March 9, 1965 J. C. WORST 3,172,848

CENTRIFUGAL EXTRACTION MACHINE HAVING SPEED CONTROL MEANS RESPONSIVE TO UNBALANCED WEIGHT DISTRIBUTION

Filed April 27, 1961 5 Sheets-Sheet 1

FIG. 1

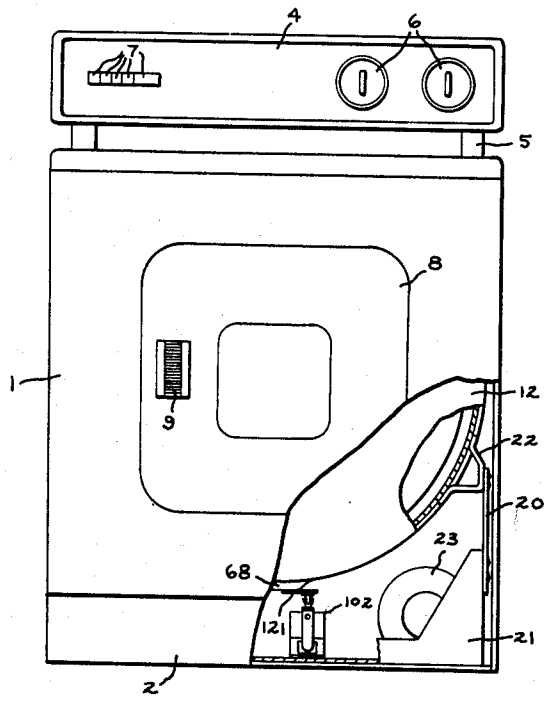
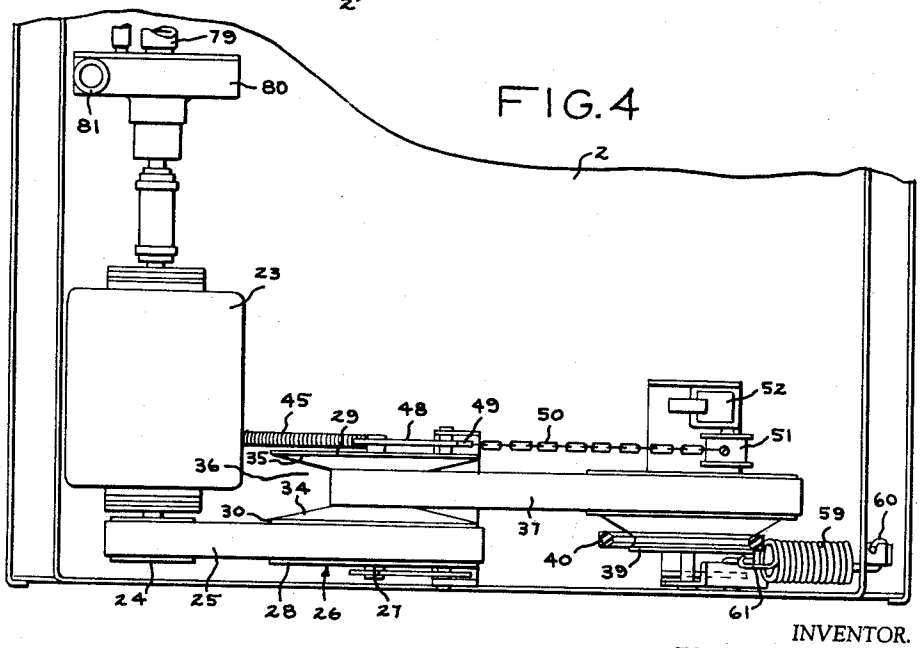


FIG. 4



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Filed April 27, 1961 5 Sheets-Sheet 2

