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W. L. SONES ET AL
COMBINATION AGITATING MEANS AND SPINNING MEANS
WITH SPEED CONTROL MEANS

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3 Sheets-Sheet 1

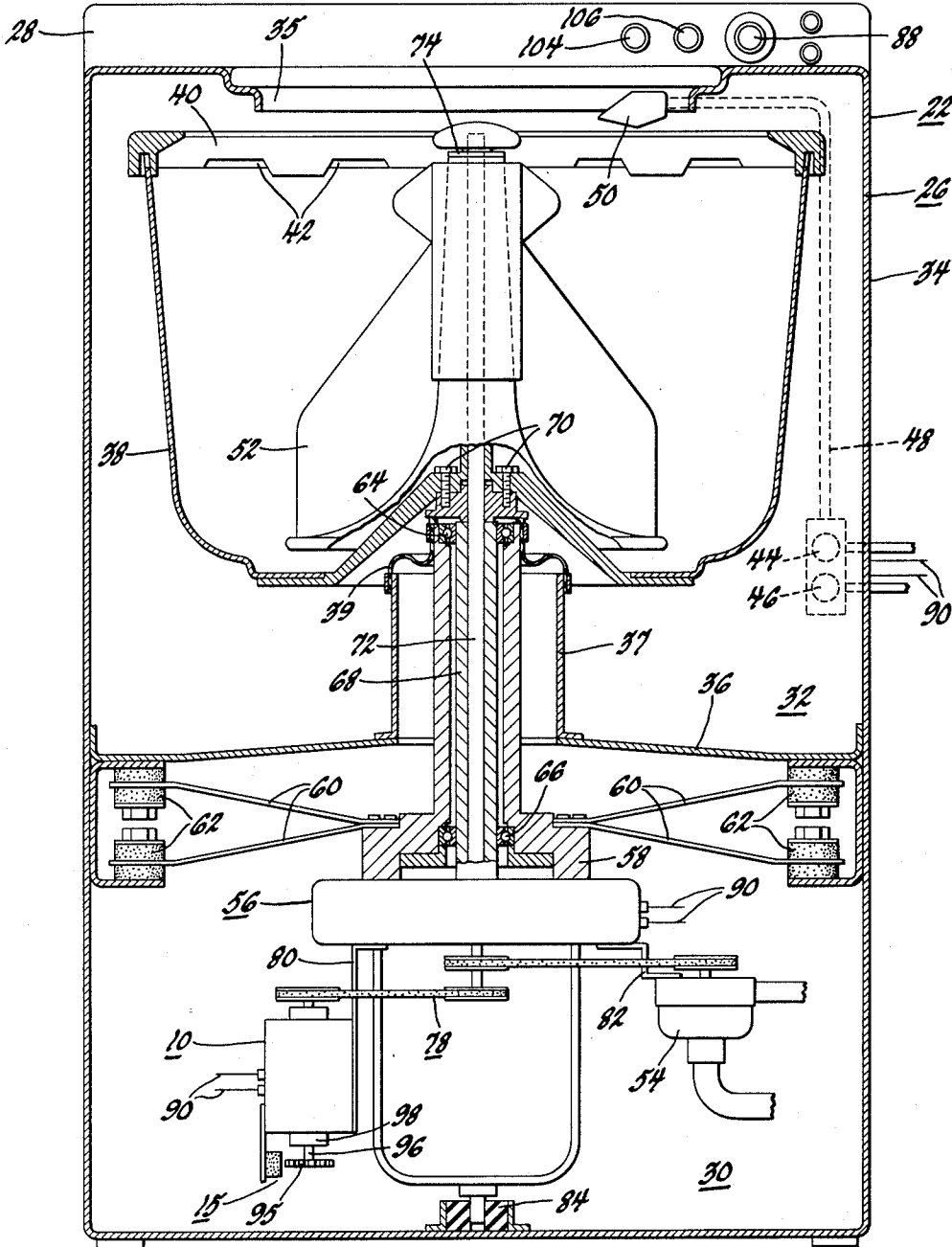


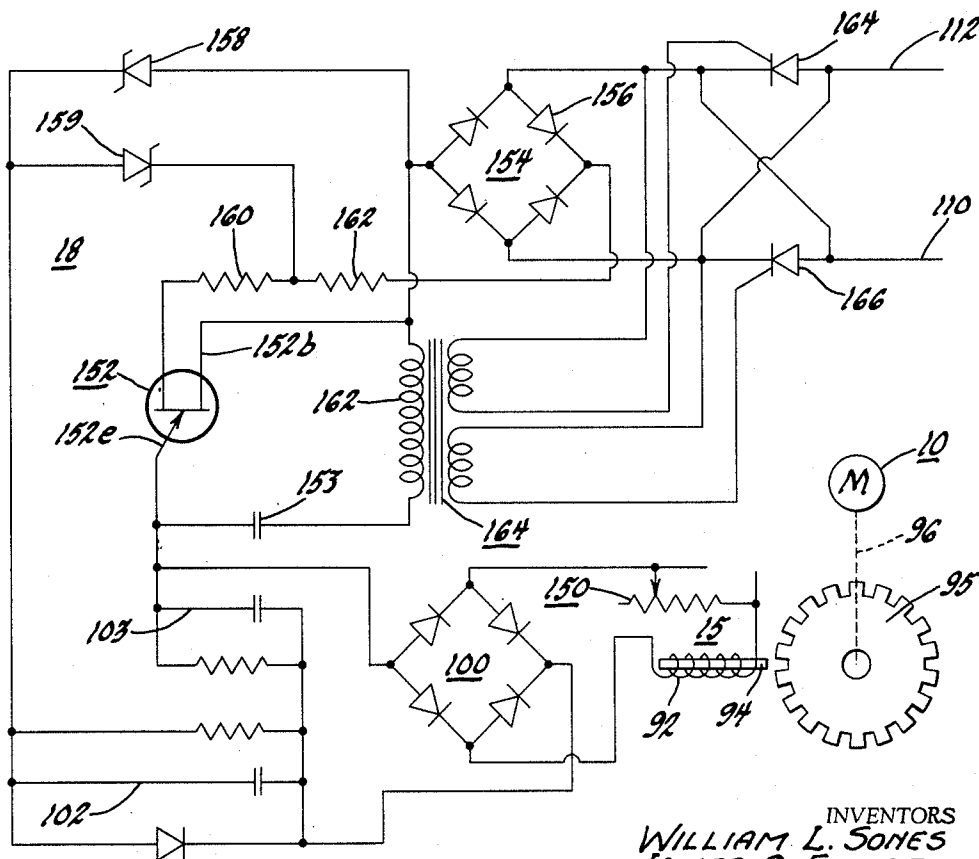
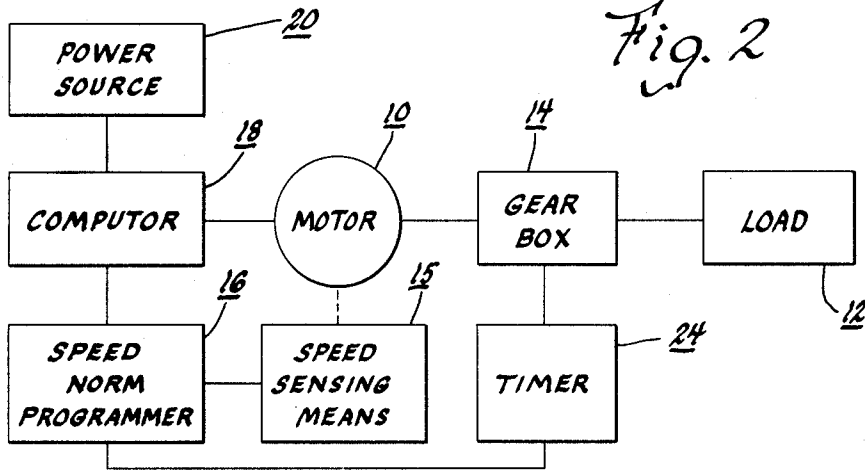
Fig. 1

