully taught in the patent to Sisson, 2,758,685, issued August 14, 1956, and in a copending application for an improvement to the Sisson mechanism Serial No. 738,362, filed May 28, 1958. A prime mover 60 may be a 4-pole, 6-pole, 2-speed reversible motor adapted to rotate selectively the mechanism housing portion 58 through a belt-and-pulley arrangement, shown generally at 62. More specifically, the motor 60 is provided with a shaft 64 on which are relatively rotatably mounted a small agitate/spin drive pulley 66 and a larger spin drive pulley 68. A selector clutch 70 is interposed between pulleys 66 and 68 and keyed against relative rotation to the shaft 64, but with relative axial movement permitted. A yoke 72 is pivoted on a bracket 74 by a high speed spin solenoid 76. When the solenoid 76 is deenergized, the selector clutch 70 is biased downwardly and is effective to transmit rotational motion from shaft 64 to the pulley 66. The energization of solenoid 76 causes clutch 70 to engagingly drive pulley 68.

With the motor in a 6-pole arrangement and operating in low speed, the pulley 66 will effect a slow speed agitation by rotating housing 58 through a driven pulley 78 and a V-belt 80. With the motor 60 still wired for low speed operation, but in reversed fashion, the pulley 66 will drive pulley 78 to rotate housing 58 in effecting a slow speed spin of tub 52. Fast reciprocation of agitator 54 is accomplished in a 4-pole motor arrangement for operation

of motor 60, still driving housing 58 through pulley 66 with solenoid 76 deenergized. Driving pulley 68 is selected by clutch 70 solely for high speed spin operation when solenoid 76 is energized to lift yoke 72 and engage clutch 70 with driving pulley 68. Thus, a high speed spinning or centrifuging operation is effected by way of motor shaft 64, selector clutch 70, driving pulley 68, V-belt 82 and driven pulley 84. For the purposes of this application, the foregoing description is believed to suffice. However, for a more complete disclosure of the components for this multi-speed driving arrangement, reference may be had to a copending application to Sisson et al. Serial No. 738,330, filed May 28, 1958.

To accommodate the teachings of this invention, the motor 60 is provided with a 4-pole start or phase winding 86, a fast speed 4-pole main winding 88 and a slow speed 6-pole main winding 90 (Fig. 4). The motor 60 includes also a centrifugal switch 92 operable in conventional manner to drop out the phase winding 86 after the motor 60 has accelerated to a predetermined percentage of the selected running speed.

Surrounding the spin tub 52 and spaced therefrom is a water container 94 mounted to the outer casing of washing machine 50 by brackets 96. A partition or bulkhead 98 closes the lower open end of the water container 94, thereby to separate in water-tight fashion the water-containing area above partition 98 from the driving mechanism disposed therebelow. Water is supplied to the interior of tub 52 through a hot water valve 100 actuated by a hot water solenoid 102 and a cold water valve 104 actuated by a cold water solenoid 106 (Figs. 1 and 4). A mixing conduit 108 carries the tub water fill at a temperature determined by the positioning of water valves 100 and 104 to a water chute 110 overlying the top opening of spin tub 52. The spin tub, in conventional fashion, is provided with a plurality of outlets 112 for exhausting water therefrom during each spinning operation of the tub. A drain conduit 114 selectively removes the water collecting above the partition 98 in accordance with the operation of a pump 116 disposed at the end of and operated by motor shaft 64.

Reference may now be had to Fig. 2 wherein a view of the console or control panel 118 is illustrated. The control panel 118 includes a fabric wash selection portion 120 controlled by a knob 122 adapted to select a first position 124 for "Regular White" fabrics, a second position 126 for "Regular Colored" fabrics, a third position 128 for "Wash-and-Wear" fabrics, a fourth position 130 for "Delicate" fabrics, and a fifth position 132 for other "Special" fabrics. The rotation of knob 122 to one of these five positions is effective to position each of five separate switches, namely, a rinse water temperature selector switch blade 134, a wash water temperature selector switch blade 136, an agitate speed selector switch blade 138, a spin speed selector switch blade 140 and a timer speed or cycle selector switch blade 142. The cycle switch is included to vary the duration of the agitation periods and the spin periods during the wash cycle. This is accomplished by shifting gears in a two-speed timer so that a 60-second escapement period or pulse is established for a "normal" cycle and a 40-second pulse for a "short" cycle. The wiring diagram in Fig. 4 illustrates the switches 134, 136, 138, 140 and 142 schematically as independent switch means, for purposes of clarity. However, it is within the purview of this invention to incorporate the desired simultaneous positioning of all five switches (those switches enclosed by a single dashed line box) to a particular wash program in accordance with the single selection at knob 122 of a particular fabric such as indicated by positions 124, 126, 128, 130 and 132.

The rinse selector switch 134, when closing a circuit with a warm rinse contact 144, provides for warm rinse water during the rinse portion of the washing cycle. An

open switch 134 deenergizes solenoid 102, and a cold rinse results. The wash selector switch 136, when closed on a warm wash contact 146, effects a warm wash solution, and when switch 136 is open, a hot wash solution.

