Dec. 26, 1961 M. F. METZGER 3,014,590

UNBALANCE AND MOTOR OVERLOAD CORRECTING SYSTEM FOR USE IN LAUNDRY MACHINES

Filed Feb. 25, 1960 5 Sheets-Sheet 1

FIG. 1

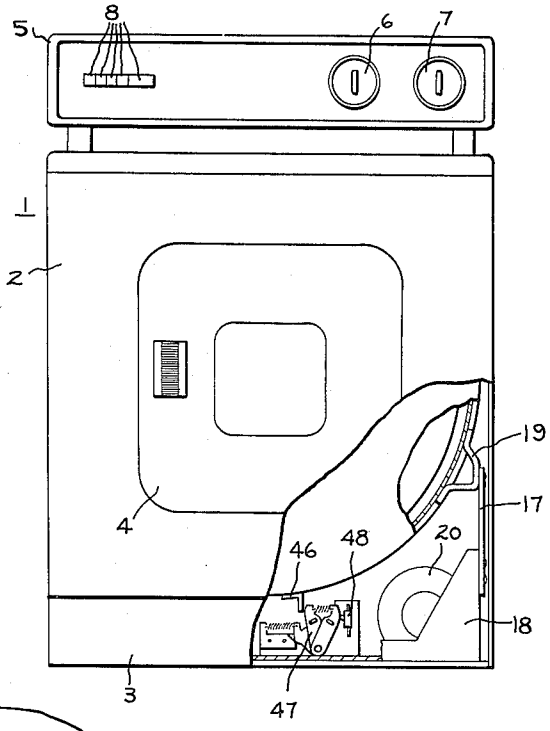
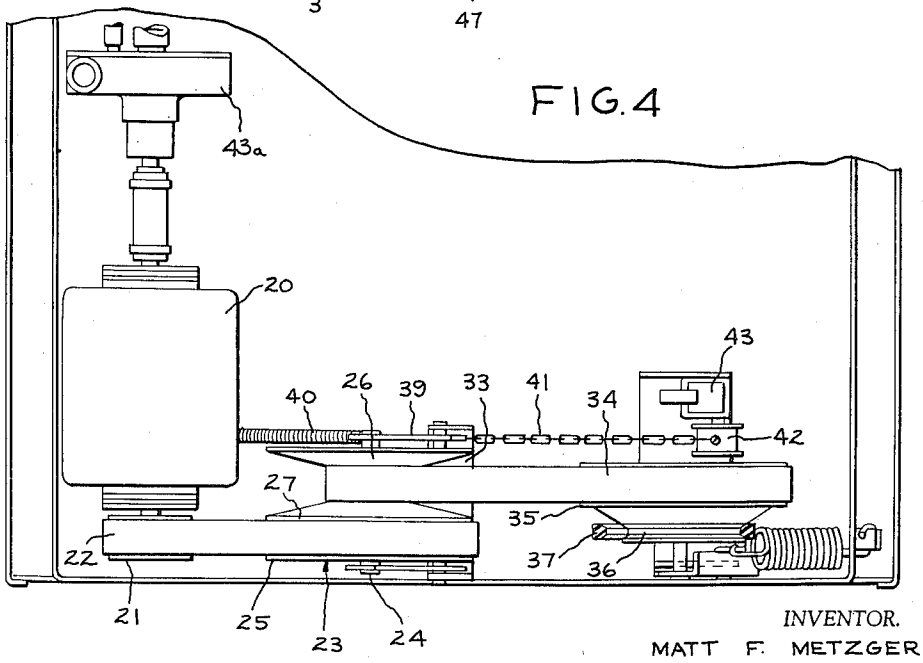


FIG. 4



INVENTOR.
MATT F. METZGER
BY Derek P Lawrence
HIS ATTORNEY

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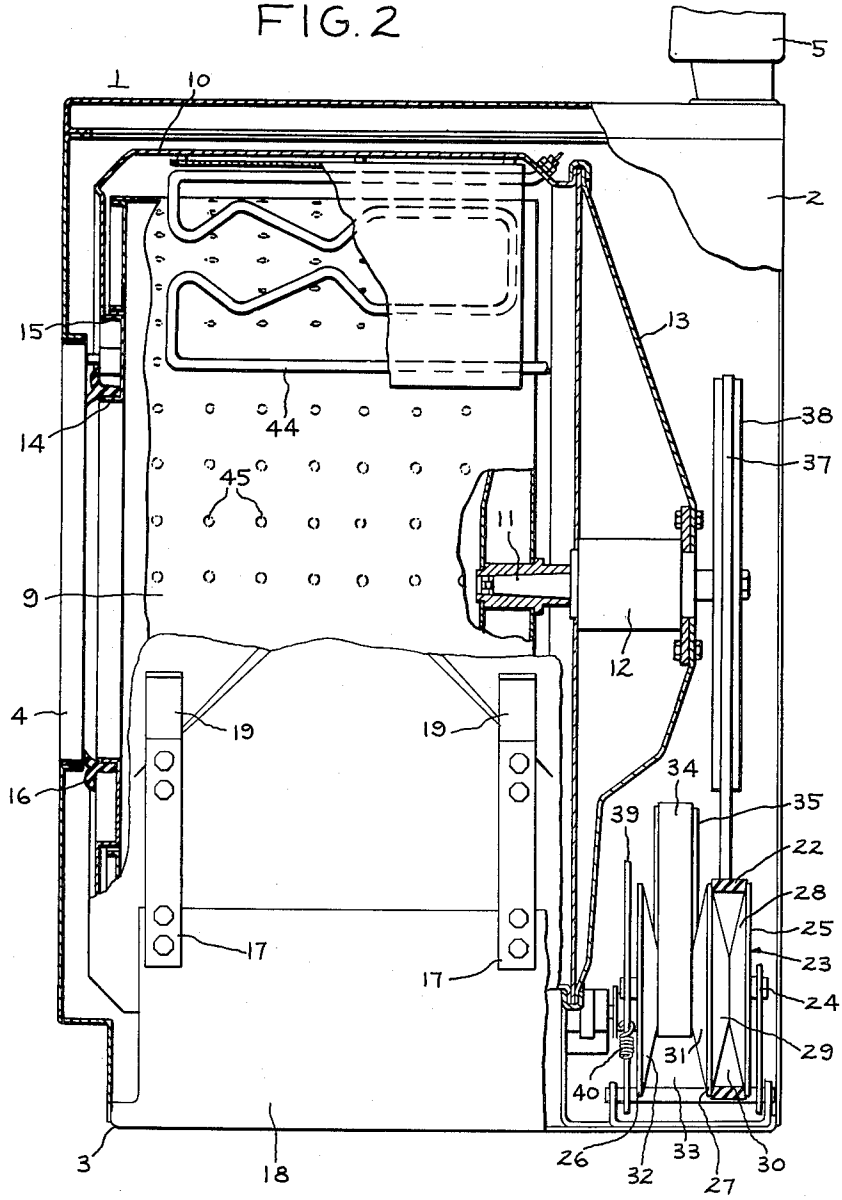
FIG. 2



