Oct. 26, 1965 C. K. BILLINGS ETAL 3,214,665

DOMESTIC APPLIANCE WITH SPIN ACCELERATION CONTROL MEANS

Original Filed Jan. 19, 1959 4 Sheets-Sheet 1

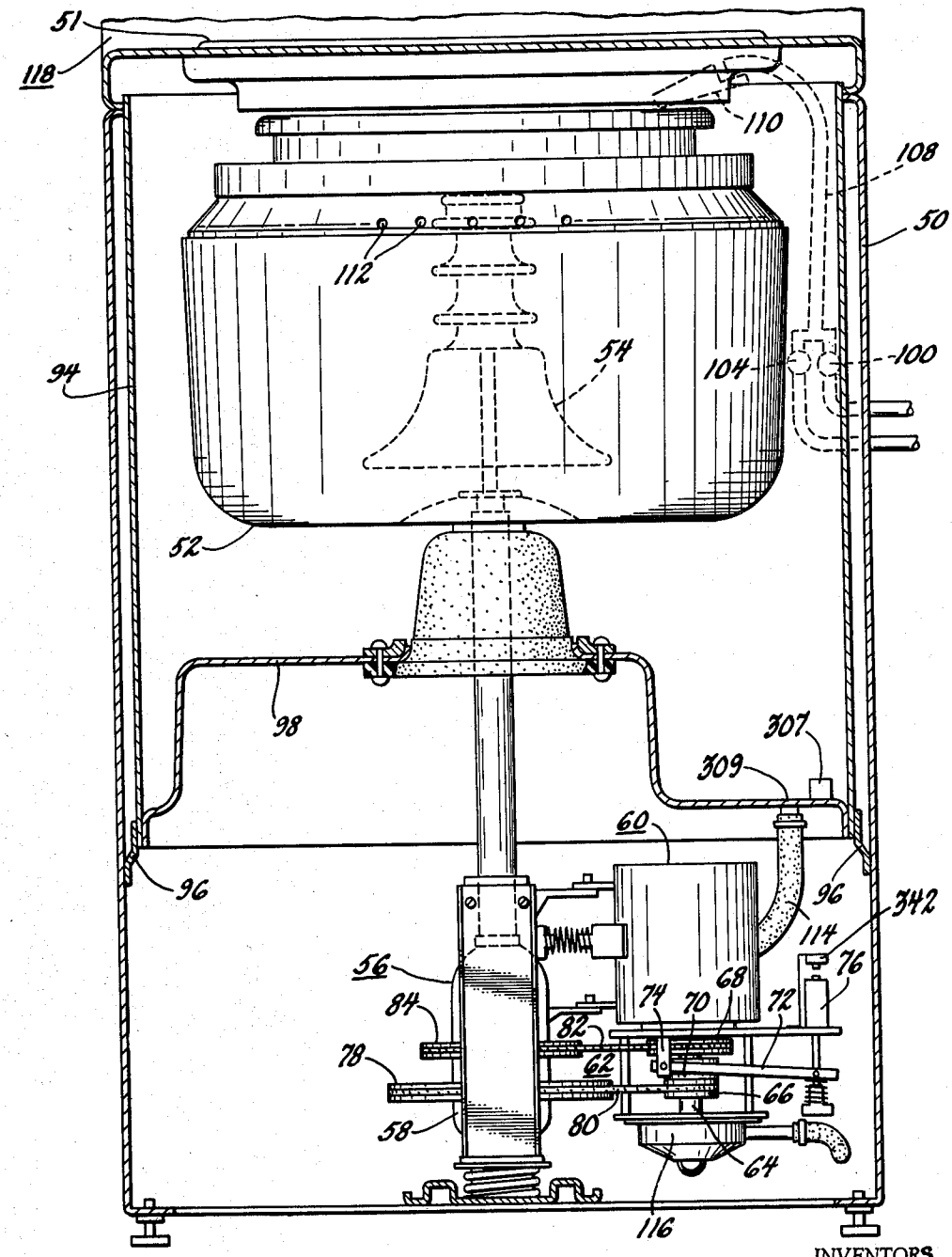


Fig. 1

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DOMESTIC APPLIANCE WITH SPIN ACCELERATION CONTROL MEANS