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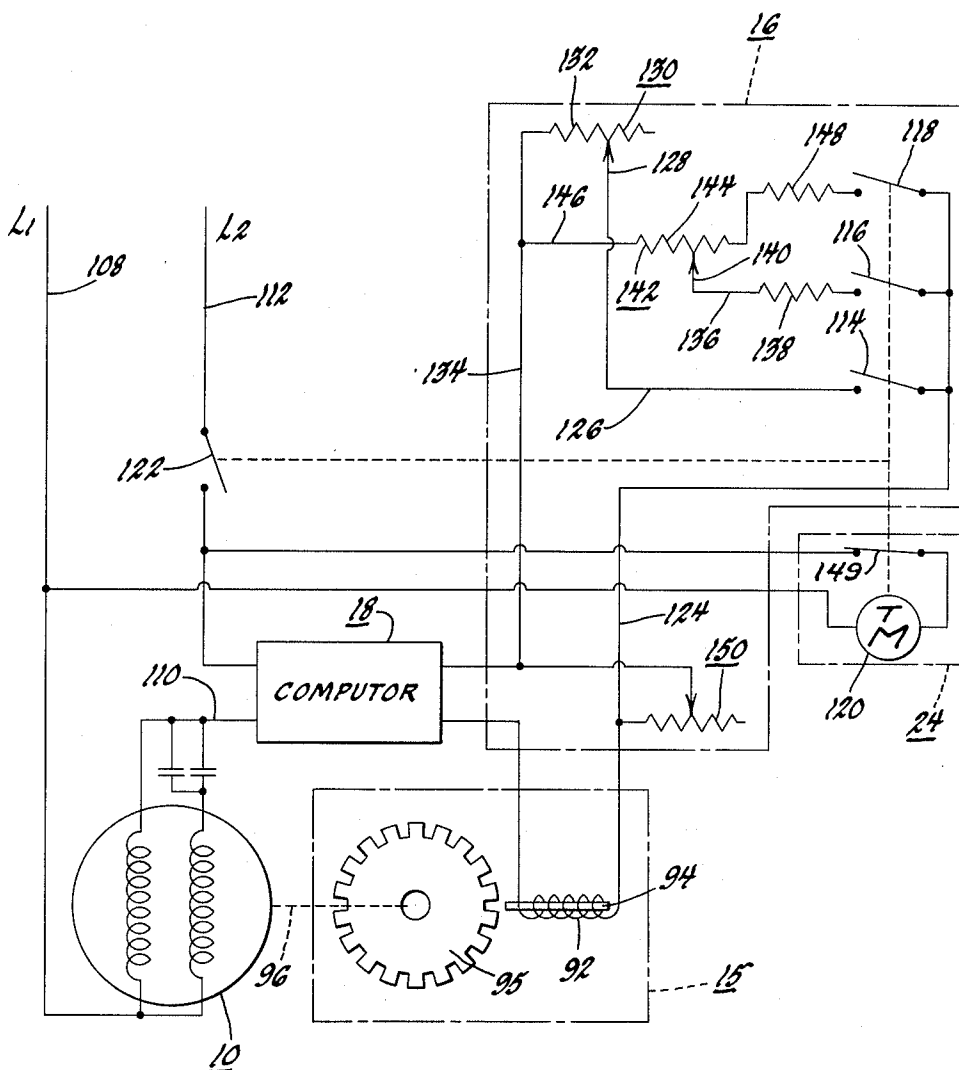


Fig. 3

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COMBINATION AGITATING MEANS AND SPINNING MEANS WITH SPEED CONTROL MEANS

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7 Claims. (Cl. 68—12)

This invention relates to a domestic appliance and more particularly to a control system for selectively varying the cleaning action of first and second operative parts of a clothes washer in order to vary the clothes cleaning capability thereof.

Many cleaning devices include a plurality of actuatable portions that serve to move a cleaning fluid into intimate contact with soiled fabric so that a cleaning agent in the fluid will remove the soil therefrom. For example, certain clothes washers have a spin tub with an agitator or pulsator located centrally thereof for oscillatory movement relative thereto. In such devices the agitator will cause washing fluid to surge through fabric in the spin tub to provide the necessary cleaning action and the spin tub serves to centrifuge the cleaning fluid from the clothes following a washing cycle. Recent developments in synthetic fabrics have resulted in a wide range of fabric types that require a greater or lesser degree of washing action in order to remove the soil therefrom. Furthermore, a typical user of a domestic washer having such actuatable parts may desire to operate the machine in a manner to balance the degree of washing action to optimize clothes wear and cleaning action.

It is, therefore, an object of the present invention to provide an improved control system for a clothes washer including means for respectively controlling first and second actuatable means in order to optimize the clothes cleaning action thereof while minimizing clothes wear.

A further object of the present invention is to provide an improved control system for a clothes washer of the type having a spin tub and an agitator or pulsator including improved means for infinitely varying the speed of rotation of the spin tub and rate of pulsating of the agitator within a predetermined range depending upon the type of fabric being processed thereby.

A still further object of the present invention is to provide an improved control system for a clothes washer including first and second manually rotatable control knobs operatively associated with means for preprogramming the speed of rotation of a spin tub and rate of pulsation of an agitator during washing and spin cycles of the clothes washer.