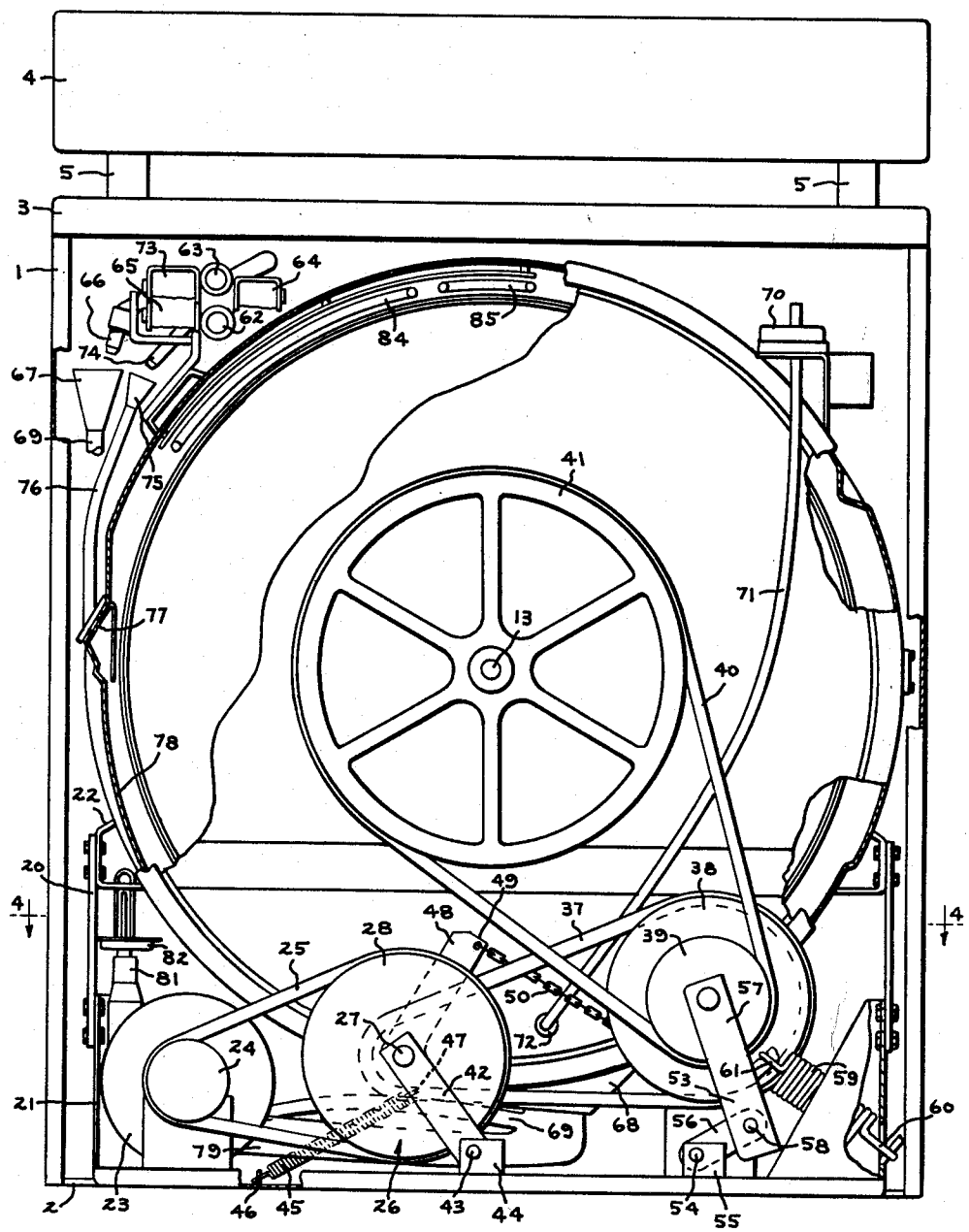


FIG. 2

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CENTRIFUGAL EXTRACTION MACHINE HAVING SPEED CONTROL MEANS RESPONSIVE TO UNBALANCED WEIGHT DISTRIBUTION