Original Filed Jan. 19, 1959 4 Sheets-Sheet 2

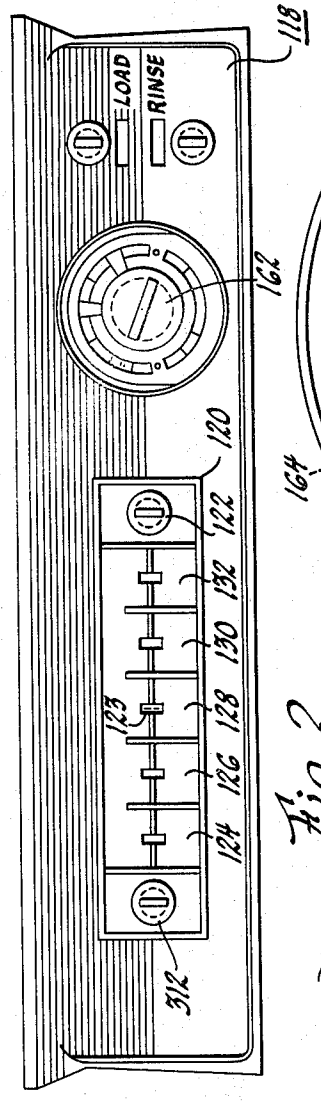


Fig. 2

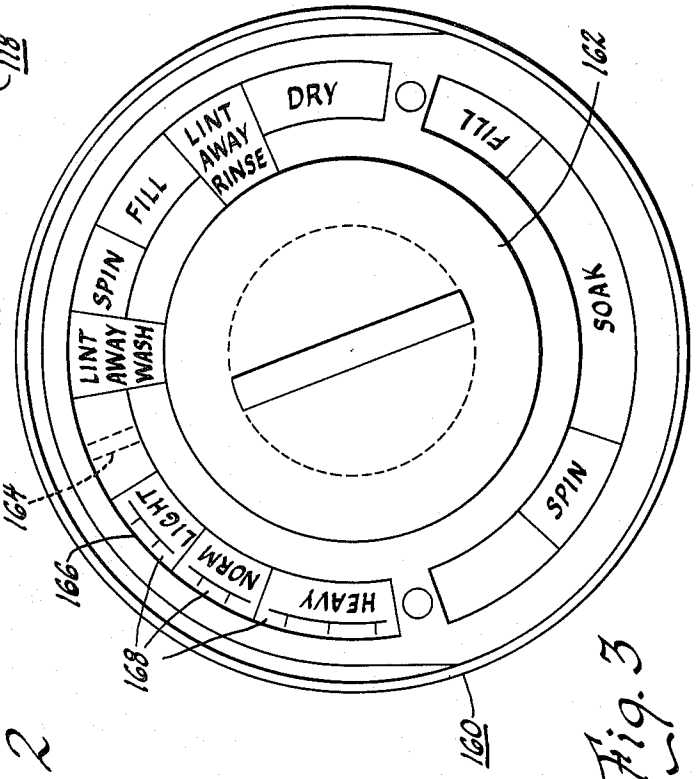


Fig. 3

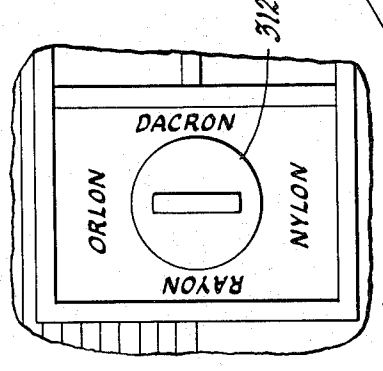
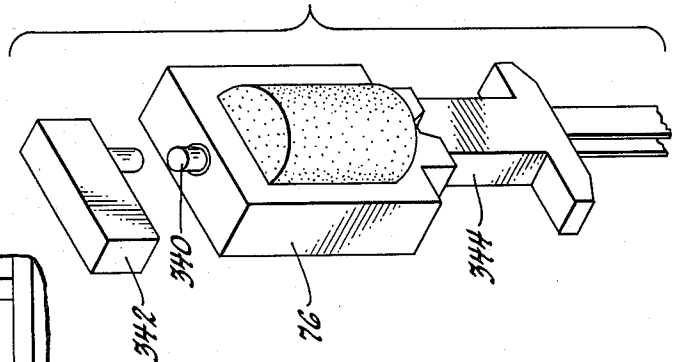