A still further object of the present invention is to provide improved control systems for a washer including a drive motor speed control computer operatively associated with a variable speed drive motor means for driving a spin tub and agitator of the washer by the provision of means in association with the computer for providing independent infinite speed control of the motor means while driving the spin tub and the pulsator during washing and spin dry cycles of operation of the machine.

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 embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a schematic diagram of a prime moving system for a clothes washer having a spin tub and an agitator;

FIGURE 2 is a block circuit diagram of an electrical control system including the present invention;

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FIGURE 3 is a more detailed circuit diagram of the present invention; and

FIGURE 4 is a detailed circuit diagram of a computer control unit suitable for use with the present invention.

In accordance with this invention and with reference to FIGURE 2, a block diagram is used to illustrate generally a clothes washer drive motor 10 for driving a load 12 through a gear box 14. The block diagram further includes speed sensing means 15 and a speed norm programmer unit 16 that initiates signals which, in turn, can be used for controlling a power source 20 to the motor 10 in accordance with the computations of a computer control unit 18. The computer takes into account differences in the size and orientation of loads such as clothes and water which can change the torque requirements of the motor 10. In other words, output speed of the motor 10 is controlled basically in accordance with the loading thereof and the measurement of motor speed by the speed sensing means 15 can be used as one variable to signal deviations from a desired performance norm.

The speed sensing means 15 is provided with suitable mechanisms to convert motor speed into electrical signals to be fed into the computer control unit 18. The computer or control unit 18 is preferably of the completely static type in that no moving parts other than the motor itself are employed in the operation thereof. Electrical circuit components are included in the computer which are adapted to meter sixty cycle power to the motor 10 from the power source 20 by varying the average voltage input to the motor to thereby effect a desired speed therein. The system further includes a timer mechanism 24 that coordinates the system with a conventional washer cycle control arrangement.

Suitable mechanisms are also provided in the speed norm programmer for varying the desired performance norm of the operative parts of the laundry device in a manner to be discussed.

The control system generally set forth in FIGURE 2 is illustrated as being incorporated in a clothes washer 22 somewhat schematically shown in FIGURE 1 as included an outer casing or shell 26 having a control panel 28 supported on the upper portion thereof. The casing 26 is generally divided into a machinery compartment 30 and a washing portion or water container chamber 32 formed by an upper cylindrical wall portion 34 of casing 26 having the upper end thereof opened at 35 and the bottom thereof closed by a bulkhead 36 having a vertically directed sleeve portion 37 sealed against leakage by an annular seal 39 at the upper end thereof for separating the water compartment 32 from the machinery compartment 30. A spin tub 38 located within the water container 32 has a top opening 40 and a plurality of ports 42 in the upper portion thereof for allowing egress of water from the tub 38 during high speed rotation thereof. The illustrative machine further includes means for filling the tub 38 with water including a water supply system having a hot water solenoid actuated valve 44 and a cold water solenoid operated valve 46 manifolded into a mixed water supply conduit 48 which terminates at a chute 50 overlying the opening 40 in the tub 38.

Within the tub 38 an agitator or pulsator 52 is mounted for oscillation to circulate or agitate the water contained in the tub 38. Thus, fabric placed within the tub 38 is washed as the pulsator 52 causes the washing fluid and any included washing agent therein to surge back and forth through the fabric. Following the washing cycle and spin cycle the laundering fluid is drained from container 32 through a line (not shown) leading to the intake of a pump 54.

The drive means for carrying out the washing and spin cycle portions of the cleaning operation is representatively illustrated as including a gear box 56 carried by a sup-

port bracket 53 suspended on a framework of lateral support arms 60 yieldably affixed to the casing 26 by snubbers 62. The upper part of the support bracket 53 serves as a stationary shaft enclosing housing having bearings 64, 66 in the opposite ends thereof for journalling a spin shaft 68 directed upwardly of the gear box 56 and having the upper end thereof secured to the bottom wall of the spin tub 38 by suitable fastening means such as bolts 70. The seal 39 cooperates with the shaft housing to perform its sealing function. The spin shaft 68 is a tubular element and thereby serves as a support for an oscillating agitate shaft 72 directed upwardly from the gear case 56 to be secured to the agitator or pulsator 52 at the upper end 74 thereof. The drive motor 10 is representatively shown as being a two-pole induction motor of the permanent start capacitor type that is operatively interconnected in driving relationship with the gear box 56 and the pump 54 by means of a suitable belt and pulley system 78. In the illustrated embodiment the motor 10 and the pump 54 are secured by suitable brackets 80, 82, respectively, to the gear box 56 and the lower portion of the suspended drive mechanism is pivotably connected in a resilient bushing 84 fixed to the bottom of the clothes washer casing for movement transversely within the limits of the bulkhead sleeve 37 to an extent dependent upon the snubbing action of the snubbers 62. The resilient bushing 84 and snubbers 62 therefore serve to damp vibrations in the spin tub 38 during the operation thereof.

