July 23, 1963 J. BOCHAN 3,098,372

CLOTHES WASHING MACHINE HAVING UNBALANCE SENSING MEANS

Filed May 31, 1962 5 Sheets-Sheet 1

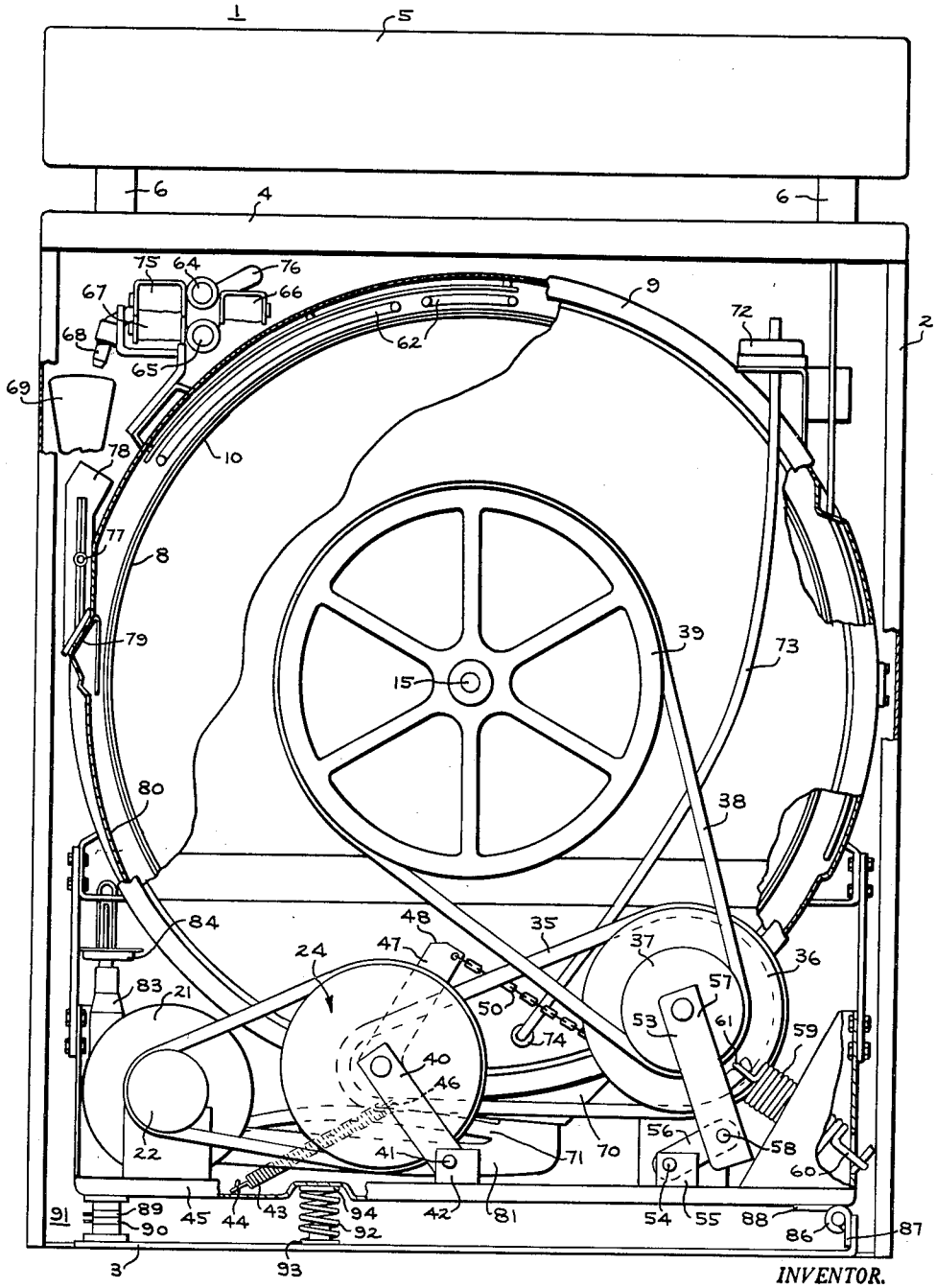


FIG. 1

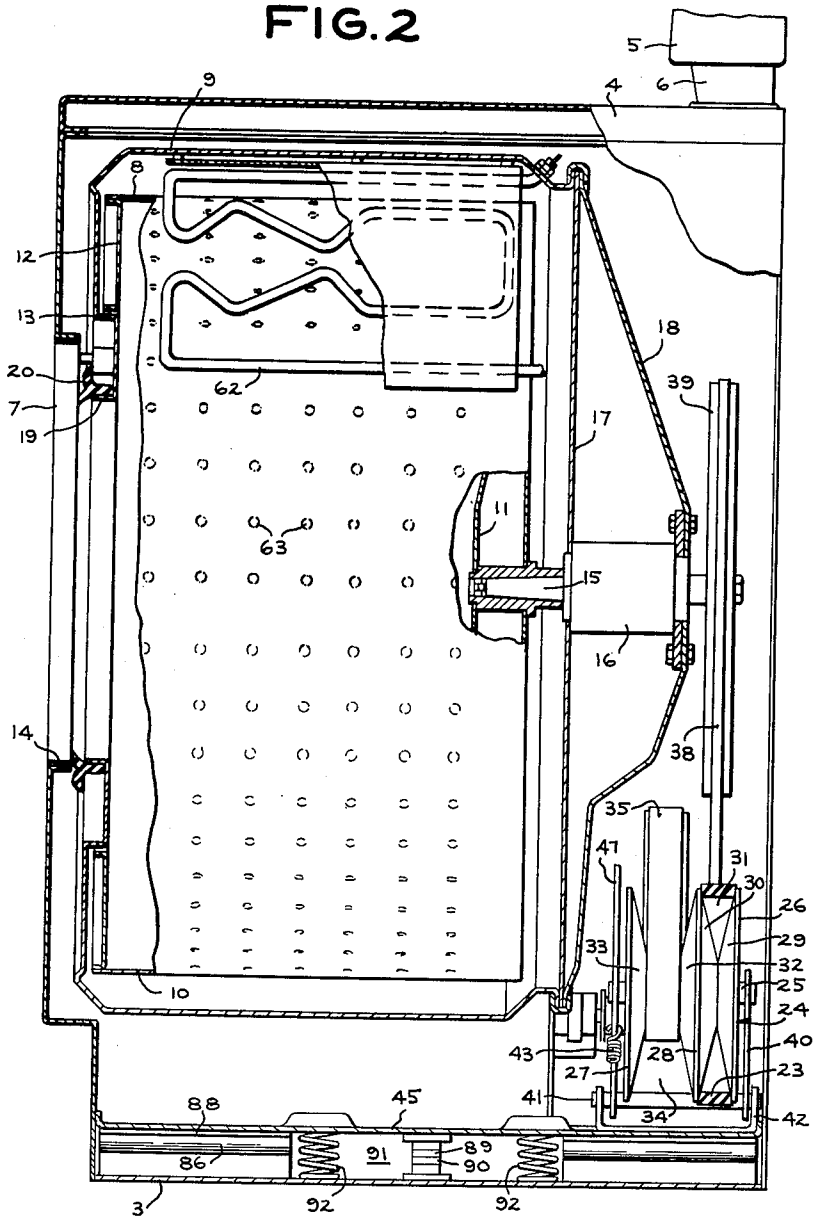
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FIG. 2