The agitate speed switch 138 may be selectively positioned on contact 148 for a fast agitate of 330 pulsations or reciprocations per minute (p.p.m.) and effects a slow agitation of 220 p.p.m. when residing on a contact 150. The spin selector switch blade 140 has an open position for a slow speed spin of 330 r.p.m. and a closed position on contact 152 for a fast spin of 850 r.p.m. The cycle switch blade 142 has a position on a contact 154 for normal timer speed operation and on a contact 156 for a short cycle or fast timer speed operation.

Research has determined the following desirable wash cycles for the particular fabrics selectable on fabric selector 120. For instance, if "Regular White" clothing 124 is selected, the control circuit of Fig. 4 will be conditioned for a normal timed cycle with switch blade 142 on contact 154; a hot water wash with selector switch 136 in open position; a warm water rinse with rinse selector switch 134 on contact 144; a high speed or fast agitate with switch blade 138 on contact 148; and a high speed or fast spin with switch blade 140 closed on contact 152.

With "Regular Colored" clothes selected on switch selector 120, a normal cycle will be effected with blade 142 on contact 154; a warm water wash with blade 136 in contact with 146; a warm water rinse with blade 134 on contact 144; a fast agitate with blade 138 on contact 148; and a fast spin with blade 140 in contact with 152.

With "Wash-and-Wear" 128 selected on fabric selector 120, a short cycle will be effected with cycle switch blade 142 on contact 156; a warm water wash with wash selector blade 136 on contact 146; a cold water rinse with rinse selector blade 134 in open position; a fast agitate with agitate selector blade 138 on contact 148, and a low speed spin with spin selector blade 140 in open position. In addition, the "Wash-and-Wear" cycle includes a cold water overflow at the end of the wash agitate period to cool off the wash water before starting the spin. This will prevent wrinkles from being set in the wash-and-wear material which would otherwise occur when such fabric is centrifuged while still warm. Specifically, at the beginning of the 16th timer advance, contacts 10 and 14 are closed by timer switches 220 and 218, respectively. Since the selection of "Wash-and-Wear" or 128 on the fabric selector 120 programs an open position for rinse temperature switch 134, the above sequential positioning of timer switches 220 and 218 will energize the cold water solenoid 106, only, for the cold water overflow. Solenoid 106 will thus be energized from L₁, switches 210, 212, wash contact 3, timer switch 216, timer switch 218, rinse fill contact 14, timer rinse feedback contact 10, timer switch 220 and solenoid 106 to L₂. In this manner, the 16th and 17th timer advance will admit cold water to tub 52 through conduit 108, thereby to effectively cool the wash-and-wear fabrics prior to initiating the spinning or centrifuging operation.

With "Delicate" fabric selected, a short cycle will be effected with cycle switch blade 142 on contact 156; a warm water wash with wash selector blade 136 on contact 146; a cold water rinse with rinse selector switch blade 134 in open position; a slow agitate with agitate selector switch blade 138 on contact 150; and a slow spin with spin selector switch blade 140 in open position.

Lastly, the "Special" fabric selection 132 on fabric selector 120 will set up a short cycle with cycle switch 142 on contact 156; a warm water wash with wash selector switch blade 136 on contact 146; a warm rinse with rinse selector switch blade 134 in contact with 144; a slow agitate with agitate speed selector switch 138 in contact with 150; and a fast spin with spin selector switch 140 on contact 152. The "Special" washing program has been designed to give maximum extraction or water

5

removal with a minimum agitation. Especially adaptable to this program are woollens such as blankets, where the high speed spin would not create a wrinkling problem.

The washing machine console of Fig. 2 includes also a timer dial, shown generally at 160. A knob 162 is centered on the dial 160 and acts to rotate an indicating arm 164 behind an arcuate window 166 which is partitioned to indicate segments of the washing cycle. Reference may be had to Fig. 3 for greater detail on the timer dial characteristics and an illustration of the control sequence obtained through the improved washing machine set forth herein. To initiate a wash period, the operator may rotate the indicating arm 164 to a desired position behind one of the windows 168 which are indicative of the wash agitation portion of the wash cycle. In accordance with the position of the indicator 164 behind the windows labeled "Heavy," "Norm" and "Light," the operator will secure the desired length of agitation. This flexibility permits the operator to take into account the degree of soil of the clothes being washed, a longer agitation period being necessary for the more soiled fabric. Of course, a "wash fill" period will precede the agitation at which time the selected amount of water will be introduced to tub 52 in accordance with a load selector control to be described more fully hereinafter. The "Lint Away Wash" is indicative of that portion of the cycle near the end of the agitation period where water is admitted to the spin tub 52 in a manner to cause overflow through tub outlet ports 112, thereby to float away that scum and line collecting on the surface of the water. As an aid in chasing this scum and lint through the tub ports 112, another novel feature of this invention includes a fast agitate during a portion of the "Lint Away Wash" and the "Lint Away Rinse" (to be described hereinafter) regardless of the selected agitate speed. That is, if slow agitate has been programmed for the fabric being washed, a slow 220 pulses-per-minute of agitator 54 will continue throughout the wash period until the beginning of the 18th timer advance (28th timer advance in the case of the "Lint Away Rinse" described hereinafter). At this point, timer switch 226 will close on spin contact 11 to bypass the agitate speed selector switch 138 and a fast 330 pulses-per-minute agitate will occur for the first ten or fifteen seconds of the 18th timer interval. This fast agitate, in addition to the overflow of water through tub ports 112, will quickly and efficiently remove all of the foreign material floating on the surface of the wash water. The "Spin" is self-explanatory and indicates merely the centrifuging of wash water from the fabrics being processed. The "Fill" indicates that portion of the cycle during which water is admitted to the tub 52 for rinsing and also the agitation that accompanies the rinsing process. "Lint Away Rinse" is that section of the washing cycle, similar to the "Lint Away Wash," wherein water is overflowed through tub ports 112 near the conclusion of the rinsing process to carry off lint and scum collecting on the surface of the rinse water. As aforesaid, a short interval of fast agitate aids this lint chasing process as just described in connection with the "Lint Away Wash." The cycle portion labeled "Dry" is indicative of the final centrifuging operation wherein the rinse water is spun from the clothing at the selected spin speed to damp-dry the clothing.