Fig. 7

Fig. 6



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DOMESTIC APPLIANCE WITH SPIN ACCELERATION CONTROL MEANS

Original Filed Jan. 19, 1959 4 Sheets-Sheet 3

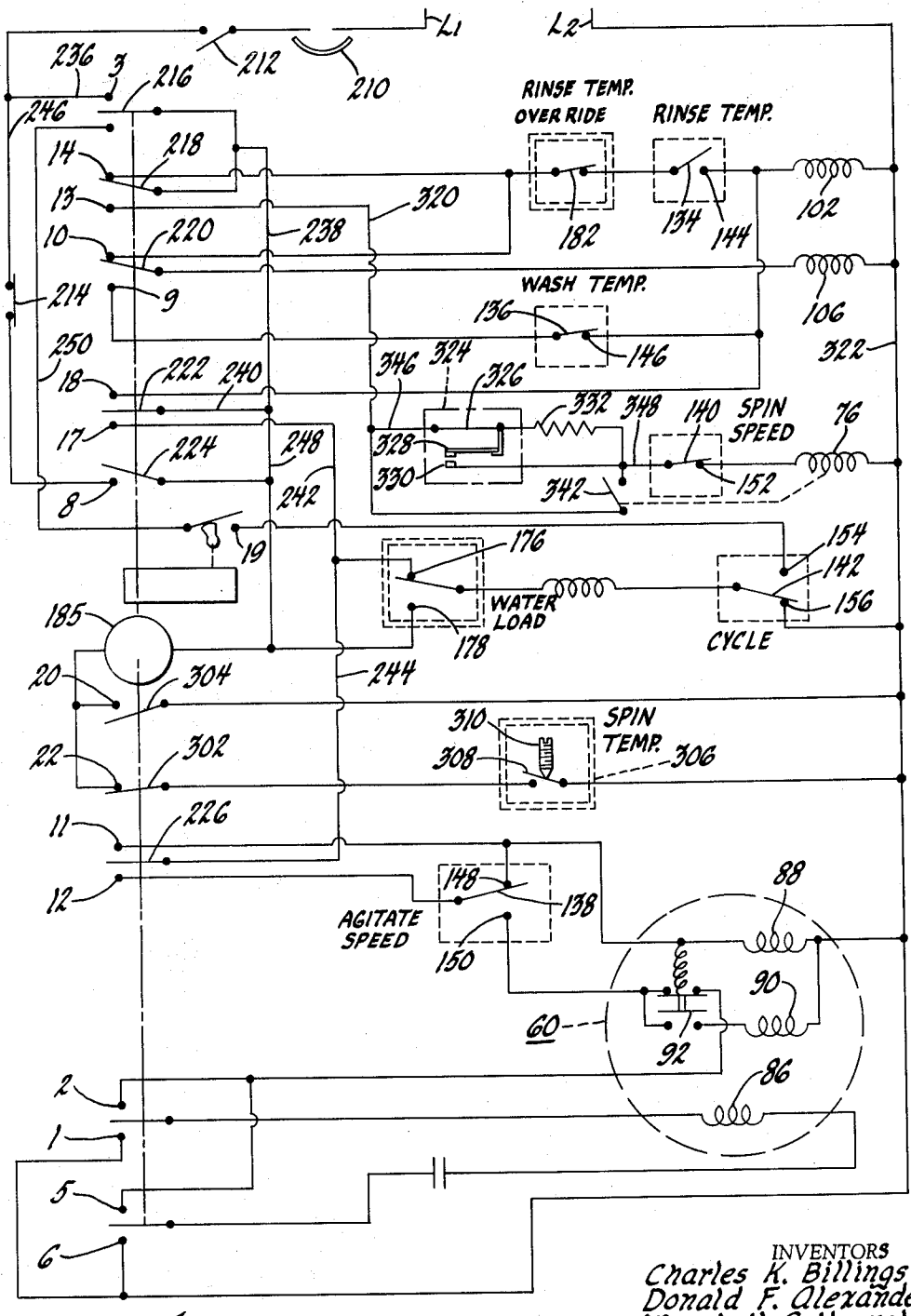


Fig. 4

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DOMESTIC APPLIANCE WITH SPIN ACCELERATION CONTROL MEANS

Original Filed Jan. 19, 1959 4 Sheets-Sheet 4

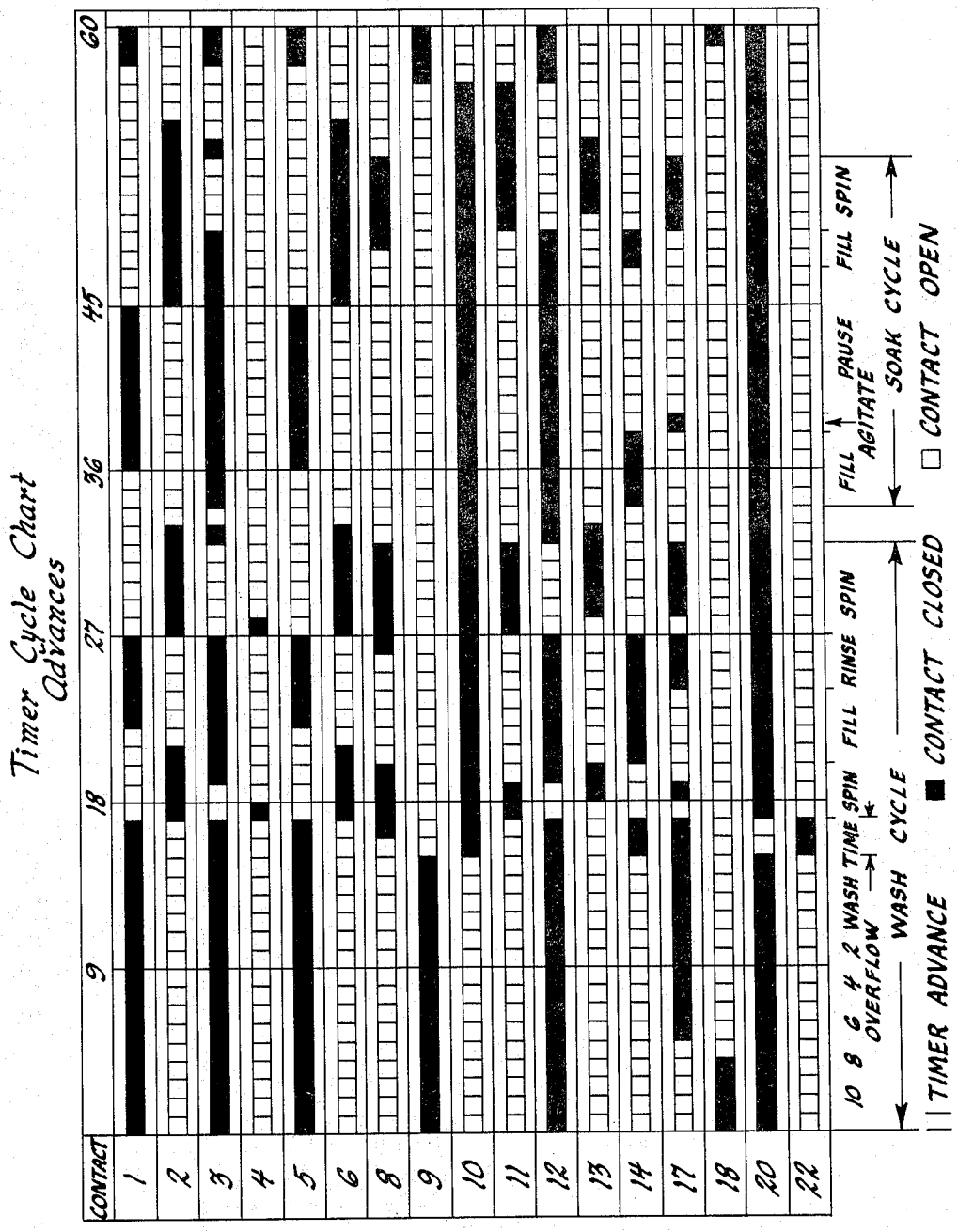


Fig. 5

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United States Patent Office 3,214,665 Patented Oct. 26, 1965

3,214,665

DOMESTIC APPLIANCE WITH SPIN ACCELERATION CONTROL MEANS

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Original application Jan. 19, 1959, Ser. No. 787,762, now Patent No. 3,078,700, dated Feb. 26, 1963. Divided and this application Sept. 22, 1960, Ser. No. 57,717
7 Claims. (Cl. 318—224)

This invention relates to a domestic appliance and more particularly to an improved operational cycle for a clothes washing machine and is a division of our copending application Ser. No. 787,762, filed January 19, 1959, now Patent 3,078,700 issued February 26, 1963.

With the progress that is being made in the development of man-made fabrics, it has become evident that standard washing procedures are no longer wholly adequate to the task. In particular it has been found that spinning or centrifuging water from such fabrics tends to set-in wrinkles which are extremely difficult to remove. The wrinkling which occurs to such fabrics is due primarily to the temperatures at which the fabrics are spun. Since the end temperature of the water and clothes before spinning is vitally important to doing a satisfactory job of washing wash-and-wear garments without inducing objectionable wrinkles, it is the purpose of this invention to thermostatically control the spinning mechanism so that centrifuging will be accomplished only when the fabric to be centrifuged is at an acceptable temperature.

The advancement of the washing machine art has also been directed to multi-speed mechanisms wherein the centrifuging or spinning operation is accomplished at more than one speed and wherein different gear ratios ars provided for the different speeds. Since one motor is utilized to spin the tub at the selected speeds, it is desirable to use a circuit design which will