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CLOTHES WASHING MACHINE HAVING UNBALANCE SENSING MEANS

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FIG. 5

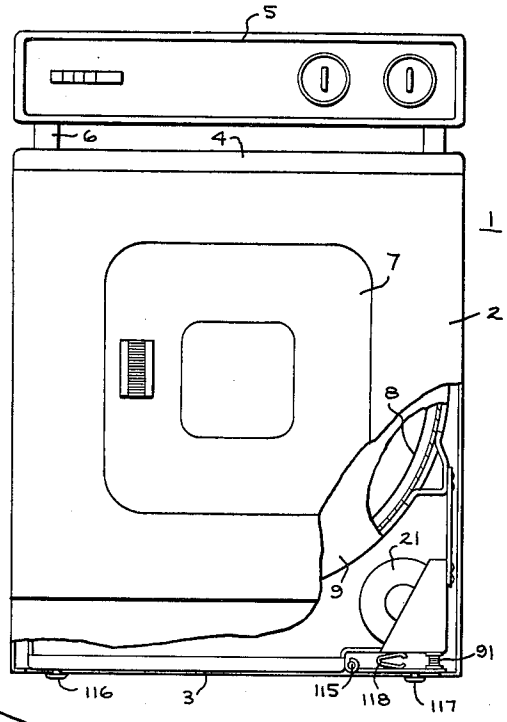
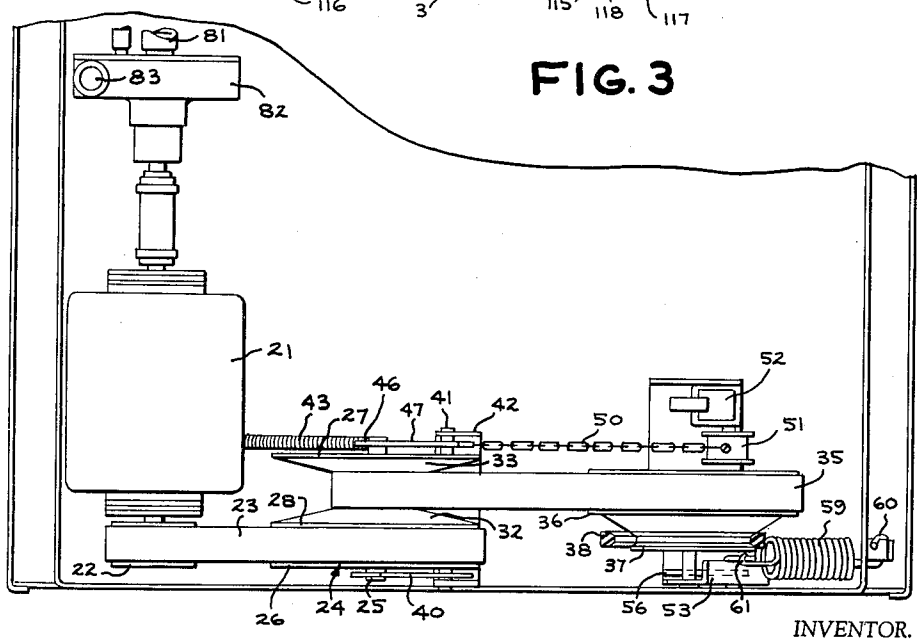