An arcuate window 170 along the bottom of the timer dial 160 represents an additional feature on the improved washing machine herein and is referred to as a "Soak" cycle. Since the indicating arm or mark 164 moves clockwise, the soak cycle begins with a "Fill" which includes a one-minute agitation at the end thereof. Immediately after the fill and brief agitation, an extended "Soak" period ensues. A spinning or centrifuging operation terminates the soaking process in removing the water from the fabrics.

The knob 162 is operative to initiate either a washing or a soak cycle merely by pushing in and rotating the

6

knob until the indicator 164 is located at the desired spot on the dial 160. Pulling out knob 162 opens a master switch to terminate all operations in the machine. Also, the normal sequential rotation of the indicating arm 164 and knob 162 by the timing mechanism will terminate the selected process in due course.

Another variable which makes it desirable to alter the washing process is the size of the clothes load to be washed. Where but a small amount of fabric or clothing is to be washed, a small amount of water is required throughout the wash and rinse portions of the cycle. The operator may, by turning a knob 172, alter the duration of the period within which wash water and rinse water is admitted to the tub 52. The knob 172 operates a load selector switch blade 174 (Fig. 4) between a high water fill contact 176 for a full load of wash and rinse water, and a low water fill contact 178. Of course, even with a small load, the soiled condition thereof may vary and this fact may be compensated for automatically by a particular selection on the fabric selector 120.

This improved washing machine cycle includes another measure of flexibility for the operator. Although a fabric selection on the fabric selector 120 will program a particular rinse water temperature found by test to be suitable for the fabrics being washed, the operator may secure a cold water rinse regardless of the programmed temperature by operating a knob 180 which, in turn, opens and closes a rinse temperature override switch 182.

Reference may now be had to Fig. 6 for a perspective view of a two-speed timer suitable for use with this invention. As stated hereinbefore, the operator, in using this improved washing machine, is given the choice of using a lesser amount of water where the clothing load is small. Also, a particular fabric selection will program the washing machine cycle for either a "normal" or a "short" cycle. In other words, with a "short" cycle, the various operations are all of shorter duration, i.e. a shorter agitate period and a shorter spin period. These variations in period duration are accomplished through the use of a two-speed timer, shown generally in Fig. 2 and more fully taught in copending application Ser. No. 485,181, filed January 31, 1955. Suffice it for this application to set forth the timer as having a timing motor 185 and a gear train speed reduction and escapement mechanism 186. The gear drive arrangement taught in the copending application just cited includes an actuating shaft 188 for a timer switch actuating cam such as 189 which pulses or advances in 6° increments (indicated by the intermittent arrows) in response to a conventional escapement arrangement included within the gear mechanism 186. A continuously rotating shaft 190 (indicated by the solid arrow) projects also from the gear mechanism 186 and is designed to rotate one complete revolution for each pulse or 6° partial rotation of cam shaft 188. The gear mechanism 186 includes a gear train shift lever 192 biased by a spring 194 to a "normal" cycle speed, wherein a sixty second escapement is utilized in pulsing cam shaft 188. A solenoid 196, when energized, is operable to lift the gear shift lever 192 to initiate a "short" cycle speed position, wherein a forty second escapement drives shaft 188. With the lever set for normal or slow speed operation, as illustrated in Fig. 2, the cam shaft 188 will rotate in intermittent pulses of 6° each sixty seconds. In the same time interval, the constant speed shaft 190 will rotate 360°. With the solenoid 196 energized, gear shift lever 192 will be raised to introduce a new gear train between the timer motor 185 and the shafts 188 and 190 such that the escapement mechanism will set up a 6° pulse of cam shaft 188 every forty seconds. In the forty second interval also and in phase with shaft 188, the constant speed shaft 190 will make a complete 360° revolution. Associated with the two-speed continuously rotated shaft 190 is a fixed contact 19 and a movable switch blade 198.