INVENTOR.
MATT F. METZGER
BY Derek P Lawrence
HIS ATTORNEY

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UNBALANCE AND MOTOR OVERLOAD CORRECTING SYSTEM FOR USE IN LAUNDRY MACHINES

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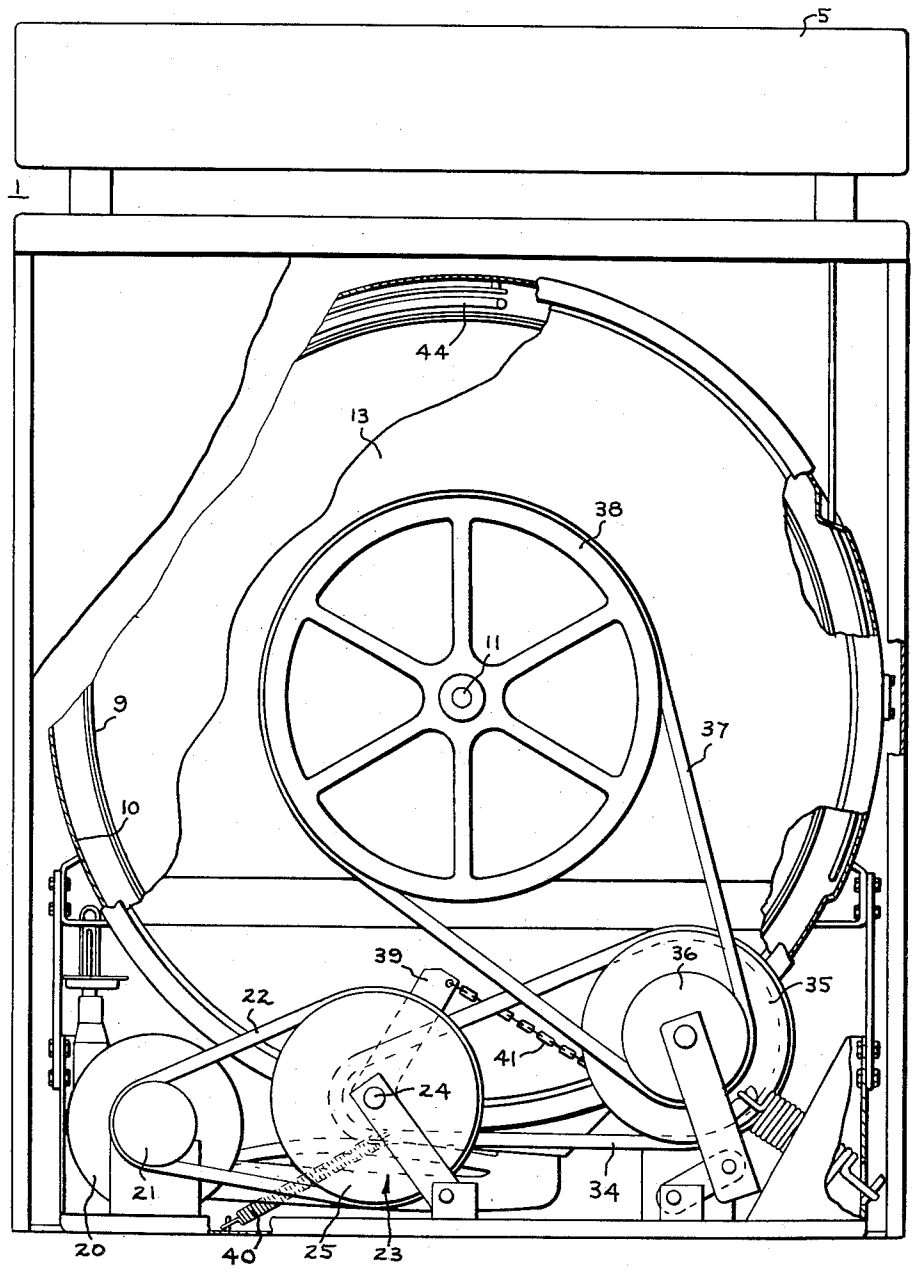

FIG. 3

INVENTOR.
MATT F. METZGER

BY Derek P. Lawrence

HIS ATTORNEY

Dec. 26, 1961 M. F. METZGER 3,014,590

UNBALANCE AND MOTOR OVERLOAD CORRECTING SYSTEM FOR USE IN LAUNDRY MACHINES

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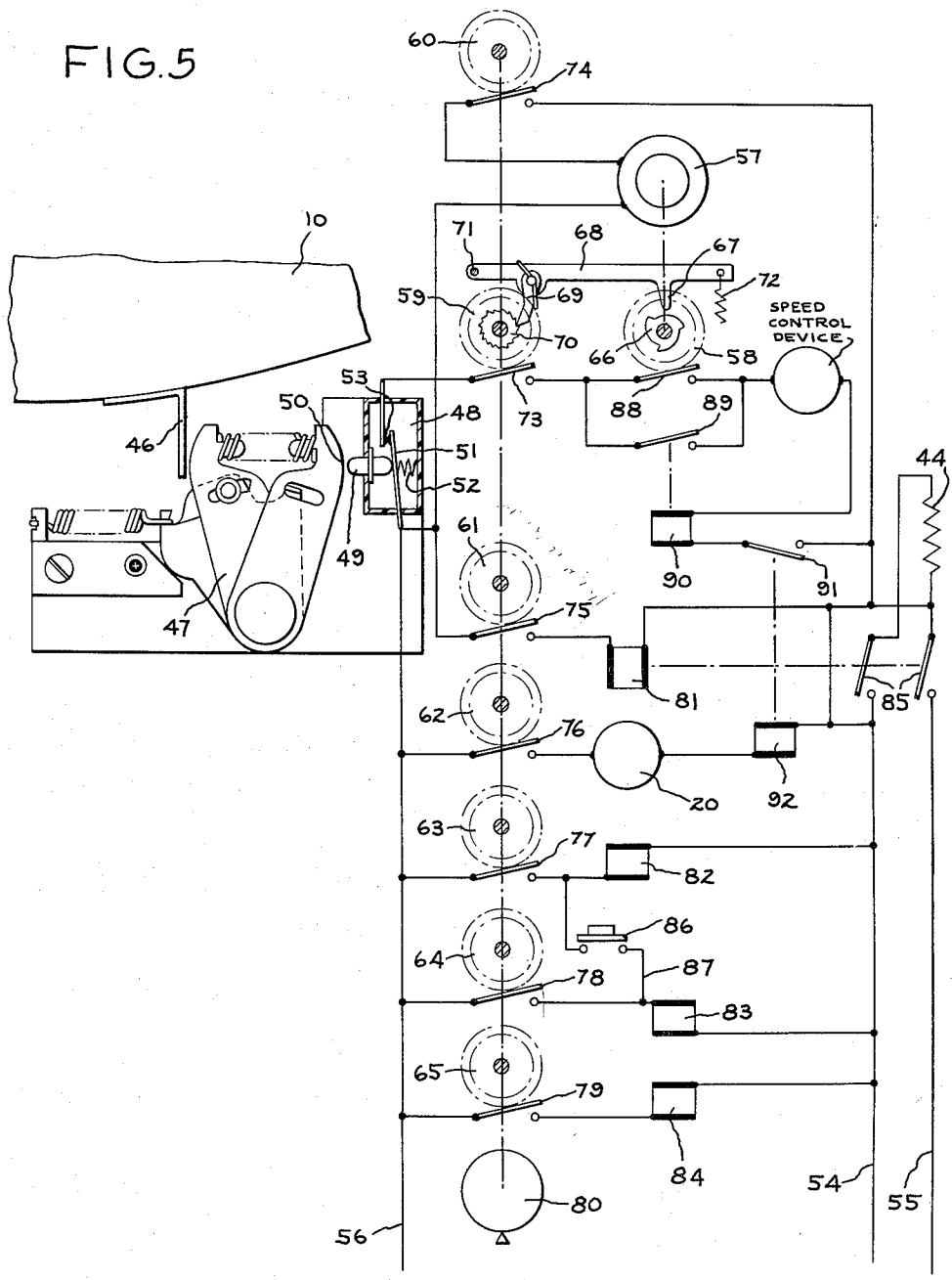
FIG.5