The drive motor 10 and gear box 56 and the water fill system for the illustrated clothes washer are electrically controlled and operated with other automatic portions of the machine by a conventional cyclical controller including the timer 24 and a manually operated dial portion 88 on the control panel 28 of the washer that operates a series of switches and through leads 90 controls the various elements in a desired sequential order. The leads connect to the motor 10, solenoids 44, 46 and the gear case 56 to condition the operative parts thereof to admit water through the supply conduit 43, spin the tub 38 and oscillate the pulsator 52 therein in accordance with the desired cleaning operation.

The drive motor 10 of the illustrated arrangement is further controlled by the transistorized computer control unit 18 which is basically of the type illustrated in the copending application of Elliott et al., Serial No. 159,014, filed December 13, 1961. The computer control unit 18 will sense and control the pulsate and spin speeds of the illustrated clothes washer and will maintain them at a preselectable reference norm which, in accordance with certain of the principles of the present invention, is established by the speed norm programmer 16. As to the sensing and controlling of the spin speeds and the number of oscillatory strokes, a sensor for motor speed is operatively associated with the motor 10 in position to feed signals therefrom of the speed thereof into the computer control unit 18 to control the energization of the motor 10. The computer, as will be discussed, maintains the desired speed norm reference of operation in the described washer throughout the operation thereof notwithstanding variations in the load powered thereby and variations in the supply voltage to the motor. Thus, through all phases of operation the speed control will be maintained at a desired norm limited only by the top speed of the motor itself.

It should be recognized that the position of knob 88 controls the operation of the washer in a conventional fashion. In other words, cycle portions devoted to washing and spinning will be set up by the cam actuated switches of the conventional cycle control and after the washer cycle control calls for a particular function, the computer control unit 18 and speed norm programmer 16 then come into play to regulate the drive motor 10 in accordance with a preprogrammed or computer permissible speed.

The computer control system of the invention is of the static, semiconductor type as best illustrated in FIGURE 4 and for purposes of illustrating the present invention receives information from the speed sensing means 15, it being understood that other variable conditions can be transformed into electrical impulses or signals to be supplied to the computer control unit for varying the output signal therefrom such as spin tub unbalance, temperature, humidity, wash fluid clarity, and the like. In general, motor speed variations produced by variable loading, line voltage and the like causes the computer control unit to affect lowering and raising of the motor voltage as required to maintain a constant speed for operating the spin tub and pulsator in a desired manner.

In the illustrated arrangement, in order to control the rotative speed of the spin tub 38 and the pulsing strokes of the agitator 52, the speed sensing means 15 associated with the motor 10 includes a permanent magnet pickup means similar to the type used in dynamometers which comprises a number of turns of wire 92 wound on a small magnet 94 as best illustrated in FIGURES 3 and 4. The permanent magnet pickup 94 is located in radial alignment adjacent to an outwardly toothed wheel means 95 suitably journaled on a shaft 96 driven by a connection 98 to the shaft of the drive motor 10. The shaft of the drive motor 10 will reflect the number of oscillations of the pulsator 52 and also the rotative speed of the spin shaft 38. As the toothed wheel means 95 rotates, the permanent magnet 94 is subjected to varying air gaps and the effective reluctance change causes flux changes in the magnet 84 which induce a voltage in the coil 92. This voltage varies both in frequency and amplitude depending upon the speed of the wheel means 95 and the correlative speed and pulsations of the devices associated in driven relationship therewith. The speed signal produced by the magnetic pickup means is rectified or converted by a full-wave rectifier 100 and capacitive filter units 102, 103 to allow the signal to be fed into the computer control unit 18.