A particularly designed cam 200 is affixed to the continuously rotating constant speed shaft 190. The cam 200

is formed with a fan-shaped projection 202 which underlies a cam surface or protuberance 204 on the switch blade 198. Whenever cam portion 202 is rotated beneath the protuberance 204, the switch blade 198 is broken from its contact 19. The novel functioning of this constant speed cam in a two-speed timer will be more fully explained hereinafter in conjunction with its circuit application. However, at this point it is important to note that the cam 200 is positioned on shaft 190 and synchronized with pulsating cam shaft 188 such that the rotating cam extension 202 lifts switch blade 198 from contact 19 for 10 seconds within 15 ± 10 seconds after the beginning of each timer pulse or advance of shaft 188. It is emphasized that the rotation of cam 200 is synchronized with the movements of cam shaft 188 and the timer switch cams shown generally at 189 thereon. It should also be noted that switch blade 198 is continuously making-and-breaking on contact 19 throughout the washing cycle. However, at only two points in the washing cycle is the switch 198, 19 placed in the motor circuit for control purposes and these points occur during the sequential advance of the timer from agitation into spin—an advance which shall be called hereinafter a "pause interval." At these points only is the continuously interrupting switch 198, 19 effective to start the next sequential operation ahead of the timer pulse which would normally initiate said operation. In this way the motor 60 will start spinning the tub 52 before the cam shaft 188 has advanced the timer switches to the spin position. This operation will be explained more fully at the particular point in the washing cycle as disclosed next following.

For purposes of explanation, the machine operation will be set forth in connection with Fig. 4 wherein the timer motor 185 is shown schematically driving the cam shaft 188 through a two-speed gear reduction and escapement mechanism 186. The continuously rotating shaft 190 is shown schematically projecting from the gear mechanism 186 to rotate the cam 200. In addition to those circuit components already set forth, the circuit includes a motor overload switch 210, a push-pull switch 212 operated by the positioning in or out of timer knob 162, and a lid switch 214. The lid switch operates to deenergize the control circuit whenever the lid 51 on the washing machine 50 is open during a spinning portion of the wash cycle. Intermittently actuated by the pulsing of cam shaft 188 and cams 189 are a series of timer switches. The cams 189 are not shown in Fig. 4 but should be understood to bias selectively each of the timer switches. Timer switch 216 is positioned between a wash contact 3 and a pause increment contact 4. A timer switch 218 is positioned between a rinse-fill contact 14 and a high speed spin timer contact 13. A timer switch 220 closes either on a rinse feed-back contact 10 or a wash feed-back contact 9. Timer switch 222 operates between a motor operation contact 17 and a wash-fill contact 18. Timer switch 224 closes on a spin contact 8 during the spin portions of the cycle. Timer switch 226 moves between a motor spin contact 11 and a motor agitate contact 12. For reversing the motor 60, reversing timer switches 228 and 230 move between reversing contacts 1 and 2, and 5 and 6, respectively.

The sequential positioning of the timer contacts just recited is set forth on the timer cycle chart of Fig. 5. Sixty pulses or timer advances are set forth across the abscissa of the chart, each advance of which is equivalent to a 6° rotational movement of the timer shaft 188. Timer contacts, recited in connection with Fig. 4, constitute the ordinate of the chart in Fig. 5. The various increments or advances which are blocked in solid indicate the related timer switch is closed on the indicated contact. Where the increments are not filled in, the contacts are open. It should also be noted on the timer cycle chart that the normal wash cycle is concluded at the end of the thirty-second timer advance

and that the "soak" cycle is operated from the 34th advance.

Let us now assume that an automatic wash cycle has been initiated by the rotation of knob 162 to place the indicator arm 164 beneath the agitate indicating windows 168 in accordance with the length of agitation desired. Since knob 162 is affixed to the end of cam shaft 188, the rotation of knob 162 will automatically advance the cams 189 to the start of the desired operation. Wash contact 3 is closed by timer switch 216. Motor timer contacts 5 and 1 are closed by timer switches 230 and 228, respectively. Timer contacts 9 and 18 are closed to initiate a wash-fill period and contact 12 is closed by timer switch 226 to initiate the operation of motor 60 for agitation. Normally, fresh water—either hot or warm, in accordance with the programming of the fabric selector 120—will be flowed into tub 52 through water inlet conduit 108. Of course, it is within the purview of this invention to use a suds water return pump, in which case this portion of the cycle would be devoted to returning the suds water from a suitable container to the wash-tub 52. After a period of time, depending on whether the timer 186 is operating on normal or fast speed—"normal" or "short" cycle as per the energization of solenoid 196, the selected amount of water will be filled and the agitation portion of the cycle conditioned to start. During the fifth timer advance at the conclusion of the fill period, the timer switch 222 engages neither contact 17 nor 18 and the timer motor 185 only is energized.