INVENTOR.
MATT F. METZGER
BY Dent & Lawrence
HIS ATTORNEY

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FIG. 6

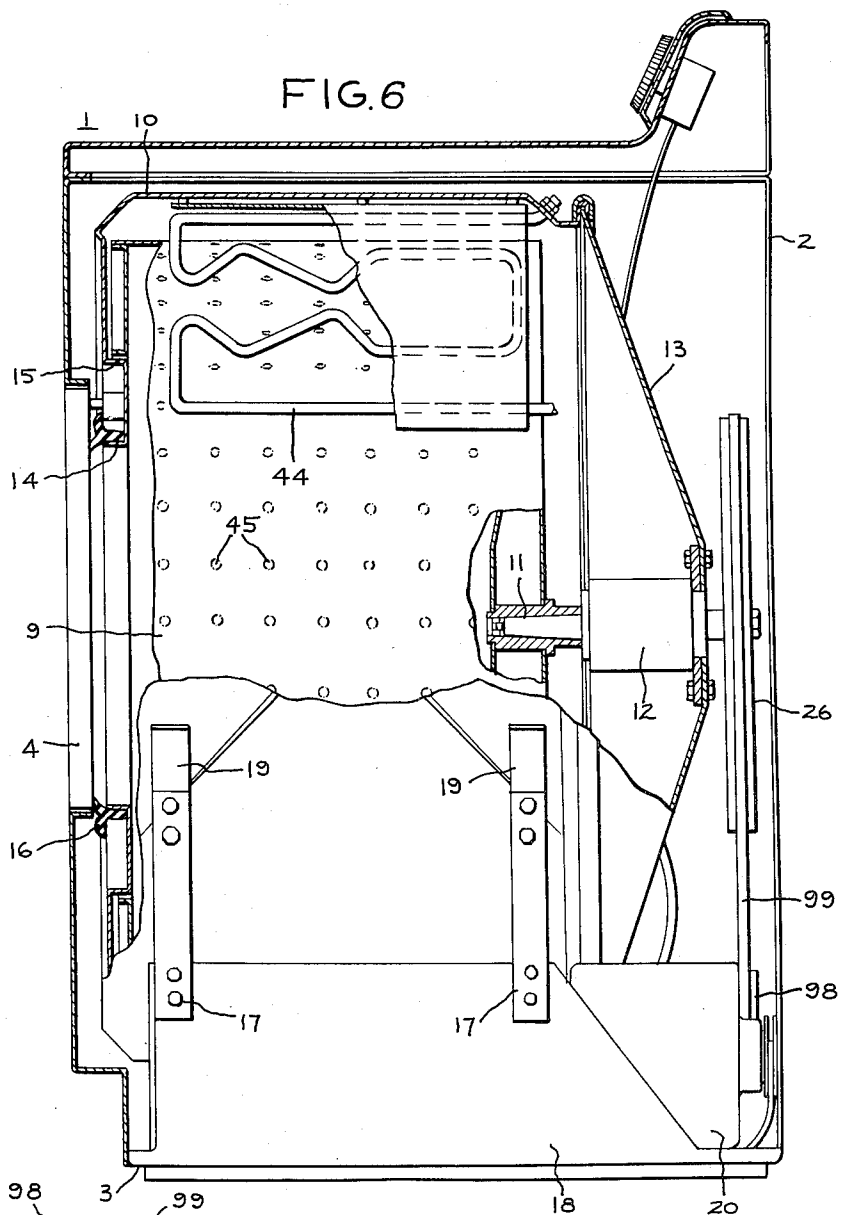

FIG. 7

INVENTOR.
MATT F. METZGER
BY Dick P Laurence
HIS ATTORNEY

United States Patent Office

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3,014,590

UNBALANCE AND MOTOR OVERLOAD CORRECTING SYSTEM FOR USE IN LAUNDRY MACHINES

Matt F. Metzger, Jeffersonville, Ind., assignor to General Electric Company, a corporation of New York

Filed Feb. 25, 1960, Ser. No. 10,962
7 Claims. (Cl. 210—138)

This invention relates to automatic laundry machines of the type having a rotatable clothes basket which is rotated at a relatively low speed to tumble the clothes in order to wash them, and at a higher speed for centrifugal extraction of liquid from the clothes; more particularly, it relates to the provision in such machines of improved means providing a return to tumble speed when either an excessive unbalance or an excessive motor overload is present during the high speed extraction operation, with the low speed redistribution being then followed automatically after an appropriate period by a return to high speed.

Many domestic washing machines provide a centrifugal extraction of liquid from wet clothes by means of a high speed rotation. It is most desirable in these machines to provide some type of safety device for correcting the situation when the clothes are so distributed in the clothes receptacle during high speed rotation that excessive unbalance is present and vibrations harmful to the machine could result therefrom. A frequently used arrangement is to provide a member positioned to be sensitive to vibrations so that it moves substantially in proportion thereto. When the vibrations attain a certain limit, the movement of the sensing member is transmitted by a suitable device to actuate a switch. This in turn provides a return to low tumble speed for redistribution of the clothes. In the past, suitable timing means have been needed for timing the redistributing low speed tumble so that upon the expiration of a predetermined period of time the unbalance sensing switch will be returned to its initial position to restart the high speed operation. Because it has generally been found necessary to utilize a separate timing device to effect this function, the structure for effecting this timing operation has in the past generally been in a relatively expensive form such as a small synchronous motor which, while it provides suitable operation, represents a substantial added cost in the structure.

It is accordingly an object of this invention to achieve an improved system for providing a timed redistribution and then a return to high speed in which the main timer itself is utilized and in which there is not needed an additional timer such as that mentioned above.

A more specific object of the invention is to provide a system of the type described hereinabove in which the timing of the redistribution tumble is effected by providing a sub-interval switch on the main timer which closes for a brief period at regular intervals such as for instance for one or two seconds every half minute. Such sub-interval switches are well known in the art, and add relatively little cost to the timer in which they are included.

Another factor to be reckoned with in automatic laundry machines of the type in question is that the electric motor normally used to rotate the clothes container may well be damaged by overloading if there is still water present in the container when the main timer causes the high speed spin operation to start.