In accordance with certain of the principles of the present invention the reference speed norm for a given programmed operation is controlled by improved means including a tub spin speed control knob 104 and a pulsator stroke control knob 106 on the control panel 28 adjacent the cycle control knob 88. These knobs enable the rate of rotation of the spin tub and the strokes of the pulsator 52 to be selectively infinitely varied within a range limited by the maximum speed of the motor 10 and a minimum speed determined by design conditions such as motor heating. Such improved control of the clothes cleaning components of the above illustrated clothes washer adapts the device for automatic washing of substantially all types of fabric since, during the washing cycle, the pulsator 52 can be regulated to have a very small number or a relatively high number of oscillatory strokes depending upon the nature of the fabric to be cleaned and the degree of soil therein. By so controlling the pulsator the user of the machine can select a particular type of clothes washing action necessary to give adequate cleaning of the fabric without unduly increasing fabric wear because of the action of the pulsator thereon. Similarly, the provision of means for infinitely varying the speed of rotation of the spin tub 38 enables a user of the machine to select a speed that will effectively damp dry a particular fabric being processed by the machine.

Referring now to FIGURE 3, the clothes washer controller of the present invention is more detailedly set forth with the variable speed drive motor 10 for oscillating the agitator 52 and spinning the tub 38 powered from a 115-volt residential power source including a line 108 electrically connected to motor 10 which is representatively illustrated as being of a permanent capacitor start type having a conductor 110 electrically connecting it to one output terminal of the computer control unit 18 which has another output terminal thereof, in turn, con-

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connected to a second line 112 from the power source. The speed norm programmer 16 more particularly comprises a plurality of cam actuated switches 114, 116, 118 operatively associated with a timer motor 120 of the timer mechanism 24 of the above-described clothes washer to be closed thereby during certain phases of the operation of the washer to thereby program the controller for a particular drive motor speed. When the clothes washer is energized the timer motor 120 will close a switch 122 in the power line 112 to energize the speed control system of the washer and following a predetermined period of time required to fill the washer with laundering fluid, the timer motor 120 will operate the switch 114 to program the control system for a desired number of pulsator strokes desired by a particular user. In this case, once the switch 114 is closed, a circuit is completed from one terminal of the winding 92 through a conductor 124 through the closed switch 114, a conductor 126, and thence to a movable contact carrying arm 128 of conductive material of a pulsator stroke control potentiometer 130 that is moved relative to a variable resistance portion 132 of the potentiometer 130 by rotating the pulsator stroke control knob 106 to include a greater or lesser portion of the resistance 132 in series with a conductor 134 electrically connecting the speed norm programmer circuit to a terminal of the input bridge 100. By virtue of the speed norm programmer circuit through pulsator stroke control potentiometer 130 a user of the above-described clothes washer can modify the voltage induced by the magnetic speed pickup arrangement to thereby control the voltage input to the drive motor 10 and hence the number of strokes of the pulsator during the agitate cycle of the washing operation.

The switch 116 is closed by the timer motor 120 during the spin cycle of the clothes washer to complete a circuit from conductor 124 through a conductor 136 having a resistance 138 therein and thence through a contact carrying arm 140 of a spin speed control potentiometer 142 that is rotatable by means of the control knob 104 relative to a resistance portion 144 of the potentiometer 142 in series with a conductor 146 electrically connected to the conductor 134 and thence to the other terminal of the bridge 100. The speed norm circuit completed when the switch 116 is closed programs the computer 18 to maintain the rotative speed of the spin tub 38 at a predetermined reference norm or speed which is made infinitely variable within the upper speed limit of the motor 10 by rotating the control knob 104 to include a greater or lesser portion of the resistance 144 in series with the magnetic coil 92 that carries the voltage induced by the magnetic speed pickup means. Depending upon the rotative position of the control knob 104, the signal produced by the speed pickup arrangement that is fed into the computer 18 can be varied to maintain the voltage input to the drive motor 10 so as to establish any desired rotative speed in the spin tub 38 during the spin cycle of operation of the clothes washer as produced by the preselectable cyclical timer control knob 88.

Similarly, during the drain cycle of operation of the above-described clothes washer, the timer motor 120 will close the switch 118 to include a resistance 148 in the input circuit to the controller to thereby program the clothes washer for a desired range of drive motor speeds required to operate the pump 54. Following the cleaning cycle a normally closed timer switch 149 is opened to de-energize the motor 120.

A calibrating potentiometer 150 is connected across the conductors 134 and 124 for adjusting the input signal to the controller 18 when calibrating the system.