FIG. 3



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FIG. 6

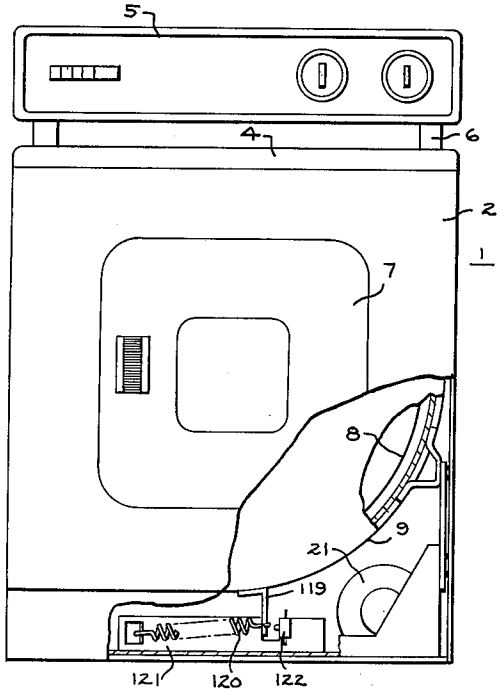
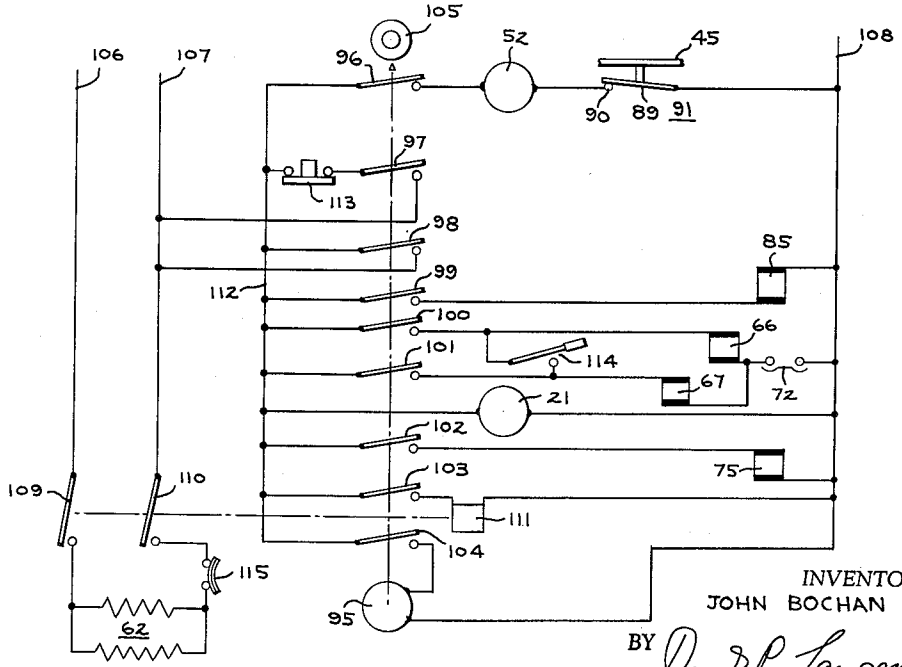


FIG. 4



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FIG. 7

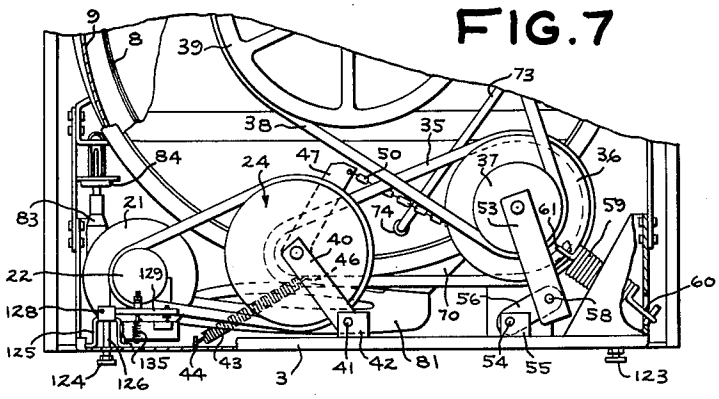


FIG. 9

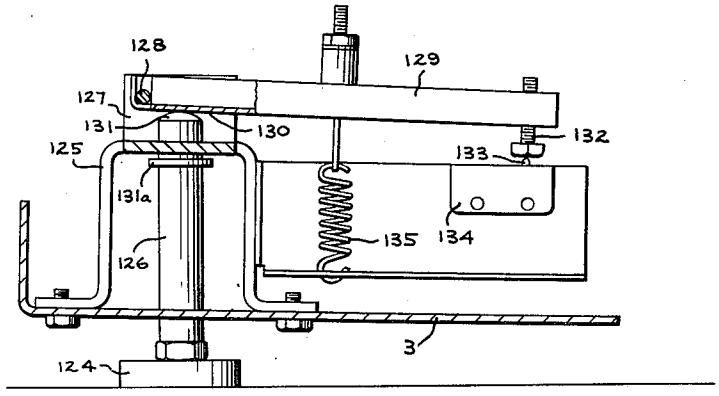
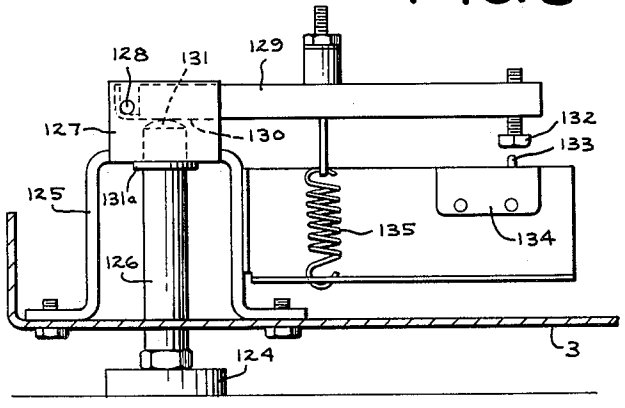


FIG. 8



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United States Patent Office

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CLOTHES WASHING MACHINE HAVING UNBALANCE SENSING MEANS

John Bochan, Louisville, Ky., assignor to General Electric Company, a corporation of New York

Filed May 31, 1962, Ser. No. 198,866
4 Claims. (Cl. 68—24)

This invention relates to machines which have rapidly moving parts wherein unbalance-caused vibrational forces may be created, and more particularly to a system for protecting the machine from such forces becoming excessive. While the invention has general application to such machines, it is particularly useful in centrifuging machines, such as washing machines which provide a liquid extraction operation by means of centrifuging after washing and rinsing clothes.