It is therefore a further object of my invention to prevent such overloads from occurring by providing means sensitive to such overloads to return the speed of the container to tumble speed, with the aforementioned sub-interval switch then being utilized to provide another attempt at high speed spin.

In accordance with the invention, I provide a laundry machine which has a rotatable clothes receptacle. Suitable means for rotating the receptacle includes an electric speed control device having an energized condition and an un-energized condition. When the speed control device is energized it causes the receptacle to be rotated at a relatively high liquid extraction speed, and when the device is un-energized it causes the receptacle to be rotated at a relatively low clothes tumbling speed. The energizing circuit for the device includes first, second and third switch means which are in series with each other and with the speed control device, and further includes a fourth switch means which is in series with the second and third switch means and the device but is in parallel with the first switch means. A timer motor is provided which causes rotation of first and second control means and these in turn respectively control the first and second switch means. The second control means is rotated by the timer through only an increment of a revolution each time the first control means is caused to pass through a full revolution. During each revolution of the first control means it causes the first switch means to close for a small portion of that revolution, opening the first switch means for the remainder of the revolution. The second control means, by closing the second switch means for a predetermined portion of a revolution, determines the length of the high speed extraction operation. The fourth switch means is made responsive to energization of the speed control device, being closed when the device is being energized and open when it is un-energized.

The third switch means is biased to closed position and constitutes the unbalance switch for the machine. Means associated with the receptacle is positioned to open the third switch means upon a predetermined magnitude of receptacle unbalance vibration of the type which results from high speed rotation with a substantially unbalanced load.

With these elements thus related to each other, a momentary opening of the third switch means because of excessive vibration de-energizes the speed control device and thus returns the container speed to a clothes redistributing tumble. However, when the first switch means reaches that part of its revolution where it is closed it causes a brief energization of the speed control device; because the fourth switch means is responsive to this energization it in turn keeps the speed control device energized independently of the first switch means. In this manner the main timer causes the container to be rotated once more at high speed after an appropriate period of redistribution of the clothes.

Another aspect of the invention relates to the possible overloading of the motor which can result when the speed control device is energized when the container still has free-standing water remaining in it. While the motor is designed to be able to rotate the container at high speed with a full load of clothes, it would be prohibitively expensive if it were designed to rotate the container at high speed with free-standing water in it. To effect this motor protection, a fifth switch is placed in series with the speed control device and all of the other switches, and it is made responsive to the amount of current drawn by the main motor, opening when the main motor current becomes excessively high as occurs in cases of overloading. When the fifth switch means opens, the speed control device is de-energized and the speed of the container returns to tumble thereby removing the overload from the motor and returning the current therethrough to a normal value so that the fifth switch means closes. Then, when the first control means reaches that portion of its revolution where it closes the first switch means, the speed control device

is started up once more in the same manner as described above. In this way, a suitable additional period of time for removal of the free-standing water from the container is allowed before the high speed rotation is started again so that the cause for the motor overload is thus removed.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention, however, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings, FIGURE 1 is a front elevational view of a domestic laundry machine showing vibration-sensing means for transmitting movement to a switch, certain surfaces of the view being broken away in order to better illustrate details;

FIGURE 2 is an enlarged side elevational view of the machine of FIGURE 1 with the side panel removed, the view being partially in section and having certain surfaces broken away in order to illustrate details;

FIGURE 3 is an enlarged rear elevational view of the machine of FIGURE 1, the view being partially in section and having certain surfaces broken away in order to illustrate further details;

FIGURE 4 is a fragmentary plan view of a drive means which may be included in the machine;

FIGURE 5 is a front elevational view of my improved unbalance sensing and redistribution timing arrangement, the view showing schematically a control circuit suitable for use in a machine embodying my arrangement;

FIGURE 6 is an enlarged side elevational view of a domestic laundry machine with the side panel removed, the view being partially in section and having certain surfaces broken away to illustrate certain details, the view illustrating a machine having a different drive system from the machine illustrated in FIGURES 1, 2, 3, and 4; and

FIGURE 7 is a fragmentary plan view of the drive means included in the machine of FIGURE 6.

Referring now to FIGURES 1, 2, and 3, I have shown my invention in one form as applied to a domestic laundry machine **1** comprising a combination washer and dryer. The machine **1** includes a cabinet **2** which is mounted on a supporting structure **3**. Access to the machine for loading and unloading of clothes is provided by a hinged door **4** disposed in the front wall of the cabinet. The backsplasher **5**, mounted at the top of the cabinet, serves as a mounting means for suitable operator controls for the machine. These controls may, for example, comprise the rotatable dials **6** and **7** and the pushbuttons **8**.

The machine **1** is of the type which includes a clothes basket rotatable about a non-vertical axis; specifically, referring to FIGURE 2, it includes a perforated basket **9** which is disposed for rotation about a generally horizontal axis. The basket **9** is mounted within an imperforate tub structure **10** which encloses it on all sides. The basket is rotatably supported from the tub structure by a horizontally extending shaft **11** which is mounted in an elongated bearing **12** hung from the rear wall **13** of the tub structure. The shaft **11**, as well as supporting the basket, also serves as a means for turning it during operation of the machine. The tub and basket are provided, respectively, with openings **14** and **15** in the front walls thereof, with the openings being aligned with the door opening in the front wall of the cabinet **2** so that clothes may be placed into or removed from the basket. The door **4** seals against a gasket **16** around the tub opening **14** to close off the tub completely during operation of the machine.

Tub **10** is supported from base **3** by means of a plurality of brackets or arms **17** which are mounted on an upstanding plate **18** fixedly attached to the base **3**. Four of these arms **17** are provided, two of them being secured to each side of the tub. The arms on the opposite sides of the tub are spaced apart so that the tub in effect is supported near its front and near its rear on each side thereof. Although the arms **17** can be secured directly to the wall of the tub **10**, preferably, and as shown, the arms **17** are attached thereto by means of suitable brackets **19**. With the tub **10** supported in the manner shown, it is caused to vibrate sideways in a plane parallel to the front of the machine if the basket **9** should be unbalanced during high speed rotation thereof. The arms **17** are relatively long compared to their width, and they flex so as to allow slight sideways vibration of the tub relative to the base **3**. However, the arms are effective substantially to prevent vibration of the tub both from front to rear and in the vertical direction since they are not at all flexible in those directions. As is more fully explained hereinafter, I provide means for sensing the amount of sideways vibration thereby to prevent that vibration from ever becoming great enough to damage the machine or to cause it to move on the floor.

Referring now particularly to FIGURES 3 and 4, and also to FIGURE 2, during the operation of the machine the basket **11** is driven from an electric motor **20**. The drive from the motor to the basket includes a pulley **21** which is secured to the motor shaft so as to rotate therewith and over which passes a belt **22** driving the adjustable sheave assembly **23**. The adjustable sheave assembly includes a shaft **24** to which are rigidly secured sheave plates **25** and **26**. An intermediate sheave plate **27** is keyed on the shaft **24** so as to be movable along the shaft to varying distances from sheave plates **25** and **26**. It will be observed (FIGURE 2) that sheave plate **25** has a sloping surface **28** which in cooperation with a sloping surface **29** on movable sheave plate **27** forms a groove **30** of adjustable width. Similarly, on its other side movable sheave plate **27** is provided with a sloping surface **31** which cooperates with a sloping surface **32** on rigidly secured sheave plate **26** to form a second groove **33** of adjustable width.