permit the use of a motor which is inexpensive and dependable. The most severe task which the motor is called on to perform is in accelerating the washing machine tub from a standing start to high speed spin, the tub being filled with water and clothing. This job requires motors which need heavier windings and more insulation to effectively accommodate the heat produced in such acceleration. It is the purpose of this invention to overcome this difficulty by preventing an acceleration of the tub and motor from zero to high speed in one operation and by taking advantage of a lower gear ratio during such acceleration from a standing start.

Accordingly it is an object of this invention to provide a control cycle for an automatic washing machine which will prevent a spinning operation while the fabric to be spun is above a predetermined temperature.

It is also an object of this invention to provide a control cycle for an automatic washing machine which will prevent the initiation of a high speed spin for a delayed period.

It is a more particular object of this invention to include a thermostatic device in series control of the spinning mechanism to delay the operation thereof until the temperature of the fabric sensed by such device has reached a predetermined temperature.

It is also a more specific object of this invention to include a delay device in the high speed spin circuit of a washing machine to insure that a high speed spin will be preceded by a low speed spin.

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

In the drawings:

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

FIGURE 2 is an elevational view of a washing machine control panel provided with the teachings of this invention;

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

FIGURE 4 is a schematic wiring diagram for controlling an automatic washing machine in accordance with the concepts of this invention;

FIGURE 5 is a timer cycle chart showing the open or closed condition of the identically numbered timer contacts in FIGURE 4;

FIGURE 6 is a perspective view of a high speed spin solenoid and switch combination utilized in accordance with this invention; and

FIGURE 7 is a fragmentary view of the control panel shown in FIGURE 2 and illustrating the spin temperature control means for different fabrics.