For many machines, such as domestic washing machines, it is relatively inconvenient, commercially undesirable, and sometimes structurally unsound, to require that the machine be rigidly secured to the floor. Such machines are generally provided with feet coated with an appropriate high-friction type material, so that they are seated on the floor quite securely by their own weight. In such machines, it will be apparent that, when upward vibrational forces exerted on the feet of the machine by the rapidly moving parts thereof become equal to the force which is provided by the weight of the machine acting down on the feet, the machine will tend to walk, or move, on the floor. This is a most undesirable occurrence since the machine itself may be damaged, other articles around the machines may be damaged by the machine bumping into them, and in any event the operator will not desire the machine to be displaced during ordinary use thereof. Along the same line of thought, the machine may have stationary frame parts which will be injured by vibrational forces even less than those required to move the machine. Thus, it can be seen that, for various reasons, it is important to limit the vibrational forces which are transmitted by the machine to its frame and to the floor on which it rests.

It is accordingly an object of my invention to provide a machine having an improved vibration-responsive arrangement wherein, in response to a predetermined vibrational force, the machine responds in a manner appropriate to prevent additional vibrational force either by decreasing the speed or else by remaining at the same speed, both approaches being known to those skilled in the art.

It is a further more specific object of my invention to achieve this goal by a system wherein the moving system which includes the part moving at high speed, is held against a stationary frame system with a predetermined force, so that when the vibrational forces equal the predetermined force the two systems will separate and appropriate control apparatus will be actuated to cause the desired stopping of further acceleration.

In carrying out my invention in one form thereof, I provide a machine which has both a moving system including driven means movable at high speed, and a rigid frame system which is provided for supporting the moving system. The two systems are so arranged that they are rigidly held together by a predetermined force and separate when vibrational forces in the moving system exceed that predetermined force. A switch is provided which has first and second positions respectively enabling and disabling controlling means to cause high speed operation of the driven means. The cooperation of the two systems—the moving system and the rigid frame system—is such as to cause the switch means to be in its first position when the two systems are held together, but then to move to its second position when the systems start to separate.

The subject matter which forms my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to organization and method of operation, together with further objects and advantages, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings,

FIGURE 1 is a rear elevational view of a domestic laundry machine, specifically a combination washer dryer, which incorporates my improved vibration control system;

FIGURE 2 is a 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 a fragmentary plan view of the machine of FIGURE 1, with the clothes and liquid containing portions of the structure removed to illustrate the drive structure of the machine;

FIGURE 4 is a schematic electrical diagram illustrating the control system for the machine of FIGURES 1 and 2;

FIGURE 5 is a front elevational view of a combination washer dryer which incorporates a second embodiment of my invention;

FIGURE 6 is a front elevational view of a combination washer dryer illustrating a third embodiment of my improved vibration control system;

FIGURE 7 is a fragmentary rear elevational view of a combination washer dryer illustrating a fourth embodiment of my invention;

FIGURE 8 is an enlarged fragmentary view, partly in section, illustrating the lower left hand portion of FIGURE 7 with the parts of the system in the position they assume when the vibrational forces are below a predetermined point; and

FIGURE 9 is a view similar to FIGURE 8 wherein the parts of the machine are shown in the position they assume when the vibrational forces reach the predetermined point.

Referring now to FIGURES 1 and 2, I have shown my invention in one form applied to a domestic laundry machine **1** comprising a combination washer dryer. The machine **1** includes a cabinet **2** which has a base **3** and carries a separate top **4** on which is supported a backsplash panel **5**. Panel **5** may, as shown, be mounted on posts **6**. The control panel **5** is provided with appropriate controls on the front thereof (not shown) for selecting appropriate cycles of washing and drying operations for the machine. Access to the interior of the machine is provided by a door **7** formed in section **1**, mounted on concealed hinges and which may be opened and closed by any suitable means (not shown).

The machine illustrated is of the horizontal axis type, that is, it has a substantially cylindrical clothes basket or receptacle **8** mounted for rotation on a generally horizontal axis within an outer enclosing tub structure **9**. Basket **8** comprises a cylindrical shell or wall **10** which is closed at its rear end by a suitable wall or plate **11**. The basket also includes a front wall **12** which is formed so as to define an access or loading opening **13** in registry with an opening **14** in cabinet section **2** provided for door **7**. The basket is rotatably supported by a shaft **15** which is mounted in an elongated bearing **16** supported from rear walls **17** and **18** of tub **9**. The tub is also provided with an opening **19** aligned with openings **14** and **13** so that clothes may be placed into and removed from the basket when door **7** is opened. The door seals against a suitable gasket **20** during operation of the machine.