Since belt **22** has a predetermined width, it can be seen that movement of sheave plate **27** relative to sheave plate **25** will cause the belt **22** to seat in groove **30** at a distance from the center of shaft **24** which is determined by the distance of sheave plate **27** from sheave plate **25**. The linear speed of belt **22** is constant, assuming the speed of motor **20** to be substantially constant, and therefore the rotational speed of the adjustable sheave assembly **23** is determined by the sheave diameter provided by the cooperation of sheave plates **25** and **27**. When the sheave plates **25** and **27** are in the position shown in the figures, sheave assembly **23** is rotating at a relatively low speed. When sheave plate **27** is moved to the left, as viewed in FIGURE 2, away from sheave plate **25**, then belt **22** will move inwardly toward shaft **24** as groove **30** widens and will cause a greater rotational speed of the sheave assembly **23** for a given rotational speed of pulley **21** by motor **20**.

A second belt **34** is driven in groove **33** by the cooperation of sheave plates **27** and **26**. When adjustable sheave plate **27** is in the position shown so that groove **33** is quite wide, belt **34** has to move in radially toward the shaft **24** a substantial amount before it seats on the surfaces **31** and **32** of sheave plates **27** and **26** respectively. This means that for a given rotational speed of the adjustable sheave assembly **23** (as imparted to it by belt **22**), belt **34** will be travelling at a relatively low rate of linear speed. If sheave plate **27** is moved to the left so that belt **34** is forced outwardly in groove **33**, then for a given rotational speed of the sheave assembly a relatively high linear speed of belt **34** is provided. Thus, by controlling the position of sheave plate **27**, an infinite variety of speeds between the two limits of the position of the sheave plate may be provided, with the arrangement shown in FIGURES 2, 3 and 4 providing the lowest output speed to belt **34** since belt **22** is causing a low speed rotation of sheave assembly **23** and rotation of the sheave assembly **23** is causing the lowest linear speed of belt **34**. The highest rate of speed will be provided if sheave plate **27** is moved as far as possible to the left.

this will provide the highest rotational speed of the assembly 23 for a given linear speed of belt 22, and the highest output linear speed of belt 34 for a given rotational speed of assembly 23.

Belt 34 passes over sheave 35 which forms a unitary assembly with sheave 36 driving a belt 37. Referring to FIGURE 2, it will be seen that belt 37 drives a sheave 38 which is rigidly secured to the end of the shaft 11 so as to rotate the basket 9.

Referring now particularly to FIGURES 3 and 4, an arm 39 is secured to one end of the shaft 24 and a spring 40 has one end secured to the arm and the other end secured to the base of the machine so as to bias the assembly to the left as viewed in FIGURE 3. Also secured to the arm 39 is a chain member 41 which at its other end is secured to a pulley 42 operated through a small electric motor and gear assembly 43. It will be seen that when pulley 42 is caused to rotate by assembly 43 it will wind up chain 41 and pull the arm 39 to move the entire adjustable sheave assembly to the right as viewed in FIGURE 3. Since belt 22 cannot stretch, it will be apparent that when this occurs belt 22 will move inwardly within groove 30 forcing sheave 27 to the left (as viewed in FIGURE 2) to effect an increase in the speed transmitted to the sheave 38 and basket 9. When the motor and gear assembly 43 is shut off, the spring 40 overcomes the motor and gear assembly and pulls the adjustable sheave 23 back to the position shown in the figures to reduce the speed. The motor and gear assembly 43 is of the type which can, without adverse effect, remain energized although stalled; this has the result that high speed operation is maintained only as long as energization of the motor 43 continues.

The proportioning of the various parts of the drive assembly above described is such as to provide an appropriate range of speeds. For instance, when the parts are in the position shown and when the diameter of the basket 9 is on the order of 26 inches, a tumbling speed of approximately 47 r.p.m. may be provided to the basket, while in the other extreme position a suitable liquid extraction centrifuging speed, such as, for instance, 250 r.p.m. may be provided. This transmission arrangement is not a part of my invention, and is in conventional use on machines commercially produced and marketed by the assignee of my invention.

Machine 1 is provided with suitable water supply means (not shown) and water drain means 43*a* (FIGURE 4) which, since they form no part of the present invention, are not further illustrated herein except for the schematic illustration thereof which will be described in connection with FIGURE 5. In addition, suitable means are provided for effecting heating during the drying portion of the cycle which may, in a combination washer-dryer, follow a centrifugal extraction operation. In the present machine, this includes a heater assembly 44 mounted within the upper portion of tub 10 so that when energized the heater 44 heats the basket 9. When the heater is energized, the heat transferred to the clothes basket is then passed on to the clothes to cause vapor migration out of the clothes. Since the outer cylindrical wall of the basket is perforated by a substantial number of small spaced openings 45, there is also some heat from the element which passes directly to the clothes by radiation. A complete operation of the machine normally provides a washing period, a draining of the washing liquid, and one or more rinses, all conducted at 47 r.p.m., a centrifugal liquid extraction at 250 r.p.m., and, if desired, a drying period at 47 r.p.m. While variations of the sequence may be provided, it will be understood that the described sequence is typical and is provided by standard control apparatus in the usual manner.

Referring now particularly to FIGURE 5 for a description of my invention, it will be recalled that tub 10 as it is mounted vibrates in response to an unbalanced load in the basket when the basket is rotating at high speed. This unbalance is transmitted from a projecting member 46 secured to the tub through a motion transmittal mechanism, generally indicated at 47 (fully described in Patent 2,823,208 issued to A. M. Stone on April 29, 1958 and assigned to the assignee of the present invention), to an unbalance switch mechanism 48 having a projecting member or button 49 which is depressed by portion 50 of mechanism 47 in response to motion transmitted to mechanism 47 from tub 10 during excessive vibration.

The unbalance switch mechanism 48 includes a switch arm 51 which is biased by a spring 52 into engagement with a contact 53. When button 49 is depressed by mechanism 47 it causes the switch arm 51 to be moved away from contact 53 against the bias of spring 52.

Turning now to the electrical circuitry in FIGURE 5, the entire control system may be energized from a suitable source of power (not shown) through a pair of supply conductors 54 and 55 and a neutral conductor 56. A potential of 110 volts is provided between each of the conductors 54 and 55 and the neutral 56, and a potential of 220 volts is provided across the two supply conductors 54 and 55. It will be understood that this arrangement is described merely for illustrative purposes as typical of the general type of arrangement in commercial usage. It will further be understood that the various conventionally provided components of a domestic laundry machine, such as heating means, water inlet means, and draining means are shown in simplified schematic form to the extent necessary to clarify the invention and that the invention is not limited to the particular arrangement shown of these elements nor is it limited to a circuit in which only these elements appear.