In accordance with this invention and with reference to FIGURE 1, a clothes washer **50** having a clothes loading door or lid **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 to Sisson Ser. No. 738,362 filed May 28, 1958, now Patent 2,987,904 issued June 13, 1961, for an improvement to the Sisson mechaism. A prime mover **60** may be four-pole, six-pole, two-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 or tub spin speed control means **76**. When the solenoid **76** is de-energized, 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 six-pole arrangement and thus operating in low speed, the pulley **66** will effect a slow speed agitation by rotating housing **58** through a driven pulley **78** affixed thereto and a V-belt **80**. With the motor **60** still energized 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 four-pole motor arrangement for operation of motor **60**, still driving housing **58** through pulley **66** with solenoid **76** de-energized. Driving pulley **68** is selected by clutch **70** solely for high 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., Ser. No. 738,330 filed May 28, 1958, now Patent 2,974,542 issued March 14, 1961.

The motor **60** is provided with a four-pole start or phase winding **86**, a fast speed four-pole main winding **88** and a slow speed six-pole main winding **90** (FIGURE 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 the 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** (FIGURES 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 FIGURE **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** will locate an indicator **123** in one of these five positions to actuate 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 FIGURE 4 illustrates the switches **134**, **136**, **138**, **140** and **142** schematically as independent switch means, for purposes of clarity. However, it may be desirable 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 most satisfactory wash cycle for the particular fabric selections **124**, **126**, **128**, **130** and **132** and these cycles are set forth more particularly in a copending application to Sisson, et al., Ser. No. 784,412 filed July 14, 1958. For the purpose of this invention, it is necessary only to set forth the "Wash-and-Wear" cycle **128**.

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. It will be noted that the "Wash-and-Wear" cycle includes a low speed spin. This arrangement is helpful in minimizing the setting of wrinkles into the man-made fabrics as a result of the centrifuging. However, it has been found that the temperature of the fabrics at the time they are centrifuged has a primary bearing on the resultant wrinkling effect of the spin-dry operation. Controlling the temperature of the fabrics prior to spin has been found to be the answer to the wrinkling problem and it is to this end that one aspect of this invention is directed.

The temperature of wet man-made fabric below which centrifuging will not cause "set-in" wrinkles is called the threshold temperature. For each fabric this threshold temperature may be different. Therefore, if a control system is to be invented which will meet the needs of future fabrics, provision must be made for a variable temperature responsive system—a system which may be preset for the fabric to be washed and which will automatically prevent the spinning of such fabrics so long as the temperature of the fabric remains above its particular threshold temperature. Of course, it is conceivable that fabrics may be discovered which should not be spun when they are below a given temperature. The concepts of the temperature responsive system here to be described are believed equally applicable in either instance.

In accordance with this invention it is proposed to include a cold water overflow period 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 material is centrifuged while still warm. Specifically, at the beginning of the sixteenth 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 L_1, 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 L_2. In this manner, cold water is admitted to tub **52** through conduit **108** to dilute the warm water and thereby cool

the fabric in the water before initiating spin to damp dry the fabric.

The admission of a cooling fluid to the tub **52** to lower the fabric temperature prior to spin is controlled as follows. A fabric spin temperature timer contact **22** is contained in the timer and acted upon by a fabric spin temperature timer switch blade **302**. In cooperation with the contact **22** the timer includes a fabric temperature by-pass contact **20** acted upon by a by-pass or shunt switch blade **304**. The timer is designed so that contact **20** is closed during all but the overflow period, timer advances **16** and **17** (see FIGURE 5), while contact **22** is closed during the overflow period only. In other words, contact **20** is open when contact **22** is closed and vice versa. Since either contact **20** or contact **22** is in series with a timer motor **185**, one or the other of these switches **20**, **304** or **22**, **302** are in control of the energization of the timer motor. In series with the fabric temperature timer contact **22** is a fabric or spin temperature thermostat **306**. The thermostat includes a switch blade **308** which cooperates with the timer switch **302** to close a circuit through the timer motor **185**. The thermostat **306** is of the adjustable type having a screw or bellows **310** for permitting selective adjustment of the thermostat to the desired spin temperature as will be described more fully next following. A temperature sensitive element **307** operating through the bellows **310** is placed in a position where it will predict most accurately the temperature of the fabrics prior to spin. In this arrangement the element **307** is placed on the bulkhead **98** adjacent the drain opening **309**. Thus, as water is overflowed from the tub **52** by way of ports **112**, the temperature thereof, and consequently the temperature of the fabric in the tub **52** will be accurately sensed as the water flows to drain.

As aforesaid, it has been determined that different fabrics have different threshold temperatures, spinning above which sets in wrinkles. This invention seeks to overcome this variable problem by controlling the centrifuging or spinning in accordance with the fabric being washed. Reference may be had to FIGURE 7 where a fragmentary portion of the control panel in FIGURE 2 is shown. A knob **312** is included for selecting the particular man-made fabric to be washed, in this instance and by way of example only, Orlon, Dacron, nylon and rayon. This control could, of course, be adapted to an indefinite number of fabric types presently available or to be developed in the future. The knob **312** is connected to the adjustable thermostat element **310** and designed to preset the thermostat so that a spinning process will not be initiated until the temperature of the fabric to be spun has reached the desired setting as programmed by knob **312**. The knob **312** may be of the push-pull on-off switch type so that the thermostatic switch blade **308** will be closed positively in those instances where regular clothing is being washed which is not affected by spinning above any given temperature. This in effect locks the thermostat **306** out of circuit control by providing a closed circuit through the thermostat.