Referring now particularly to FIGURE 3, and also to FIGURES 1 and 2, during the operation of the machine the basket **8** is driven from an electric motor **21**. The drive from the motor to the basket includes a pulley **22**

which is secured to the motor shaft so as to rotate therewith and over which passes a belt 23 which drives an adjustable sheave assembly 24. The adjustable sheave assembly includes a shaft 25 to which are rigidly secured two sheave plates 26 and 27. An intermediate sheave plate 28 is keyed on shaft 25 so as to be movable along the shaft to varying distances from the sheave plates 26 and 27. It will be observed from FIGURE 2 that sheave plate 26 has a sloping surface 29 which, in cooperation with a sloping surface 30 on movable sheave plate 28, forms a grove 31 of adjustable width. Similarly, on its other side movable sheave plate 28 is provided with a sloping surface 32 which cooperates with a sloping surface 33 of rigidly secured sheave plate 27 to form a second groove 34 of adjustable width.

Since belt 23 has a predetermined width, it can be seen that movement of sheave plate 28 relative to sheave plate 26 will cause the belt 23 to seat in groove 31 at a distance from the center of the shaft 25 which is determined by the distance of sheave plate 28 from sheave plate 26. The linear speed of belt 23 is constant, assuming the speed of motor 21 to be substantially constant, and therefore the rotational speed of the adjustable sheave assembly 24 is dependent on the effective sheave diameter provided by the cooperation of sheave plates 26 and 28. When the sheave plates 26 and 28 are in the position shown in the figures, sheave assembly 24 is rotating at a relatively low speed. If sheave plate 22 is moved to the left, as viewed in FIGURE 2, away from sheave plate 26, then belt 23 will move in radially toward shaft 25 as groove 31 widens and will cause a greater rotational speed of the sheave assembly 24 for a given rotational speed of pulley 22 by motor 21.

A second belt 35 is driven in groove 33 by the sheave formed by the cooperation of sheave plates 28 and 27. When adjustable sheave plate 28 is in the position shown so that groove 34 is quite wide, belt 35 has to move in radially toward shaft 25 a substantial amount before it seats on the surfaces 32 and 33 of sheave plates 28 and 27 respectively. This means that for a given rotational speed of the adjustable sheave assembly 24 (as imparted to it by belt 23), belt 35 will be traveling at a relatively low rate of linear speed. If sheave plate 28 is moved to the left so that belt 35 is forced outwardly in groove 34, then for a given rotational speed of the sheave assembly, a relatively high linear speed of belt 35 is provided. Thus, by controlling the position of sheave plate 28, an infinite variety of speeds between the two limits of position of the sheave plates may be provided, with the arrangement shown in FIGURE 2 providing the lowest output speed to belt 35 since belt 23 is causing the lowest rate of rotation of sheave assembly 24, and rotation of the sheave assembly 24 is causing the lowest linear speed of belt 35. The highest rate of speed will be provided if sheave plate 28 is moved as far as possible to the left to provide the highest rotational speed of the assembly 24 for a given linear speed of belt 23, and the output linear speed of belt 35 is the highest possible for a given rotational speed of assembly 24.

Belt 35 passes over a sheave 36 which forms part of a unitary assembly with a sheave 37 driving a belt 38. Referring now primarily to FIGURES 1 and 2, it will be seen that belt 38 drives a sheave 39 which is rigidly secured to the end of the shaft 15 so as to rotate basket 8.

Returning now to the adjustable sheave assembly 24, and with particular reference to FIGURES 1 and 3, it will be observed that the assembly is mounted on an arm 40 which is pivotably secured on a pin 41 within a bracket 42. A spring 43 has one end 44 secured to a support 45 concerning which further details will be given below (and to which bracket 42 is also secured). The other end 46 of the spring is secured to an arm 47 which is also secured to the shaft 25 so as to be rigid therewith and with arm 40. By means of spring 43, the assembly is biased to the left as shown in FIGURE 1.

At the outer end 48 of arm 47, there is secured a chain member 50. At its other end (FIGURE 3) chain member 50 is secured to a pulley 51 operated through a small electric motor and gear train assembly 52. It will be seen that when pulley 51 is caused to rotate by assembly 52 it will wind up chain 50 and through arm 47 will move the entire adjustable sheave assembly 24 to the right as viewed in FIGURE 1, causing arm 40 to pivot to the right. Since belt 23 cannot stretch, it will be apparent that when this occurs, belt 23 will move inwardly within groove 31 forcing sheave 28 to the left (as viewed in FIGURE 2) to effect an increase in the speed transmitted to sheave 39 and basket 8. When motor gear train assembly 52 is shut off, the spring 45 overcomes the motor and gear train and pulls the adjustable sheave 24 back toward the position shown in the figures to reduce the speed. The motor and gear train assembly 52 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 continues.

The assembly of sheave 36 and 37 is also movably mounted, on a linkage arrangement 53 pivotably secured on a pin 54 mounted within a bracket 55 secured on part 45. The linkage arrangement includes two arms 56 and 57 which are pivotably secured together through a pin 58. A spring 59, secured at one end 60 to part 45 of the machine, is secured at its other end 61 to the assembly of sheaves 36 and 37 so as to bias them downwardly and to the right as viewed in FIGURE 1 in order to effect a belt tensioning function for belts 35 and 38.

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, a tumbling speed of approximately 47 r.p.m. may be provided to the basket 8, while in the other extreme position a suitable centrifuging speed, such as for instance 350 r.p.m., may be provided.

To heat the clothes during the heat drying portion of the cycle, there is provided in the machine a suitable heater assembly 62. When the heaters are energized during the drying cycle, they operate to heat the basket 8 which through its rotation then contacts the clothes to transfer its heat to the clothes. In addition, since the outer cylindrical wall 10 of the basket is perforated by a great many small spaced openings 63 (FIGURE 2), the heater assembly also heats the clothes directly by radiation. The heat thus transferred through the clothes causes vapor migration out of the clothes so as to effect drying thereof.