A conventional sequence control mechanism includes a timer motor 57 which controls a plurality of cams 58, 59, 60, 61, 62, 63, 64 and 65 in accordance with the usual arrangement. This is achieved by having the timer motor output connected to cam 58 so as to drive it continuously thereby causing it to go through one complete revolution in a relatively short period of time, which may, for instance, be on the order of 20 to 40 seconds. Cam 58 carries with it a member 66 which is engaged by a follower 67 forming part of a member 68 carrying a ratchet 69 which engages a ratchet wheel 70 secured to cam 59. The member 68 is pivotally secured at a point 71 and is biased to a downward position by any appropriate means such as a spring 72. As cam 58 rotates in a counterclockwise direction as a result of the energization of timer motor 57, follower 67 will be moved up and down three times by the member 66 for each revolution of the cam 58. For each up and down movement it will be observed that the ratchet member 69 will push the ratchet wheel around thereby to provide a rotary impulse to cam 59. Cams 59 through 65 are rotatable together so that each time an impulse is imparted to cam 59 it is also imparted to the cams 60 through 65.

Thus, in effect, cam 58 is rotated substantially continuously by the motor 57 while the other cams 59 through 65 are rotated by impulse in the conventional manner. The relationship of the ratchet wheel 70 to member 66 is such that the cams 59 through 65 rotate only a small increment of the revolution for each full revolution of the cam 58. For instance, while the cam 58 rotates through one full revolution in a matter of a fraction of a minute as described above, cams 59 through 65 will normally require a period on the order of 30 to 90 minutes to make a full revolution. While other means may be provided for obtaining the desired relatively fast movement of cam 58 and relatively slow movement of cams 59 through 65, it is important to the invention that this relationship exist, and the above foregoing arrangement is a relatively simple construction which is schematically similar to many structures in commercial use for effecting the desired results.

Cams 59 through 65 control the positions of switch members 73 through 79 respectively. Switch 74 controls the energization of the timer motor, and it will be under-

stood that in most conventional machines this switch will remain closed by cam 60 from the start to the end of the operation of the machine. The operation is conventionally started by manually moving a dial 80, which controls the positions of the cams, to a start position; it ends when the cams have rotated through so much of a revolution as to cause the cam 60 to open switch 74 at which time the laundry operation will be terminated. During this operation of the timer motor it causes the cams 61 through 65, through their control of switches 75 through 79 respectively, to control the operation of the conventional components of a laundry machine such as, for instance, as shown, a heater control relay 81, the main drive motor 20, a hot water solenoid 82 and a cold water solenoid 83 which control the valves permitting inlet water to be provided to the machine, and a drain valve solenoid 84 controlling the removal of water from the machine. The heater relay 81 normally controls the position of a pair of switches 85 which, when closed, permit energization of heater 44 across the source of 220 volt power through conductors 54 and 55. One other conventional item shown is the provision of a manually operable switch 86 in a conductor 87 which is connected across the valve solenoids 82 and 83 so that if warm water is desired for a washing operation it may be obtained by manual closing of switch 86.

In addition, during the operation of the timer motor, it controls through cam 59 switch 73 which, when closed, permits energization of the speed control device which in FIGURE 4 is shown as gear motor 43. As described, when the speed control device is energized it causes the operation of motor 20 to effect a high speed rotation of the basket 9, and when it is opened the motor 20 is caused to provide a low speed rotation of the basket 9.

The switch 73 controlled by cam 59 is in series with the switch 51 controlled by the member 49 which is responsive to vibration of the basket 9 and tub 10. In series with both the switches 51 and 73 and with the speed control device is a switch 88 controlled by cam 58. Connected across switch 88, that is, in parallel with it, is a switch 89 which is in series with all the other components of the speed control device circuit described thus far, that is, switches 51 and 73 and the speed control device itself. Switch 89 is controlled by a current responsive member 90, such as a relay, which is connected in series with the speed control device. When relay 90 is energized it closes switch 89 and when it is not energized it opens switch 89. It will be observed that because of the series relationship of the speed control device and the relay 90 energization of the speed control device necessarily involves energization of the relay.

Also in the energizing circuit of the speed control device is a normally closed switch 91 in series with all the other components of the circuit. Switch 91 is controlled by a current responsive member 92 connected in series with the main drive motor 20 in the energizing circuit for the main drive motor. The relay 92 is so adjusted that during normal operation of motor 20, that is, when it is not overloaded, the current through the relay is not enough to cause the relay to pull switch 91 to its open position. However, when an overload occurs and there is excessive current in the drive motor circuit the relay 92 moves switch 91 to an open position.

It will be observed that, with the exception of heater 44, all the energizing circuits for the different components of the machine are connected across conductor 54 and neutral 56, that is, across the source of 110 volt power. When it is desired to start a laundering operation in the machine, the dial 80 is rotated to a starting position in which switch 74 is closed to energize the timer motor. The timer motor is then energized and causes the cams 59 through 65 to progress through a segment of a circle which may, conventionally, approach a full circle. As the cams so progress, they open and close their associated switches at appropriate times to cause a desired sequence of laundering operations to take place, it being understood that in the simple schematic circuit shown switch 74 is maintained closed by cam 60 until the end of the operation is reached. Thus, for instance, a washing operation may be provided by closing switches 76 and 77 to cause tumbling of the basket (since the speed control device is not energized) and to provide hot water into the tub 10 for a washing operation. When a suitable amount of water has been introduced the switch 77 opens and switch 76 remains closed to continue the washing operation.

After a suitable amount of washing time, switch 79 is closed to cause energization of the drain valve 84 which then effects removal of the water in a conventional manner (not shown). After removal of the water the switch 79 is opened and either of switches 77 or 78 or both may then be closed to provide hot, cold or warm water for a rinse operation, it being understood that switch 76 remains closed throughout this time. After sufficient water for the rinse operation is introduced, switches 77 and 78 are opened and the tumbling action continues with water in the basket until switch 79 is closed to cause removal of the water. This rinsing action may be followed by as many additional rinsing actions as desired.

At the end of the last rinsing action it is normally desired, before providing a heat drying operation by energization of heating element 44, to extract as much liquid from the clothes as possible by a high speed rotation of the basket 9, the liquid extracted from the clothes being removed by the drain means. While, of course, such an extraction may be provided subsequent to the washing step or to any one or more of the rinse steps, it is of substantial importance to provide it subsequent to the last rinse step.

In order to effect this operation, switches 73 and 79 are closed, switches 74 and 76 continuing to remain closed and the other switches being opened. The fact that the switch 79 is closed causes all water removed from the clothes to be drained from them as it is passed from the clothes into outer tub 10 as a result of the high speed of rotation of the basket 9. In order for this high speed rotation to take place it will be seen that switches 51, 73 and 91 must all be closed and that either one or the other of switches 88 and 89 must be closed. Switch 51 is biased to a closed position as previously described and therefore is in position to permit the high speed operation to take place. Switch 91 is normally closed as described and therefore, barring a situation which will be described hereinafter, is also in position to permit the energization of the speed control device to take place. Also, as described, at the beginning of the period in which high speed extraction is desired cam 59 closes switch 73 so that this switch also is in the desired position.