Contacts 1, 3, 5, 9, 12 and 17 will be closed by their appropriate timer switches at the sixth timer advance and a vertical reciprocation of agitator 54 within the tub 52 will be started. This improved washing cycle includes a provision for operating the agitator 54 at either 220 or 330 pulses per minute, in accordance with the programming set up by the fabric selector 120. This operation is controlled particularly by the positioning of the agitate speed selector switch blade 138 for either a fast or 330-pulse-per-minute agitate on contact 148 or a slow 220-pulse-per-minute agitate on contact 150. This agitate will continue until the 16th timer advance, at which point additional contacts 10 and 14 will be closed to institute an overflow fill period and contact 9 will open. Warm or cold water as per the fabric selector and the rinse temperature override switch blade 182 will flow into the tub 52 to float away the scum and lint from the surface of the water through tub ports 112. During the 18th timer advance contacts 2, 4, 6, 8, 10 and 11 are closed for the entire advance, thus setting up a 330-pulse-per-minute agitate regardless of the fabric selector setting. The lid switch 214 is made effective and the connections to the motor start winding 86 are reversed to set up a spin cycle. The circuitry established during this 18th timer advance places interrupting switch 198, 19 in the motor control circuit to set up the "pause interval" for quick reversal. This operation will now be explained.

It is at this portion of the timer cycle at which the novel concepts of this invention are brought into play to effect a motor reversal in a time period less than the normal pulse of the timer mechanism. This is desirable since the dirt which has been dislodged during the agitation process remains in solution during the agitation but would tend to settle out to the bottom of tub 52 and on the clothes lying therein during the timer interval interposed between the termination of the agitation and the initiation of spin. The circuitry of this arrangement is believed best understood with a detailed operational break-down for the 17th, 18th and 19th timer advance (this will also apply equally for the 27th, 28th and 29th advance as the sequential washing operation goes from rinse agitate into spin dry). As aforesaid, it is desirable to reverse the motor 60 to set up a spin operation

as quickly as the motor can be reversed. It has been found that a motor 60 will coast to a stop within four or five seconds. Thus, the motor could be reversed to rotate the mechanism housing 58 in a spin direction immediately after the motor has coasted to a stop. But with the timer pulses operating at either sixty or forty-second intervals, an undesirable waiting period for the start of spin ensues, in which time the dirt or sediment falls from the wash solution. Therefore, this invention includes a novel application of a constant speed timer cam for proceeding from agitate to spin in a period of approximately ten seconds. It should be understood, however, that this ten-second interval for motor reversal can be shortened still further by appropriate design of cam extension 202.

During the 17th timer advance, the motor 60 is energized to effect an agitation from L₁, overload switch 210, push-pull switch 212, conductor or line 236, wash contact 3, timer switch 216, line 238, line 240, timer switch 222, motor contact 17, line 242, line 244, timer switch 226, motor agitate contact 12, agitate speed selector switch blade 138 to the motor 60 in accordance with the agitate speed selected to L₂. At the beginning of the 18th timer advance and for approximately fifteen seconds thereafter, the high speed agitation is imposed with the motor 60 being energized from L₁, control switches 210 and 212, line 246, lid switch 214, spin contact 8, timer switch 224, line 248, line 238, timer switch 216, pause interval contact 19, line 244, timer switch 226, spin contact 11 bypassing the agitate speed selector switch 138 through the high speed windings of motor 60 to L₂. The circuitry thus established places the continuously opening and closing switch blade 198 in the motor control circuit. After the elapse of approximately fifteen seconds of the 18th timer advance (ten seconds if the solenoid 196 has been energized to set up the timer for forty-second escapements), the cam extension 202 will have rotated to a point adjacent the protuberance 204 of the switch blade 198 and the circuit will be broken when the cam extension 202 lifts the blade 198 from contact 19. During the ten-second time interval which it takes for the cam extension 202 to pass beneath the protuberance 204, the motor 60 coasts to a stop. Since the reversing switches 228 and 230 were repositioned on timer spin contacts 2 and 6, respectively, at the start of the 18th advance, the motor 60 is conditioned for restarting in a spinning operation as soon as switch 198 closes. As the cam extension 202 passes from beneath the protuberance 204, the switch blade 198 will close on timer contact 19 and the motor 60 and start winding 86 will be energized for spin from L₁, switches 210 and 212, line 246, lid switch 214, timer spin contact 8, timer switch blade 224, line 248, line 238, timer switch blade 216, timer contact 4, line 250, the constant speed cam switch 198 in contact with pause interval contact 19, line 244, timer switch 226, spin contact 11, line 252 bypassing the agitate speed selector switch 138, the 4-pole main winding 88 and the phase or start winding 86 of motor 60 to L₂. The spin portion of the cycle will be energized thusly for the balance of the 18th timer advance. At the beginning of the 19th advance, selected timer switches will be repositioned to continue motor energization through L₁, switches 210, 212, line 246, lid switch 214, timer spin contact 8, timer switch 224, line 248, line 240, timer switch 222, motor contact 17, line 242, line 244, timer switch 226, spin contact 11, line 252, motor 60 to L₂. The motor 60 will accelerate in conventional manner with the centrifugal switch 92 dropping out the start winding 86 at the appropriate point in the motor's acceleration. It should be mentioned that the explanation of the circuitry necessary to initiate a spin cycle in a period less than one normal timer advance was explained in connection with a sixty-second timer pulse for the 18th and 28th advance, i.e. a fifteen-second agitate, a ten-second pause

increment and a thirty-five second spin period. However, if the solenoid 196 has been energized to set up a fast timer speed operation as per the operator's positioning of load selector switch 174 and cycle switch 142, the escapement will prescribe forty-second timed intervals or pulses and the fifteen-second, ten-second and thirty-five second increments of a sixty-second advance will be proportionately reduced.