The means whereby water is admitted to and discharged from tub 9 during operation of the machine is shown in FIGURE 1. The water supply means includes connections 64 and 65 through which hot and cold water is supplied to the machine for the washing operation. A valve controlled by a solenoid 66 admits hot water to the machine and a valve controlled by an opposed solenoid 67 admits cold water to the machine. The hot and cold water valves under the control of the solenoids 66 and 67 discharge through a common outlet conduit 68, through a suitable air gap, and then through a funnel 69 which leads to a sump 70 formed at the bottom of tub 9. The connection is made through a suitable conduit 71, a portion of which is shown near the sump 70, which connects the funnel 69 to the sump. The air gap provided by the funnel 69 makes it impossible for the water to be siphoned from the machine and to contaminate the incoming water supply line. A pressure actuated sensing device, or water level control, 72 controls both solenoids 66 and 67 as will be explained below, to provide the proper water level in the machine during the washing operation. Sensing device 72 is connected to the interior of tub 9 by a suitable line 73 which connects wtih the tub almost at the bottom thereof at 74 as shown.

The illustrated machine is of the type which uses cold water during the drying cycle for condensing the moisture

extracted from the clothes. The condenser water is admitted to the machine through an additional solenoid actuated valve controlled by a solenoid **75** which is energized during the drying operation so that the valve passes water at a slow rate sufficient to condense from the air the moisture vaporized from the clothes. As shown, the condenser water valve discharges into a conduit **76**. From this conduit the water flows through an appropriate air gap (not shown) to the inlet **77** of a vent trap **78** which is of the type commonly provided in connection with machines of this type in order to seal off the tub and basket from atmosphere during heat drying of the clothes while leaving the tub vented to atmosphere at other times. An appropriate construction for vent trap **78** is, for instance, fully described and claimed in Patent 2,800,008, Raczynski, issued on July 23, 1957, and assigned to the General Electric Company, owner of the present invention. From the vent trap **78**, the condenser water flows into the tub **9** through an opening **79** and then flows in a thin sheet down the lower left wall **80** of the tub so as to cool a substantial portion of the area of the side wall and provide a large cool surface for condensing the moisture extracted from the clothes.

The wash and rinse water used during the washing portions of the operation, and the condenser water and the moisture extracted from the clothes during the heat drying operation, are discharged from the machine through the sump **70** mounted at the bottom of the tub. A suitable discharge hose **81** leads from the sump to a pump **82** which may, as shown in FIGURE 3, be driven directly from motor **21** and which discharges through a conduit **83** to a drain valve **84** controlled by a solenoid **85** (shown only in FIGURE 4). The valve may be of the conventional type which, when solenoid **85** is energized, is closed and otherwise is biased to open position. Thus, the continually operating pump **82** passes liquid from sump **70** through conduit **83** and valve **84** to a drain conduit (not shown) except during energization of solenoid **85**.

It will be noted that the basket, tub and the drive system for driving the basket are all mounted on the member **45** rather than directly on the base **3**. The member **45** in turn is pivotably supported on the base **3** at one end by means of a hinge **86**. Hinge **86** is secured at one end **87** to the base **3** and at the other end **88** to the support member **45**. At the other end of member **45**, a pair of electrical contacts **89** and **90** of a switch **91** are provided, contact **89** secured to member **45** and contact **90** secured to base **3**. Thus, in a position of rest, the support member **45** in effect form an auxiliary base seated on the base **3** by means of hinge **86** and switch **91**.

The full weight of the moving system of the machine presses down to maintain this arrangement, this condition being modified where so desired by the presence of a spring **92** having one end **93** pressing against base **3** and the other end **94** pressing upwardly against member **45**. Preferably, the action of the spring is to tend to separate the contacts of switch **91** so that the weight of the machine minus the force of the spring is the net force pushing down keeping switch **91** closed.

It will be seen that switch **91** will remain closed as long as upward vibrational forces trying to open the switch **91** remain less than the total net force represented by the downward weight of the moving system minus the force of spring **92**. When the vibrational forces become such as to equal or to be greater than the force of the moving system minus the force of the spring, the net force on the switch is such that the switch is opened at least during one part of each vibration. As will be seen herebelow this provides a highly desirable and effective vibrational controlling system.

Turning now to FIGURE 4, there is shown in schematic form a control arrangement for controlling the sequence of operation of the various components of the machine hereinabove described, and which includes my invention. It will, of course, be understood that in actual practice various interlocking arrangement of the different functions may be provided together with various electrical safety features; however, these frequently assume some complexity and have been omitted since they do not form a part of the invention and such circuit modifications are well known to those skilled in the art.

The basic operation of the means for ocntrolling the sequence is provided through a suitable timer motor **95**. It further includes a series of switches **96, 97, 98, 99, 100, 101, 102, 103** and **104** which are actuated in a desired sequence by appropriate switch operating means (such as cams, not shown) driven by the timer. Typically, the cams are also manually controlled by a dial **105** so that they may be rotated to cycle starting position by the operator with motor **95** then carrying them through the cycle. In effect, the motor rotates the cams which then open and close the switches in a predetermined order based on the particular contour given to the cams.

The power for energizing the different components shown in FIGURE 4 is supplied from a three wire power source comprising power supply lines **106** and **107** and a neutral line **108**. This three wire source may, for instance, comprise the conventional 230 volt domestic supply having a voltage of 230 volts between supply lines **106** and **107** and a voltage of 115 volts between each of the supply lines and neutral line **108**. The heating assembly **62** is connected across the supply lines, with energization of the assembly being controlled by movable contacts **109** and **110** which in turn are controlled by a relay coil **111** in series with switch **103**.