The washing machine control panel of FIGURE 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 opening **166** which is partitioned to indicate segments of the washing cycle. Reference may be had to FIGURE 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 full" 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 lint collecting on the surface of the water and to selectively cool the fabric as described hereinabove. The "Spin" is self-explanatory and indicates merely the centrifuging of wash water from the fabrics being processed after the fabrics have been cooled. Thus, the thermostat **306** will initiate the spin. 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. For additional details of the washing cycle shown in the drawings and programmed in FIGURE 2, reference may be had to the aforesaid copending application Ser. No. 748,412, now Patent 2,976,710 issued March 28, 1961.

In operation, the user of a washing machine **50** provided with this invention may raise the lid **51** and place within the tub **52** a quantity of fabrics or clothing, the spinning temperature of which is critical if wrinkling is to be eliminated. The user will select the Wash-and-Wear cycle **128** by positioning indicator **123** for such operation by knob **122**. To insure a temperature responsive centrifuging operation, the operator will then preset knob **312** to the particular fabric being washed. The dial in FIGURE 7 is shown including four presently known man-made fabrics but such control may include others as required. As aforesaid, one position of the knob **312** may lock switch blade **308** closed to eliminate this thermostatic control feature.

The knob **312** will be thus placed in condition to actuate the thermostatic sensing device **306**. In a conventional manner a timer knob **162** will be positioned to initiate a washing cycle as more fully taught in copending application Ser. No. 748,412 filed July 14, 1958, now Patent 2,976,710 issued March 28, 1961. Water at the selected temperature will be introduced to tub **52** and an agitating cycle will follow wherein the fabric is cleaned. Near the end point of the agitation, the sixteenth and seventeenth advance on the timer cycle chart of FIGURE 5, contacts **10** and **14** (FIGURE 4), will be closed to initiate an overflow period. At this time, cold water is introduced through the energization of solenoid **106** to the tub **52**. The water level will rise until it overflows through ports **112** into the chamber located immediately above the bulkhead **98** and will consequently flow to drain through the drain opening **309**. In so doing, the thermostatic sensing element **307** will sense the temperature of the water being removed or overflowed from the tub **52**. Since the fabric within the tube will have the same temperature as the water therein, the element **307** will in effect be sensing the fabric temperature as well. In accordance with the teachings of this invention, the overflow period is placed under the control of timer switch contacts **20** and **22** as seen in the timer cycle chart of FIGURE 5. The timer switch **304** is opened to open contact **20** at the beginning of the sixteenth timer advance. Simultaneously therewith timer contact **22** is closed by timer switch **302**. Thus, the timer motor **185** which had been energized in series with timer contact **20** at the beginning of the washing cycle is now placed under the control of timer contact **22** and its associated switch **302**. In series with contact **22**, however, is a thermostatic device **306** through which the fabric temperature sensing ele-

ment **307** works. Let us assume that the overflow period has just been initiated at the beginning of the sixteenth timer advance. The water being overflowed to the drain opening **309** will be comparatively warm, the element **307** sensing this condition and holding the thermostatic switch **308** in an open position. Since timer switch **20**, **304** is opened as well as the switch blade **308** in the thermostat **306**, the timer motor **185** will be deenergized and the entire operational cycle of the washing machine will be placed under the control of the thermostatic device **306**. As more cold water is introduced through conduit **108** to the tub **52**, the temperature of the water being overflowed, and consequently the fabric in said water, will be decreased to a point at which the sensing element **307** closes switch **308** to reenergize the timer motor **185**. With the timer motor again energized, the timer switches will be sequentially positioned in accordance with the programmed washing cycle of FIGURE 5. The first advance after the fabric has reached the desired temperature and the timer motor is again energized, the timer switch **304** will be closed and the timer switch **302** opened to effectively by-pass the thermostatic device for the remainder of the washing cycle. The final spin in the washing cycle as shown in FIGURE 5 need not have the thermostatic control over the fabric to be spun since the water within the tub **52** just prior to the second spin is programmed as cold. Of course, it is within the purview of this invention to place the thermostatic device **306** in control of the spinning operation wherever needed, simply by appropriately positioning the timer switches **20**, **304** and **22**, **302** at the desired point in the timer cycle. It should now be seen that an arrangement has been provided whereby the fabric being washed is centrifuged only at that temperature found most desirable to prevent wrinkles from being set into the fabric. The adjustable nature of the thermostat **306** effects this operation in accordance with the preselection by the user on knob **312**.