At the beginning of the spin period which is initiated after the ten-second pause interval in the 18th timer advance, the spin cycle will be initiated at a slow speed of 330 r.p.m. for spinning the tub 52 in removing most of the water therefrom. At the 19th timer advance the timer contact 13 is closed to place the spin speed selector in the circuit and the spin speed will be determined by the positioning of the spin selector switch blade 140. If closed on fast spin contact 152, the spin solenoid 76 will be energized to lift the shifter fork 72 and thus the selector clutch into engagement with drive pulley 68, thereby accelerating tub 52 to a fast or 850 r.p.m. spin. Without the energization of solenoid 76, the spin will remain 330 r.p.m., the motor shaft 64 driving pulley 66 through the selector clutch 70 and thus rotating the mechanism housing 58 by way of driven pulley 78. It should be noted that a more particular description of the prime moving arrangement for rotating the mechanism 56 in either a spin direction or an agitate direction is more fully taught in the copending applications Serial No. 738,330 to Sisson et al. and 738,362 to Sisson, both filed May 28, 1958, and cited hereinbefore.

The spin cycle is interrupted at the beginning of the 20th timer interval or advance, leaving only the timer motor energized and the spin solenoid 76, if fast spin has been selected. In this relationship timer contacts 8, 3, 6, 2, 13, 12 and 19 are closed and a one-interval pause exists between the 19th interval at which time spin was taking place, and the 21st interval where water starts entering the tub 52 for the rinse fill. To effect this fill, contacts 3, 6, 2, 14, 12 and 10 are closed and warm or cold water, in accordance with the fabric selector switch 134 and the rinse temperature override switch 182 will enter the tub 52. The duration of the fill period, as aforesaid, will be governed in accordance with the selection on the load selector knob 172 as transmitted to switch 174. If a small amount of water is desired, this selection will position the load selector switch 174 on low water contact 178 and the timer solenoid 196 will be energized during the fill period to operate the timer cam shaft 188 with forty-second escapement intervals thereby shortening the duration of the fill period.

During the rinse-fill and particularly at the 23rd timer interval contacts 3, 5, 1, 14, 12 and 10 will be made to condition the motor 60 for an agitation period. At the start of the 25th timer interval contacts 3, 5, 1, 14, 12, 9 and 17 will be closed and a rinse agitation period will be initiated with either 220 or 330 pulses per minute in accordance with the fabric selection in positioning agitate speed selector switch 138. The agitation will continue until the 27th timer interval at which time contact 8 is closed and an overflow fill period initiated. As before, water will enter the tub 52 until the scum and lint collecting on the surface of the rinse water is flowed out of the tub ports 112 to drain.

At the 28th timer interval the motor is again prepared for reversal from agitate to spin in a lesser amount of time than the duration of one timer advance. The procedure is reenacted in precisely the same manner as was explained in connection with the 18th timer advance and need not be restated here. From the 29th timer interval until the completion of the 32nd timer interval, the motor 60 will be rotated in a manner to effect the spinning operation at a speed selected by switch blade 140. At the conclusion of this drying period an alarm (not shown) may be sounded to signal the end of the normal

11

washing cycle. The 33rd timer interval illustrates that contacts 3, 6, 2, 13, 12 and 10 are closed, deenergizing all but the timer motor 185 and the spin solenoid 76, should high speed spin have been selected. The 34th timer advance finds only contacts 10 and 12 closed and the wash cycle is thereby completed—the timer motor 185 being deenergized upon the opening of timer wash contact 3.

The completely flexible control which the user has over this improved wash cycle with reference to water loads and long or short operational cycles is best explained with reference to Fig. 4 and the circuitry established to operate the timer speed solenoid 196 which includes the load selector switch 174 and the cycle selector switch 142. If, for instance, a normally sized load of normally soiled clothes is to be washed, the load selector switch blade 174 is set for full water load on contact 176 and the cycle switch blade 142 is positioned for a "normal" cycle on contact 154, the solenoid 196 will be shorted out and the timer will operate with 60-second timer advances throughout the fill and operating portions of the wash cycle.

If it is sought to wash a normally sized load which is but slightly soiled, the following circuitry may be established. With the load selector switch 174 on contact 176 for a normal or full water load and the cycle switch 142 on contact 156 for a short operating cycle of agitate and spin, the solenoid 196 will be energized whenever timer contact 17 or contacts 4 and 8 are closed (with the exception of the ten-second pause interval during the 18th and 28th timer interval as the programming advances from agitate to spin). During all fill periods, the timer speed solenoid 196 will be deenergized so that a full load of water will be admitted to tub 52.