All of the components of the machine other than the heating assembly are connected between a conductor **112** and neutral line **108**. Conductor **112** may be connected to conductor **107** through either of timer switches **97** and **98**. When connection between conductor **112** and conductor **108** is completed, the elements of the machine are energized subject to the opening and closing of the other timer control switches. While switch **98** is directly connected to conductor **112**, switch **97** is connected through a manually operable contact member **113** so that switch **97**, under the control of manually operable switch **113**, controls the connection of conductors **107** and **112** once switch **98** is opened.

The only other elements shown in FIGURE 4 which have not been individually described hereinabove include a conventional manually operable switch **114** for making a water temperature selection, and the usual temperature limiting device **115** for opening the heater circuit at a predetermined high temperature for safety purposes.

It will be noted that each of the timer operated switches controls one of the electrical components of the machine. In addition, the gear motor assembly **52** is controlled by the switch **91** as well as by the timer switch **96**. Also the water valves are jointly under the control of the liquid level control **72** and may either be energized independently by the timer switches or, of manual switch **114** is closed, may both be energized at once by closure of either of switches **100** or **101**.

It can now be seen from viewing FIGURE 4, in combination with FIGURES 1, 2, and 3, that proper opening and closing of the different timer operated switches will make the machine perform a desired series of operations. For instance, initially there may be closure of switch **98** to cause energization of the main motor **21**, and also closure of switches **99, 100**, and **104** respectively to close the drain valve, to cause entry of water, and to cause the timing operation to begin. At the end of a predetermined length of time, as timed by motor **95**, switch **100** may open and switch **99** may also open to de-energize the solenoid **85** and permit water to be pumped out of the machine.

This sequence may then be repeated several times, with either switch **100** or switch **101**, or both, being selected to cause entry of water depending upon the temperature

of water desired, and with the water then being let out shortly thereafter to provide an appropriate number of rinse operations. At the end of the last rinse operation, the switch **99** is left open, and switch **96** is closed. This causes energization of the gear motor assembly **52** with the result that the adjustable sheave assembly **24** starts to be pulled over to the right as viewed in FIGURE 1 to increase the rotational speed of the basket.

It will be understood at this point that, if the clothes in the basket have not distributed themselves properly, they may create an unbalanced load so that unbalance-caused vibrations will tend to increase in magnitude as the speed goes up. It is to be recalled that the moving system, that is, the part which includes the rotating basket and the drive system, is rigidly seated on the base of the machine and thus by its own weight virtually all vibrations are substantially prevented until the point is reached where force resulting from the vibrations overcomes the force keeping switch **91** closed so that it opens.

When switch **91** opens, it can be seen from FIGURE 4 that this causes a de-energization of the gear motor assembly **52**. The strength of spring **43** and the rate at which the gear motor **52** pulls the adjustable sheave assembly are so adjusted with respect to each other that cyclic opening of the switch **91** as a result of the vibrations causes the spring, during the open period of switch **91**, to substantially equal the amount of pull of the gear motor assembly **52** when the switch is closed. As a result, the adjustable sheave assembly remains in a position wherein the rotational speed of the basket is the maximum which is acceptable without the force of the vibrations becoming greater than may desirably be accepted. Thus, during this portion of the cycle, the basket spins to extract liquid centrifugally at the highest speed which is permissible with the unbalanced conditions existing within the basket.

Continuing briefly the description of the complete cycle, the timer motor **95** tolls a predetermined length of spin operation, and then switch **96** is opened to terminate this spin operation, and switches **102** and **103** are closed. The closure of switch **103** energizes heater **62** while the closure of switch **102** energizes the solenoid **75** to cause a slow flow of water to spread itself out along wall **80** of the tub and then pass out to drain. This causes a drying operation on the clothes as previously described so that after an additional predetermined amount of time, as tolled by the motor **95**, the entire operation is terminated with the clothes in a clean and dry state.

My inventive contribution lies in the concept and arrangement for causing the vibrational forces being transmitted through the rigid frame of the machine, and thus to the floor, to be limited by utilizing a predetermined force to hold a switch closed, with the vibrational forces acting to open the switch against this predetermined force when the maximum safe speed has been reached. In the example described, the force of gravity acting on the moving system, as opposed by the spring **92**, represents the total force which is to be overcome by the vibrational force.

In FIGURE 5 there is shown a second embodiment of my invention in which a switch **91** is again provided, but in which, rather than the entire moving system of the machine being mounted on the hinged part, the hinge is located as shown by the numeral **115**. With this arrangement, while the weight of the moving system does determine the force closing switch **91**, the amount of room taken up by the system is substantially less than that of the first embodiment. The machine of FIGURE 5 has feet **116** on one side and feet **117** on the other side. Hinge **115** is located between them, and in this way the feet are hinged with respect to each other. As a result, the structure functions in the same manner as described in connection with the embodiment of FIGURE 1. In other words, the embodiment of FIGURE 5 effects the desired purpose of utilizing a predetermined force to maintain the switch **91** closed until the vibrational forces become such that there is a pivoting about hinge **115** to cause an opening of the contacts. It will be noted that a suitable spring, shown by the numeral **118**, may be provided as before, in parallel relationship with the switch **91** so to speak, in order to bring the total force required for separation of switch **91** down to the desired value.

In the two embodiments described thus far, the force of gravity, opposed by a spring, represented the predetermined force which had to be overcome by vibrational forces in order for a corrective action to take place as to the speed of the machine. In the third embodiment, as shown in FIGURE 6, a predetermined force is used as before, but instead of the force of gravity providing a major part of this, a different approach is used. Specifically, a rigid downward extending flange **119** is provided secured to the outside of tub **9** as part of the moving system. This secured through a strong spring **120** to an upwardly extending flange **121** formed as part of the stationary system. The force with which spring **120** holds member **119** against member **121** represents the predetermined force which is to be overcome by vibrational forces before corrective action may be taken.