As already stated, switch 88 is closed for a brief period, on the order of one or two seconds, for each rotation of cam 58, and for purposes of illustration it will be assumed that the cam rotates at the rate of one revolution each thirty seconds (although, of course, other similar arrangements such as 1 r.p.m. for cam 58 with two closings of switch 88 per revolution are directly equivalent). Thus, assuming that switch 88 is closed two seconds each time, a complete energizing circuit for the speed control device will be provided no longer than twenty-eight seconds after the closing of switch 73. The closing of this switch 88 then completes the energizing circuit and the speed control device is energized as well as the relay 90 in series therewith. The energization of the relay 90 closes switch 89 which, by bypassing switch 88, causes the speed control device circuit to continue to be completed even after the two second closed period of switch 88 has elapsed and cam 58 has once again caused it to open. As a result, the speed control device raises the speed of the basket 9 toward its high centrifugal extraction speed.

If the clothes in the basket should have distributed themselves so as to cause excessive unbalance in the basket, the motion of the tub will, eventually, cause portion 50 of mechanism 47 to depress button 49 thereby

pushing switch 51 away from contact 50 against the action of spring 52. While this action normally occurs for only a brief period, it nonetheless opens the circuit to the speed control device and to the relay 90. The speed control device is de-energized and the relay 90 is de-energized. De-energization of the relay 90 opens switch 89 so that reclosing of switch 51, which occurs as soon as the speed starts to decrease in response to de-energization, does not preclude the return of the basket speed to a redistributing tumble. It will be understood that switch 51 is designed to stay open long enough for relay 90 to operate, and that if the simple spring arrangment shown for switch 51 does not provide sufficient time, various inexpensive expedients, such as dashpots, overcenter snap-action switching, and button over travel, may be built into the switch to increase its "open" time.

The clothes thus redistribute themselves until such time as the cam 58 causes closing of switch 88. By this time the switch 51 is closed and a suitable period of clothes redistribution has elapsed. Thus, by virtue of the closing of switch 88 the speed control device and the relay 90 are re-energized, and contact 89 is locked in to retain the speed control device energized. If, as will occur sometimes, the unbalance trip should take place just before the switch 88 is closed by cam 58 so that redistribution does not have time to take place, it will be clear that the mechanism 47 will almost immediately again depress the button 49 to open switch 51 and that therefore the worst that can happen is for more than one trip to be required before a suitably timed period of redistribution takes place.

It can be seen that by the provision of the particular circuitry of the speed control device energizing circuit a suitable period of clothes redistribution is insured upon a trip of the unbalance switch 51. This is done without the need for an additional timer and with an exceedingly simple single pole, single throw biased unbalance switch.

Referring now to the purpose of switch 91 in the circuit, it will be clear that it may occur sometimes that the water may drain out of the tub 10 and basket 9 relatively slowly and that, therefore, when the speed control device energizing circuit is completed there may still be free-standing water in the tub and basket. To obtain maximum economy and efficiency in the operation of drive motor 20, it needs to be designed so that the maximum load which it can accept for any length of time is below that which is represented by a high speed rotation of the basket 9 with water present in the tub 10. In order to prevent damage to the motor on the rare occasions when this will occur, the relay 92 and switch 91 are provided. When the motor is overloaded in an undesirable fashion, it draws more current and this current in turn passes through relay 92 and is sufficient to cause the relay 92 to open the switch 91. Opening of switch 91 de-energizes the speed control device thus permitting the speed of the container to be returned toward tumble. This removes the overload from the motor so that the switch 91 closes; however, a suitable additional period adequate for the device 84 to cause removal of the free-standing water is provided by virtue of the fact that the switch 88 will not normally be closed for a period of several seconds and thus low speed rotation during the removal of the additional water continues until the cam 58 does close switch 88, at which point the speed device control circuit is re-energized in the same manner as before.

With the above-described arrangement it will be seen that a highly economical yet completely effective means of effecting redistribution and a return to high speed is obtained as well as an effective preventative for overloading of the motor which could occur by providing the high speed spin while water is still present in the tub 10.

Referring now to FIGURES 6 and 7 there is shown a laundry machine which has a somewhat different type of drive system. This arrangement is shown to illustrate the fact that my invention is applicable not only to the particular type of drive described in connection with FIGURES 1, 2, 3, and 4 but also in connection with other electrically controlled drive systems in which high speed is obtained by energization of an electrical component and low speed is obtained by de-energization of the electrical component. Using the same numerals for parts which are the same as those in FIGURES 1, 2 and 3, the drive motor 20 includes a pulley 93 on its shaft and pulley 93 is joined through a belt 94 to a pulley 95 connected into a two-speed transmission 96. When solenoid 97, which in this case represents the speed control device, is de-energized the transmission 96 provides a relatively low output speed to pulley 98, whereas when the solenoid is energized a relatively high output speed is provided to pulley 98. Transmission 96 is of the conventional type, and the use of solenoids such as 97 for effecting speed changing is also a conventional and known solution to the problem.

Pulley 98 is connected by a belt 99 to the main driving pulley 26; when the transmission 96 provides a low speed to pulley 98 the pulley 26 is driven at a speed appropriate to effect tumbling of clothes in the basket 9, and when transmission 96 rotates pulley 98 at a high speed the rotational speed of pulley 26 is such as to effect high speed centrifugal extration of liquid from the clothes in the basket 9. It will readily be seen that the circuit of FIGURE 5 is operative in precisely the same manner for the type of machine shown in FIGURES 6 and 7, with the speed control device in this case being a solenoid rather than a gear motor.

While it has been found from practical experience that, for maximum effectiveness, a separate relay 90 in series with the speed control device is desirable, it will readily occur to mind that a portion of the speed control device itself, such as a coil of a motor, may be used as the motivating force for the contact 89 and thus this type of modification is clearly included in my inventive concept. Also, other current-responsive arrangements, such as a potential relay connected across the speed control device, or controlled rectifiers, may be used and are included in my concept. This applies, of course, also to the provision of relay 92. While it has been found from practical experience to be desirable to provide a separate relay 92, it is possible by modification of the motor 20 and of part of the coils in the motor to control switch 91 from the motor directly rather than having a separate device in series therewith. Also, a bimetal device with a heater element and (in the case of an induction motor) a centrifugal switch will give the desired response to motor current variations, and thus these modifications also are included within my inventive concept.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will thus be apparent to those skilled in the art that various changes and modifications, including but not litmited to those mentioned above, may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a laundry machine: a rotatable clothes receptacle; means for rotating said receptacle including an electrical speed control device having an energized condition and an unenergized condition, said rotating means rotating said receptacle at a low clothes tumbling speed when said speed control device is in an unenergized condition and rotating said receptacle at a high liquid extraction speed when said speed control device is energized; an energizing circuit for said speed control device including first, sec-

ond, and third switch means in series with each other and with said speed control device, and further including fourth switch means in parallel with said first switch means and in series with said speed control device and said second and third switch means; timer control means including a timer motor, first control means rotatable by said timer motor, and second control means rotatable by said timer motor through a small increment of a revolution each time said first control means passes through a full revolution; said first control means during each revolution thereof closing said first switch means for a small portion of such revolution and opening said first switch means for the remainder of such revolution; said second control means during a revolution thereof closing said second switch means for a predetermined portion of such revolution to determine the length of a high speed extraction operation; said fourth switch means being responsive to energization of said speed control device and being closed when said speed control device is energized and open when speed control device is unenergized; said third switch means being biased to closed position; and means associated with said receptacle positioned to open said third switch means upon a predetermined magnitude of receptacle unbalance vibration resulting from high speed rotation with a substantially unbalanced load, whereby, during closure of said second switch means, momentary opening of said third switch means de-energizes said speed control device until said first control means reaches that portion of its revolution where said first switch means is closed and the consequent energization of said speed control device closes said fourth switch means to keep said speed control device energized independently of said first switch means.