One other feature of the improved circuit includes a spin operation which always starts in a low 330 r.p.m. tub speed until the second timer pulse interval of the spin cycle. Thus, at the beginning of the spin period which is initiated shortly after the start of the eighteenth 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. This one timer interval delay permits most of the water to be spun from the tub **52** before initiating high speed spin, thereby minimizing the strain on the motor **60**. At the nineteenth 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**. Since the speed change ratio is greater in transmitting power from motor **60** through large pulley **68** to the rotatable housing **58** than through the smaller pulley **66**, it would appear desirable to accelerate the tub **52** through the most advantageous ratio, i.e., through pulley **66**. This too is accomplished by always preceding high speed spin with low speed spin. 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 application Ser. No. 738,330, Patent 2,974,542, cited hereinbefore.

This aspect of the invention is directed to providing an operational cycle which will insure that a high speed spinning operation will be started in or preceded by low speed spin. As seen in the timer cycle chart of FIGURE 5, the timer contact **11** is closed at the beginning of the eighteenth timer advance and the motor **60** is energized to effect a low speed spinning operation, the clutch **70** being dogged to pulley **66**. One timer advance later or at the beginning of the nineteenth timer interval, contact **13** will be closed by timer switch **218** to energize the spin circuit. Under normal operation where the washing cycle is permitted to proceed normally from start to finish, the delay of one timer advance is always included to permit the tub **52** to spin first in low speed until most of the water is spun from the tub by means of ports **112**. Thereafter, when contact **13** is closed, the spin circuit is energized for high speed spin, the solenoid **76** is energized to lift the clutch **70** into driving engagement with high speed spin pulley **68** and the tub **52** and the clothing therein are spun at such speed. However, there are certain ways in which the operator may avoid this built-in timer delay and it is to this potentiality that one aspect of the present invention relates.

One situation in which the operator could avoid the one timer advance delay of high speed spin is to open the lid **51** during high speed spin, i.e., when the spin speed selector switch blade **140** is closed on contact **152**. When the lid **51** is open, lid switch **214** is opened as well. This lid opening will deenergize the motor **60** and cause the tub **52** to coast to a stop. Thus, the reclosing of the lid **51** and, consequently, the lid switch **214** will set up an immediate energization of the prime moving means for high speed spin. With reference to FIGURE 1, high speed spin is accomplished by the energization of solenoid **76** which lifts the clutch **70** by means of yoke **72** into frictional driving engagement with the drive pulley **68**. In this fashion driven pulley **84** affixed to the mechanism housing **58** is rotated at high speed, thereby imparting a high speed spin to the tub **52**. Accelerating tub **52** from zero r.p.m. to 850 r.p.m. imparts severe strain to the motor **60** and requires additional insulation on the windings thereof to offset the added heat loss from such rapid acceleration

Another means by which the user may avoid the high speed spin delay built into the timer cycle is to manually advance the timer dial **162** through the eighteenth timer advance which is designed into the timer cycle as a high speed spin delay. To so do causes the prime moving means to be energized immediately for high speed spin. The addition of a delay means to the high speed spin circuit in accordance with the teachings of this invention overcomes both of these operational possibilities and insures that a low speed spin will always precede a spin of high speed.

With reference to FIGURE 4, the high speed spin circuit may be described as from L_1, switch **210**, switch **212**, line **246**, lid switch **214**, timer switch **224**, line **248**, line **238**, timer switch **218**, line **320**, spin speed selector switch blade **140**, high speed spin solenoid **76** and line **322** to L_2 To insure that solenoid **76** will not be energized until the motor **60** is energized first for low speed spin drive through pulley **66**, a timed delay device or thermal switch means **324** is added to the circuit. This device **324** may be of the hot wire relay of the general type shown in the patent to Werner 2,242,769 issued May 20, 1941, and adapted to close a circuit therethrough after approximately ten seconds. This delay provides time for the driving mechanism to rotate the tub **52** in low speed spin before the solenoid **76** is energized. For purposes of clarity low speed spin may be described with reference to FIGURE 1 wherein the deenergization of high speed solenoid **76** permits the dogged engagement of clutch **70** with drive pulley **66**, thereby driving the rotatable housing **58** of the agitate and spinning mechanism **56** to effect a low speed spin of the tub **52**. The time delay device **324** may include a hot wire or a bimetallic element **326** which is effective after a predetermined

period to close a set of internal contacts **328**, **330** within the delay device **324**. A resistor **332** may be included in series with the delay device **324** and in parallel with the contacts **328**, **330** so that the time delay of the device may be properly adjusted—an increase in resistance of the element **332** serving to lengthen the delay. The fact that the resistor **332** is in series with the solenoid **76** limits the voltage across the solenoid and prevents the actuation of the latter. The resistance should be sized to limit the voltage across the solenoid to one-third the normal solenoid operating voltage. Thus, the energization of the prime moving means for high speed spin will first close a circuit through the time delay device **324** and prevent the energization of solenoid **76** until a predetermined period thereafter at which time the contacts **328** and **330** close. At this time the solenoid **76** will be energized to lift the yoke **72** in causing the clutch **70** to engage the high speed spin pulley **68**. In this manner, the tub **52** will be accelerated to high speed spin only from a low speed spin rather than from a dead start. Further, this will reduce the temperatures at which the motor **60** is required to operate and permit the use of a smaller motor.