The signal input from the magnetic speed pickup device 15, as modified by the speed norm programmer, is rectified by the bridge 100 and passes therefrom through the capacitive filter units 102, 103 which feeds the input signal into the computer control unit 18 which is slightly modified over the computer control unit of the above copending

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application of Elliott et al. to meet the requirements of the above-illustrated type of clothes washer. For purposes of this specification, the computer may be briefly described as including a unijunction transistor 152 connected emitter 152e to base 152b across a capacitor 153. The signal from the capacitive filters 102, 103 in response to variations in the input signal from the magnetic speed pickup as modified by the speed norm programmer controls firing of transistor 152 in combination with a control potential produced by a bridge circuit 154 of diodes 156 that rectify the A.C. power source across lines 110, 112 to D.C. power with the voltage across the output of bridge 154 being regulated by Zener diodes 158, 159 in conjunction with resistances 160, 162. Depending upon the imbalance between the control potential produced by the bridge 154 and the variable input signal from the bridge 100 and capacitive filters 102, 103 the unijunction transistor 152 fires to produce a motor control signal in the primary coil 162 of a pulse transformer 164. Firing of the transistor 152 allows capacitor 153 to discharge through a low impedance discharge path from the transistor emitter 152e, base 152b and primary coil 162 to produce a voltage spike therein. The resultant control signal or voltage spike passing through the primary side of the pulse transformer 164 serves as the intelligence for operating a power supply switch to the motor 10 comprised of a pair of oppositely facing silicon controlled rectifiers 164, 166 which are actuated by a pulse signal in the secondary side of the transformer 164 to be energized for a predetermined period of the full-wave form of the power supply to produce a variable energization of the motor 10 and hence control the output speed thereof.

By virtue of the above-described control system, a user of the illustrated clothes washer can preselect the particular type of washing and spinning action that is desired for a particular type of fabric. For example, during the washing of a very delicate fabric, the user of the machine can manually rotate the pulsator stroke control knob 106 to a low-speed setting and also move the spin speed control knob 104 to a desired low-speed spin setting and then initiate machine operation by means of the machine cycle control knob 88. When the pulsator 52 commences to oscillate relative to the spin tub 38 during the washing cycle of the machine operation, the on-off switch 122 is closed along with pulsator switch 114 and the current flow through the input lines 124, 134 to computer 18 is of a relatively large magnitude because of the fact that the contact carrying arm 128 of the pulsator stroke potentiometer 130 is located relative to its variable resistance 132 so as to include only a small portion thereof in the circuit. This causes a substantial imbalance between the signal input to the computer 18 and the control potential from the bridge 154 and, accordingly, the SCR's 164, 166 are controlled by the unijunction transistor 152 to fire only during a relatively small portion of the full-wave form of the power source across lines 108, 112. Accordingly, the motor 10 is de-energized a substantial percentage of time and the speed thereof is reduced to provide the desired washing action by the agitator as preselected by the user. The spin speed of the drum 38 can be similarly controlled by rotating the spin speed control knob 104 to vary the amount of resistance in the speed norm programmer circuit.

While the improved control arrangement is illustrated in conjunction with a washer machine having a spin tub and an oscillating pulsator, it will be appreciated that the system is capable of varying the mode of operation of any washing device having actuatable clothes cleaning elements that might beneficially be operated through an infinite range of operations to improve soil removal and fabric wear.

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 combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means for actuating said agitating means and said spin tub means including prime mover means, semiconductor switch means in power supply relationship with said prime mover means, means for deriving a control voltage responsive to the speed of said prime mover means, means processing said control voltage for controlling conductivity of said semiconductor switch means to maintain said prime mover at a predetermined speed norm, and speed norm programmer means for infinitely varying said control voltage within predetermined limits to operate said prime mover means at variable speeds for producing a desired agitating means cleaning action and spin tub extraction during the operative cycles thereof.

2. In combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means for actuating said agitating means and said spin tub means including prime mover means, semiconductor switch means in power supply relationship with said prime mover means, means for deriving a control voltage responsive to the speed of said prime mover means, means processing said control voltage for controlling conductivity of said semiconductor switch means to maintain said prime mover at a predetermined speed norm, first control means for programming first selectable modulation of said control voltage for maintaining said prime mover means at a desired speed norm corresponding to a desired agitator means cleaning action, and second control means for programming a second selectable modulation of said control voltage for maintaining said prime mover means at a desired speed norm corresponding to a desired spin tub extraction speed for producing a desired condition in the processed material.