2. The apparatus defined in claim 1 wherein said speed control device is an electric gear motor.

3. The apparatus defined in claim 1 wherein said speed control device is a solenoid.

4. In a laundry machine: a rotatable clothes receptacle; means for rotating said receptacle including an electrical speed control device having an energized condition and an unenergized condition, said rotating means rotating said receptacle at a low clothes tumbling speed when said speed control device is in an unenergized condition and rotating said receptacle at a high liquid extraction speed when said speed control device is energized; an energizing circuit for said speed control device including first, second, and third switch means in series with each other and with said speed control device, and further including fourth switch means in parallel with said first switch means and in series with said speed control device and said second and third switch means; timer control means including a timer motor, first control means rotatable by said timer motor, and second control means rotatable by said timer motor through a small increment of a revolution each time said first control means passes through a full revolution; said first control means during each revolution thereof closing said first switch means for a small portion of such revolution and opening said first switch means for the remainder of such revolution; said second control means during a revolution thereof closing said second switch means for a predetermined portion of such revolution to determine the length of a high speed extraction operation; current responsive means in series with said speed control device controlling said fourth switch means, said current responsive means closing said fourth switch means when said speed control device is energized and opening said fourth switch means when said speed control device is unenergized; means biasing said third switch means to closed position; and means associated with said receptacle positioned to open said third switch means upon a predetermined magnitude of receptacle unbalance vibration resulting from high speed rotation with a substantially unbalanced load, whereby a momentary opening of said fourth switch means de-energizes said speed control device until said first control means reaches that portion of its revolution where said first switch means is closed and the consequent energization of said current responsive device closes said fourth switch means to keep said speed control device energized independently of said first switch means.

5. In a laundry machine: a rotatable clothes receptacle; means for rotating said receptacle including an electric drive motor and an electric speed control device having an energized condition and an unenergized condition, said rotating means rotating said receptacle at a low clothes tumbling speed when said speed control device is in an unenergized condition and rotating said receptacle at a high liquid extraction speed when said speed control device is energized; an energizing circuit for said drive motor; an energizing circuit for said speed control device including first, second, third and fourth switch means in series with each other and with said speed control device, and further including fifth switch means in parallel with said first switch means and in series with said speed control device and said second, third and fourth switch means; timer control means including a timer motor, first control means rotatable by said timer motor, and second control means rotatable by said timer motor through a small increment of a revolution each time said first control means passes through a full revolution; said first control means during each revolution thereof closing said first switch means for a small portion of such revolution and opening said first switch means for the remainder of such revolution; said second control means during a revolution thereof closing said second switch means for a predetermined portion of such revolution to determine the length of a high speed extraction operation; said fifth switch means being responsive to energization of said speed control device and being closed when said speed control device is energized and open when said speed control device is unenergized; said third switch means being biased to closed position; and means associated with said receptacle positioned to open said third switch means upon a predetermined magnitude of receptacle unbalance vibration resulting from high speed rotation with a substantially unbalanced load; said fourth switch means being responsive to an overload current in said drive motor circuit and being opened when said overload current is present in said drive motor circuit and closed when there is no overload current in said drive motor circuit; whereby momentary opening of either said third or fourth switch means de-energizes said speed control device until said first control means reaches that portion of its revolution where said first switch means is closed and the consequent energization of said speed control device closes said fifth switch means to keep said speed control device energized independently of said first switch means.

6. In a laundry machine: a rotatable clothes receptacle; means for rotating said receptacle including a drive motor and an electric speed control device having an energized and an unenergized condition, said rotating means rotating said receptacle at a low clothes tumbling speed when said speed control device is in an unenergized condition and rotating said receptacle at a high liquid extraction speed when said speed control device is energized; an energizing circuit for said speed control device including first, second, and third switch means in series with each other and with said speed control device, and further including fourth switch means in parallel with said first switch means and in series with said speed control device and said second and third switch means; timer control means including a timer motor, first control means rotatable by said timer motor, and second control means rotatable by said timer motor through a small increment of a revolution each time said first control means passes through a full revolution; said first control means during each revolution thereof closing said first switch means for a small portion of such revolution and opening said first switch means for the remainder

of such revolution; said second control means during a revolution thereof closing said second switch means for a predetermined portion of such revolution to determine the length of a high speed extraction operation; said fourth switch means being responsive to energization of said speed control device and being closed when said speed control device is energized and open when said speed control device is unenergized; an energizing circuit for said drive motor; said third switch means being responsive to the presence of an overload current in said drive motor circuit and being opened when there is an overload current in said drive motor circuit and closed when there is no overload current in said drive motor circuit, whereby, during closure of said second switch means, momentary opening of said third switch means de-energizes said speed control device until said first switch means reaches that portion of its revolution where said first switch means is closed and the consequent energization of said speed control device closes said fourth switch means to keep said speed control device energized independently of said first switch means.

7. In a laundry machine: a rotatable clothes receptacle; means for rotating said receptacle including a drive motor and an electric speed control device having an energized condition and an unenergized condition, said rotating means rotating said receptacle at a low clothes tumbling speed when said speed control device is in an unenergized condition and rotating said receptacle at a high liquid extraction speed when said speed control device is energized; an energizing circuit for said speed control device including first, second and third switch means in series with each other and with said speed control device, and further including fourth switch means in parallel with said first switch means and in series with said speed control device and said second and third switch means; timer control means including a timer motor, first control means rotatable by the timer motor, and second control means rotatable by said timer motor through a small increment of a revolution each time said first control means passes through a full revolution; said first control means during each revolution thereof closing said first switch means for a small portion of such revolution and opening said first switch means for the remainder of such revolution; said second control means during a revolution thereof closing said second switch means for a predetermined portion of such revolution to determine the length of a high speed extraction operation; said fourth switch means being responsive to energization of said speed control device and being closed when said speed control device is energized and open when said speed control device is unenergized; an energizing circuit for said drive motor; and a current sensitive relay in series with said drive motor in said drive motor energizing circuit, said relay opening said third switch means when there is a motor overload current passing through said drive motor circuit and closing said third switch means when the current in said drive motor circuit is below the overload level, whereby, during closure of said second switch means, momentary opening of said third switch means de-energizes said speed control device until said first switch means reaches that portion of its revolution where said first switch means is closed and the consequent energization of said speed control device closes said fourth switch means to keep said speed control device energized independently of said first switch means.

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