With this structure, the moving system and the stationary system remain rigidly against each other, as before, under normal circumstances. When the vibrational forces become sufficient to overcome the spring, the moving system starts to separate from the stationary system. As soon as this happens, the switch **122** is opened once each vibration, with the same results as for the other structures. In other words, in this case a spring acting substantially horizontally has taken the place of the downward effect of gravity. Nonetheless though, the same basic concept is present of having the moving system and stationary system rigidly secured together until the predetermined force at which corrective action is to be taken is reached.

Referring now to FIGURES 7, 8 and 9, there is shown yet a fourth embodiment of my invention wherein a substantial number of the operating parts of the drive and basket are shown, similarly to the showing of FIGURE 1 for the first embodiment. It is to be noted that in this fourth embodiment, the moving system includes the base **3**, that is, there is no intermediate support. The base **3** in turn is supported on one side by feet such as the one shown by the numeral **123**, and at the other side of the machine is supported at its rear by a foot **124** which is shown in enlarged form in FIGURES 8 and 9 to illustrate details.

The securement of base **3** to foot **124** is effected by securing a U-shaped bracket member **125** to the base, as shown, and forming an opening through it so that the leg **126**, which is rigidly connected to foot **124**, may pass up through the bracket member. The bracket member has upturned portions **127** through which passes a pin member **128**. An elongated part **129** is pivotably secured on the pin member, with its base portion **130** resting on the top **131** of leg **126**.

Since the weight of the moving system of the machine is pressing down on base **3**, base **3** moves down slightly with respect to leg **126** and because of this the member **129** is caused to pivot up to the position shown in FIGURE 8. Preferably, suitable stop means such as a snap ring **131***a* are incorporated on leg **126** where it passes through member **125**, so as to limit the movement of the leg relative to the member **125** to a very small amount. This insures that when the leg has caused member **129** to pivot to the position shown in FIGURE 8, further movement upward will be prevented.

At the outer end of the member **129**, there is provided a screw **132** whose head is intended to engage the projecting part **133** of a switch **134**. It can readily be seen that whenever the gravity-caused forces pushing down on base **3** are overcome by vibrational forces, the

base 3 will start to move up on leg 126 with the result that the member 129 pivots downwardly, as shown in FIGURE 9. When this happens, screw 132 engages the button 133 of switch 134 to open it and cause the same speed-limiting effect as has already been described.

It can be seen that in this case the moving system of the machine (including the base and cabinet) pivot about leg 126 as an axis, assuming substantial rigidity of the machine parts. Thus, the entire machine becomes, in effect, the moving system with the single exception of leg 126, foot 124, and member 129. It will be noted that, as before, a spring 135 may be provided to effect the desired adjustment in the amount of vibrational force required to trip switch 134. In addition, it will be seen that the structure is highly effective from an actual production standpoint: after assembly, the screw 132 may easily be adjusted to give switch operation at the proper time.

It will be seen from the foregoing that my invention, in the various embodiments thereof, incorporates the concept of a substantially rigid connection between a moving and a supporting system until a speed is reached at which the vibrational forces should not be allowed to increase further. At this point, appropriate action is then taken. For purposes of illustration I have shown an arrangement wherein the speed is kept at the maximum permissible in the light of the particular unbalance situation. It will, however, be recognized that the tripping of the switch may cause a return to tumble speed for redistribution of the clothes with a subsequent return to higher speed, as is done in many commercially available machines today. This would involve only modification of the internal workings of the switch so that a timed period would elapse before it is returned to its set position.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modications 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 the invention.

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

1. A washing machine comprising:

(*a*) a moving system including a rotatably mounted clothes receiving basket;

(*b*) means for washing clothes in said basket and for rotating said basket at high speed;

(*c*) a rigid frame system provided for supporting said moving system, said moving system being pivotally mounted on said frame system and being seated on said frame system in rigid engagement therewith at a point removed from the pivot so that said systems are held together at said point by a predetermined gravitational force and separate when vibrational forces in said moving system overcome said predetermined force;

(*d*) controlling means for causing said basket to rotate at high speed at the end of a washing operation;

(*e*) switch means adjacent said point of rigid engagement having a pair of contacts enabling and disabling said controlling means to cause high speed rotation of said basket when said contacts are respectively closed and opened;

(*f*) said systems cooperating to press said contacts together by gravitational force when said systems are rigidly held together by said predetermined force, said contacts being arranged so that they open when said systems start to separate.

2. The apparatus defined in claim 1 wherein said machine has a substantially rectangular base forming part of said frame system, said hinge being formed at one side of said base and said switch being positioned at the other side of said base.

3. The apparatus defined in claim 1 wherein said rigid frame system includes a substantially rectangular base, said hinge and said switch means both being adjacent one side of said base.

4. The apparatus defined in claim 1 wherein said one of said contacts is on said moving system and the other of said contacts is on said frame system, said contacts forming said point of contact of said systems.

References Cited in the file of this patent

UNITED STATES PATENTS

2,035,481	Hume	Mar. 31, 1936
2,974,801	Bernstein	Mar. 14, 1961
3,014,591	Stone et al.	Dec. 26, 1961

FOREIGN PATENTS

409,390	Great Britain	May 3, 1934
598,739	Great Britain	Feb. 25, 1948
1,147,120	France	June 3, 1957
1,190,885	France	Apr. 6, 1959