Since heat must be dissipated by the relay device **324** whenever the high speed spin circuit is energized, it is desirable to remove the device **324** from the spin circuit whenever the solenoid **76** is energized. For this purpose solenoid **76** may include a switch actuator button **340** which projects through the core of the solenoid and extends toward a switch **342**. Thus, the energization of the solenoid **76** will cause the armature **344** thereof to raise, thereby pushing the actuator button **340** upwardly into actuating engagement with the switch **342**. The closing of switch **342** will shunt the time delay device **324** out of the spin circuit and thus eliminate the continuous heat loss which would arise should the delay device **324** remain in series with the high speed spin solenoid **76** throughout the spinning operation. Of course, it is within the purview of this invention to place the switch **342** at the other end of the solenoid **76**, such that the lifting of the armature **344** will close the switch **342**.

The high speed spin circuit is thus comprised of a delay circuit and a delay by-pass circuit. Whenever the lid switch **214** is actuated by the opening and closing of the washer lid **51** during high speed spin and/or whenever the time delay will be provided as follows. The motor through the eighteenth on twenty-eighth timer advance (the high speed spin delay intervals built into the timer) the time delay will be provided as follows. The motor **60** will be energized to rotate the agitate and spinning mechanism **56** through driving pulley **66**. At the same time, the high speed spin circuit will be energized from L_1, safety switches **210**, **212**, line **246**, lid switch **214**, timer switch **224**, line **248**, line **238**, timer switch **218**, timer contact **13**, line **320**, line **346**, time delay device **324**, line **348**, spin speed selector switch **140**, high speed spin solenoid **76**, line **322** to L_2. After a predetermined period, the delay contacts **328**, **330** will close and the high speed spin solenoid **76** will be energized to raise the clutch **70**; with the actuation of the solenoid **76** switch **342** will be closed to by-pass the time delay device **324** and high speed spin will be continued with the motor **60** driving the agitate and spinning mechanism **56** through drive pulley **68**.

It should now be seen that a completely safe circuit arrangement has been provided for high speed spin. Regardless of the user's operation of the washing machine **50**, the prime moving means including the motor **60**, the clutch **70**, and the selected belt and pulley arrangement **62** will always be conditioned for a low speed spin prior to high speed. This takes advantage of the best pulley speed changing ratio during the initial acceleration of the tub **52** and, further, permits adaptation of a less expensive motor to a multi-speed operation.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A speed control arrangement for an appliance having a tub comprising, prime moving means for rotating said tub at high and low speed and including tub speed control means energizable for effecting rotation of said tub at said high speed and deenergizable for effecting rotation of said tub at low speed, a speed selector switch connected to said tub speed control means and closable for conditioning said tub speed control means for energization to effect rotation of said tub at high speed and delay means for said prime moving means to insure tub rotation is initiated only at said low speed, said delay means including a thermally responsive switch closing means in series with said speed selector switch and said tube speed control means and selectively energizable for energizing said tub speed control means when said speed selector switch is closed to effect rotation of said tub at said high speed after a predetermined time interval of rotation of said tub at said low speed.

2. The speed control arrangement of claim **1** including a resistance means in parallel with said thermally responsive switch closing means and in series with said speed selector switch and said tub speed control means for controlling the duration of said predetermined time interval.

3. The speed control arrangement of claim **2** including means responsive to the energization of said tub speed control means for by-passing said delay means at the end of said predetermined time interval.

4. A speed control arrangement for an appliance having a tub comprising, prime moving means for rotating said tube at high and low speed and including tub speed control means selectively energizable for effecting rotation of said tub at said high speed and for effecting rotation of said tub at low speed, and delay means for said prime moving means to insure tub rotation is initiated only at said low speed, said delay means including a thermally responsive switch closing means connected to said tub speed control means and selectively energizable for controlling said tub speed control means to effect rotation of said tub at said high speed after a predetermined time interval of rotation of said tub at said low speed.

5. The speed control arrangement of claim **4** wherein said thermally responsive switch closing means includes a relatively fixed contact, a relatively movable contact, a thermally responsive element connected to said movable contact for moving said relatively movable contact into engagement with said relatively fixed contact when heated and resistance means selectively energizable with said delay means and in heat transfer relationship to said thermally responsive element.

6. A control circuit for a rotatable container having a prime moving means including a motor for rotating said container at high and low speeds and comprising, means energizable for conditioning said prime moving means for high speed rotation of said container, a power supply, a high speed circuit connected to said power supply and including in series power supply relationship a first timer switch means closable to energize said high speed circuit, a speed selector switch means settable for high or low container rotation speed, a thermal time delay switch closing means and a high speed conditioning means, and second timer switch means closable with said first timer swithc means for energizing said motor, said first timer switch means energizing said thermal delay device to delay energization of said high speed conditioning means when said speed selector switch means is set for high container rotation speed.

7. The control circuit of claim **6** including a resistance means in parallel with said thermal time delay switch

closing means and in series with said first timer switch means and said speed selector switch means for controlling the duration of said delay before energization of said high speed conditioning means.

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