With the load selector switch 174 set on 178 to give a small load of water or short fill for a small load of clothes and the cycle switch 142 on contact 156 for a short operating cycle, the solenoid 196 will be energized throughout the operation of the washing machine with the exception of the ten-second pause interval. This circuitry is established where a small amount of relatively clean clothes is to be washed and a small amount of water and relatively short operating periods are necessary to satisfactorily clean the clothing.

Where a small amount of normally soiled clothing is to be washed, the load selector switch 174 may be placed on contact 178 for short water fill periods and the cycle switch 142 may contact 154 to effect a normal operating cycle. In this manner, the timer will operate with sixty-second escapements or timed advances during all but the fill periods, at which time solenoid 196 will be energized to shorten the duration of fill time. In this circuitry the timer speed solenoid 196 is placed in series with the windings of the motor 60 and is energized whenever the motor 60 is not operating.

One other feature of the improved washing machine circuitry touched on hereinbefore in connection with the washing sequence, includes a spin operation which always starts in a low 330 r.p.m. tub speed on the 4-pole windings until the second pulse interval of the spin cycle. At this point contact 13 is closed to place the spin speed selector switch 140 in the motor control circuit. Thus, if fast spin has been selected with switch 140 closed on contact 152, the solenoid 76 will be energized to place the selector clutch 70 into engagement with the fast spin drive pulley 68 to rotate the spin tub 52 at 850 r.p.m. This one timer interval delay permits the maximum amount of water to be spun from the tub 52 before initiating the high speed spin, thereby minimizing the strain on the motor 60.

The improved washing machine cycle includes also a portion devoted to a soak cycle which may be utilized to freshen fabrics not necessarily dirty but merely wrinkled from storage. Without elaboration as to the positioning of the timer contact which may be seen on the

12

timer cycle chart of Fig. 5, the soak cycle includes a fill period of four timer increments, a one increment agitation wherein the water is briefly agitated to inundate the material being processed and dissolve the detergent, an eight increment soak period, a second two increment fill period, wherein water is overflowed through tub ports 112 in a lint and scum removing procedure, and a four increment spin cycle for centrifuging the water from the material. It may be noted that the motor reversing arrangement utilized to advantage in going from agitate to spin in the normal wash cycle is unnecessary in the soak cycle where an extended idle soaking period is interposed between the agitate and the spin or damp-dry portions of the soak cycle.

Since both the normal cycle and the soak cycle are programmed on respective segments about the 360° of a rotating cam such as 189, those timer increments from 54 to 60 not explained in connection with either the normal wash cycle or the soak cycle are utilized in the rotation of the cams for conditioning the timer switches for the start of the next cycle.

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 control system for a washing machine having consecutively actuated periods of agitation and spin, prime mover means rotatable in one direction during said agitation period and in a reverse direction during said spin period, timing means for advancing said machine through said periods in a plurality of timed pulsed increments of one duration, speed changing means for causing said timing means to advance said machine through said periods in timed pulsed increments of a second duration, and means for reversing said prime mover means to initiate a spin period in an interval less than one of said timed increments.

2. In combination, an automatic washing machine having a spin tub and an agitator, reversible power means for rotating said spin tub when operated in a first direction and for agitating said agitator when operated in a second direction, valve means for admitting water to said tub, a first circuit means including a first switch for conditioning said power means for operation in said second direction and said valve means for energization during agitating, a second circuit means including a second switch for conditioning said power means for operation in said first direction for energization during rotation of said tub, a third switch in series relationship with said second switch and said power means, a timer for sequentially positioning said switches throughout a plurality of timed increments, said timer including an intermittently rotated shaft for controlling said first and second switch, and a continuously rotated shaft for controlling said third switch, and a fourth switch in said second circuit means and positioned by said timing means to a closed position for one of said timed increments between said agitating and said rotation of said tub, whereby said third switch energizes said power means for rotating said spin tub in an interval less than one of said timed increments.

3. In combination, an automatic washing machine having a spin tub and an agitator, reversible power means for rotating said spin tub when operated in one direction and for agitating said agitator when operated in the reverse direction, a first circuit means including a first switch for conditioning said power means for energization in the reverse direction during agitating, a second circuit means including a second switch for conditioning said power means for energization in said one direction during rotation of said tub, a third switch in series relationship with said second switch and said power means, a timer for sequentially positioning said switches throughout a plurality of timed increments, said timer including an intermittently rotated shaft for controlling said first

13

and second switch, and a continuously rotated shaft for controlling said third switch, and a fourth switch in said second circuit and positioned by said timing means to a closed position for one of said timed increments between said agitating and said rotation of said tub, whereby said third switch interrupts said agitating and initiates said rotation in a shorter time period than one of said timed increments.

4. In a control system for a washing machine having consecutively actuated periods of fill, agitation and spin, prime mover means rotatable in one direction during said agitation period and in a reverse direction during said spin period, timing means for advancing said machine through said periods in a plurality of timed pulsed increments of one duration, speed changing means for causing said timing means selectively and independently to advance said machine through said periods in timed pulsed increments of a second duration, and means for reversing said prime mover means to initiate a spin period in an interval less than either of said timed increments.