3. In combination, means for agitating material in the presence of a cleaner, spin tub means for conditioning the material following a predetermined agitate cycle, means for actuating said agitating means and said spin tub means including prime mover means, first and second manually actuatable control knobs, semiconductor switch means in power supply relationship with said prime mover means, means for deriving a control voltage responsive to the speed of said prime mover means, means for processing said control voltage for controlling the conductivity of said semiconductor switch means to maintain said prime mover means at a predetermined speed norm, and means operatively associated with said first and second manually actuatable control knobs for preprogramming the speed of rotation of said spin tub and the rate of pulsation of said agitator means by modulating the control voltage to produce a desired operative speed of said prime mover means during the agitate and spin cycles of operation.

4. In combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means including prime mover means for actuating said agitating means and said spin tub means, semiconductor switch means in power supply relationship with said prime mover means, means for deriving a control voltage responsive to the speed of said prime mover means, means for processing said control voltage for controlling the conductivity of said semiconductor switch means to maintain said prime mover means at a predetermined speed norm irrespective of variations in the load driven thereby and fluctuations in the power supply thereto, first and second manually actuatable control knobs, first control means connected in circuit with said control voltage processing means for modulating said control voltage in a predetermined manner to produce a desired agitator means cleaning action, said first control means being actuated by manually positioning said first actuatable control knob, second control means including

means in circuit with said control voltage processing means for modulating said control voltage in a predetermined manner for producing a desired spin tub extraction action, said second control means being controlled by positioning said second control knob to a predetermined setting, and means for independently placing said first and second control means in circuit with said control voltage processing means so that modulating action thereof will correspond to the agitate and spin cycles of operation.

5. In combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means including prime mover means for actuating said agitating means and said spin tub means, semiconductor switch means in power supply relationship with said prime mover means, means for deriving a control voltage responsive to the speed of said prime mover means, means for processing said control voltage for controlling the conductivity of said semiconductor switch means to maintain said prime mover means at a predetermined speed norm irrespective of variations in the load driven thereby and fluctuations in the power supply thereto, first and second manually actuatable control knobs, first control means connected in circuit with said control voltage processing means for modulating said variable control voltage in a predetermined manner to produce a desired agitator means cleaning action, said first control means including means for infinitely varying said control voltage within first predetermined limits by manually positioning said first actuatable control knob, second control means including means in circuit with said control voltage processing means for modulating said control voltage in a predetermined manner for producing a desired spin tub extraction action, said second control means including means for infinitely varying said control voltage within second predetermined limits by positioning said second control knob, and means for independently placing said first and second control means in circuit with said control voltage processing means so that modulating action thereof will correspond to the agitate and spin cycles of operation.

6. In combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means including a variable speed induction motor for actuating said agitating means and said spin tub means, semiconductor switch means in power supply relationship with said induction motor, means for deriving a control voltage responsive to the speed of said induction motor, means for processing said control voltage for controlling the conductivity of said semiconductor switch means to maintain said induction motor at a predetermined speed norm irrespective of variations in the load driven thereby and fluctuations in the power supply thereto, and speed norm programmer means for infinitely varying said control voltage within predetermined limits to operate said induction motor at desired speeds for producing a desired agitating means cleaning action and spin tub extraction during the operative cycles thereof.

7. In combination, means for agitating material in the presence of a cleaner, spin tub means for extracting the cleaner from the material, means including an induction motor for actuating said agitating means and said spin tub means, semiconductor switch means in power supply relationship with said induction motor, means for deriving a control voltage responsive to the speed of said induction motor, means for processing said control voltage for controlling the conductivity of said semiconductor switch means to maintain said induction motor at a predetermined speed norm irrespective of variations in the load driven thereby and fluctuations in the power supply thereto, said control voltage deriving means including a magnetic type speed pickup including means for varying the reluctance in a permanent magnet and a coil having a variable voltage induced therein by the varying reluctance in said permanent magnet, said means for processing

said control voltage including means for receiving said variable coil voltage and processing said variable coil voltage to produce an output signal for controlling the conductivity of said semiconductor switch means, first and second manually actuatable means, first control means 5 connected in circuit with said coil including means for modulating said variable control voltage in a first predetermined manner to produce a desired agitator means cleaning action, said first control means being actuated by positioning said first manually actuatable means, second 10 control means including means in circuit with said coil for modulating said variable induced voltage therein in a second predetermined manner to vary the conductivity

of said semiconductor switch means for producing a desired spin tub extraction action, said second control means being controlled by positioning said second manually actuatable means, and means for independently placing said first and second control means in circuit with said magnetic speed pickup means so that modulating actions thereof will correspond to the agitate and spin cycles of operation.

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