5. In a control system for a washing machine having consecutively actuated periods of agitation and spin, prime mover means operable in a first direction during said agitation period and in a second direction during said spin period, timing means for advancing said machine through said periods in a plurality of timed pulsed increments of one duration, speed changing means for causing said timing means to advance said machine through said periods in timed pulsed increments of a second duration, and means for conditioning said prime mover means for operation in said second direction to initiate a spin period in an interval less than said timed pulsed increments.

6. In a control system for a clothes washing machine having sequentially actuated periods of water fill, agitation and spin, prime mover means for agitating said clothes when operated in a first manner to release sediment to said water and for spinning said clothes when operated in a second manner to remove water therefrom, timing drive means for advancing said machine through said periods in a plurality of timed pulsed increments of one duration, speed changing means including a selectively actuated gear shift for causing said timing means to advance said machine through selected ones of said periods in timed pulsed increments of a second duration, and means including a continuously interrupted switch for conditioning said prime mover means at the conclusion of operation in said first manner for operation in said second manner to initiate said spinning before said sediment settles from said water.

7. In a control system for a clothes washing machine having sequentially actuated periods of water fill, agitation and spin, prime mover means for agitating said clothes when operated in a first condition to release sediment to said water and for spinning said clothes when operated in a second condition to remove water therefrom, timing drive means for advancing said machine through said periods in a plurality of timed pulsed increments of one duration, speed changing means including a selectively actuated gear shift for causing said timing means to advance said machine through selected ones of said periods in timed pulsed increments of a second duration, and means including a continuously interrupted switch for conditioning said prime mover means to initiate said spinning before said sediment settles from said water, and in an interval less than one of said timed pulsed increments.

8. In a control system for a washing machine having a cycle for wash and wear fabrics including sequentially actuated periods of water fill, agitation, water overflow and initial spin, a hot water control means for said water fill period and said water overflow period, a cold water control means for said water fill period and said water overflow period, prime mover means operable during said agitation period and said initial spin period,

14

timing means for advancing said machine through said periods, said timing means including means for energizing said hot and cold water control means to effect a warm water fill, means for energizing said prime mover to agitate said fabrics, means for energizing said cold water control means to effect a cooling of said fabrics during said water overflow period, and means for energizing said prime mover for said initial spin of said fabrics after said cooling.

9. In a control system for a washing machine having a cycle for wash and wear fabrics including sequentially actuated periods of water fill, fast or slow agitation, water overflow and spin, a hot water control means for said water fill period and said water overflow period, a cold water control means for said water fill period and said water overflow period, means for preselecting said slow agitation, prime mover means operable during said agitation period and said spin period, timing means for advancing said machine through said periods, said timing means including means for energizing said hot and cold water control means to effect a warm water fill, means for energizing said prime mover to agitate slowly said fabrics, means for automatically energizing said cold water control means to effect a cooling of said fabrics during said water overflow period, means for automatically energizing said prime mover for fast agitation during a portion of said water overflow period, and means for energizing said prime mover to spin said fabrics after said cooling.

10. In combination, a washing machine for wash and wear fabrics having a tub, an agitator in said tub and means for moving said agitator and spinning said tub, timing means for sequentially advancing said machine through first and second periods of water fill, agitation and spin, means for admitting water at one temperature to said tube during said first water fill period and means operable prior to said first spin period for cooling said water to prevent setting wrinkles in said fabric during said spin.

11. In combination, a washing machine for wash and wear fabrics having a tub, an agitator in said tub and means for moving said agitator and spinning said tub, timing means for sequentially advancing said machine through periods of first water fill, first agitation, first spin, second water fill, second agitation and second spin, means for admitting water at one temperature to said tub during said first water fill and means operable prior to said first spin for admitting water at a lower temperature to said tub for cooling said fabric to prevent setting wrinkles in said fabric during said first spin.

12. In combination, a washing machine for soiled fabric having a tub, an agitator in said tub and means for moving said agitator at selectable fast and slow speeds to remove soil from said fabric, means for preselecting said fast or slow speed, timing means for advancing said machine through periods of water fill, agitation and water overflow, including means operable during said overflow for energizing said moving means for fast agitation irrespective of said preselecting means, whereby lint and scum are rapidly forced from the surface of said water.

13. In a control system for a washing machine having sequentially actuated periods of agitation and spin in a wash cycle and a soak cycle, prime mover means operable in one direction during said agitation period and in a reverse direction during said spin period, timing means for advancing said machine through said periods and said cycles in a plurality of different timed pulsed increments, and means for reversing said prime mover means to initiate a spin period in an interval less than any one of said timed pulsed increments only in said wash cycle.

14. In combination, a washing machine for soiled fabric having a tub, an agitator in said tub and means for moving said agitator at fast and slow speeds to remove soil from said fabric, timing means for advancing

15

said machine through periods of water fill, agitation and water overflow, including means automatically operable during said overflow for energizing said moving means for fast agitation only, whereby lint and scum are rapidly forced from the surface of said water.

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