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FIG. 3

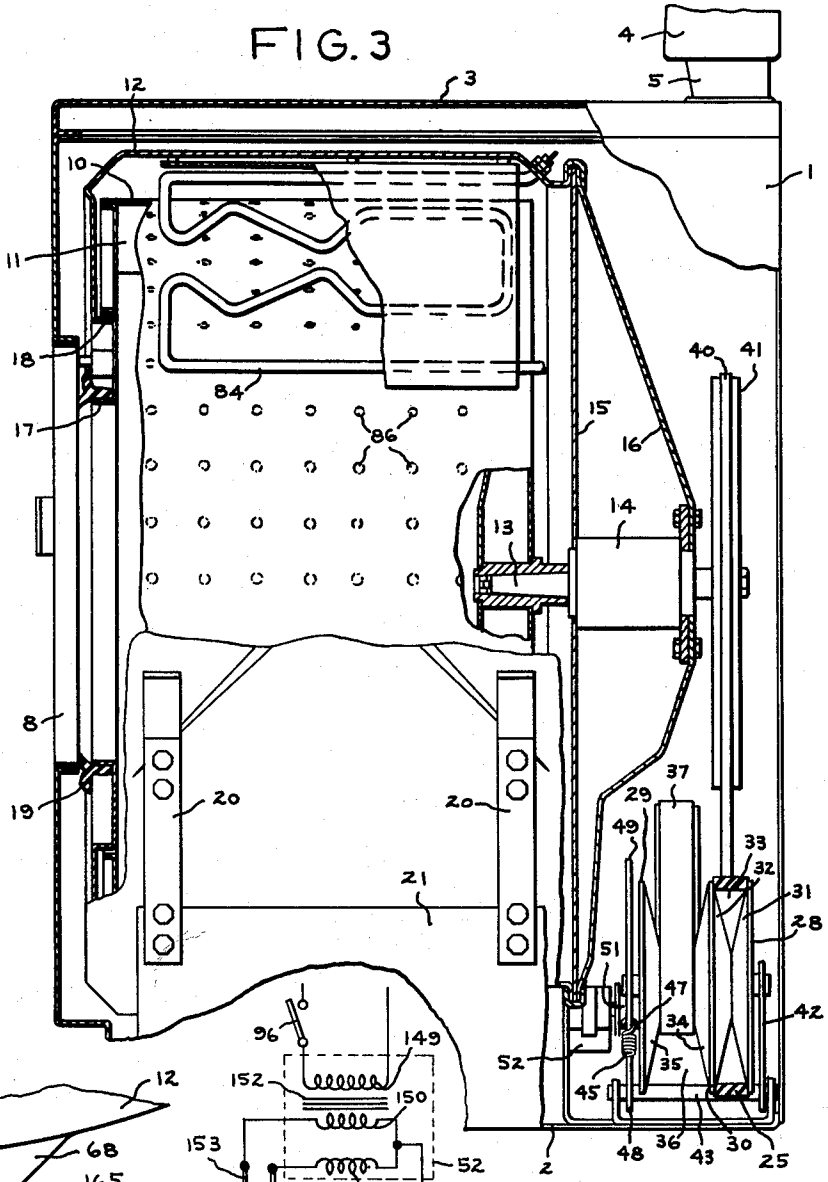


FIG. 10

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CENTRIFUGAL EXTRACTION MACHINE HAVING SPEED CONTROL MEANS RESPONSIVE TO UNBALANCED WEIGHT DISTRIBUTION

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FIG.5

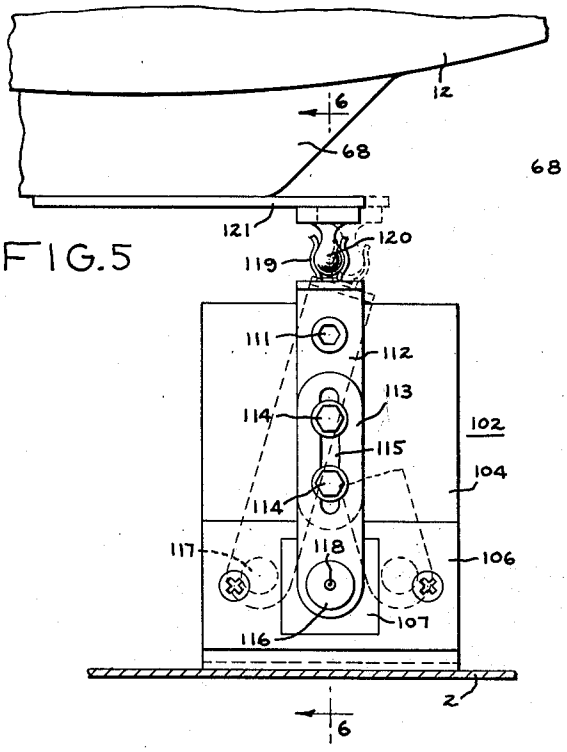


FIG.6

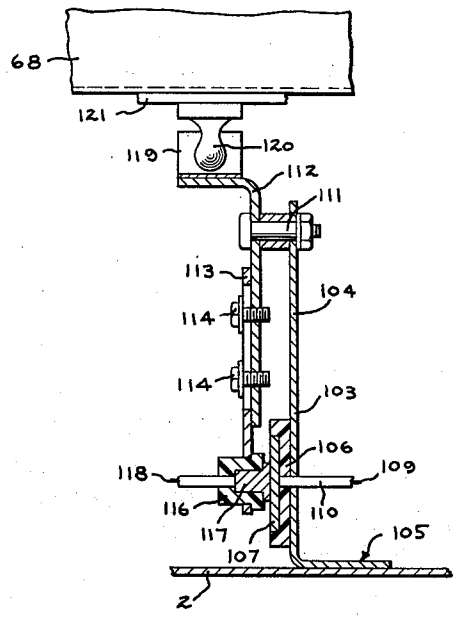
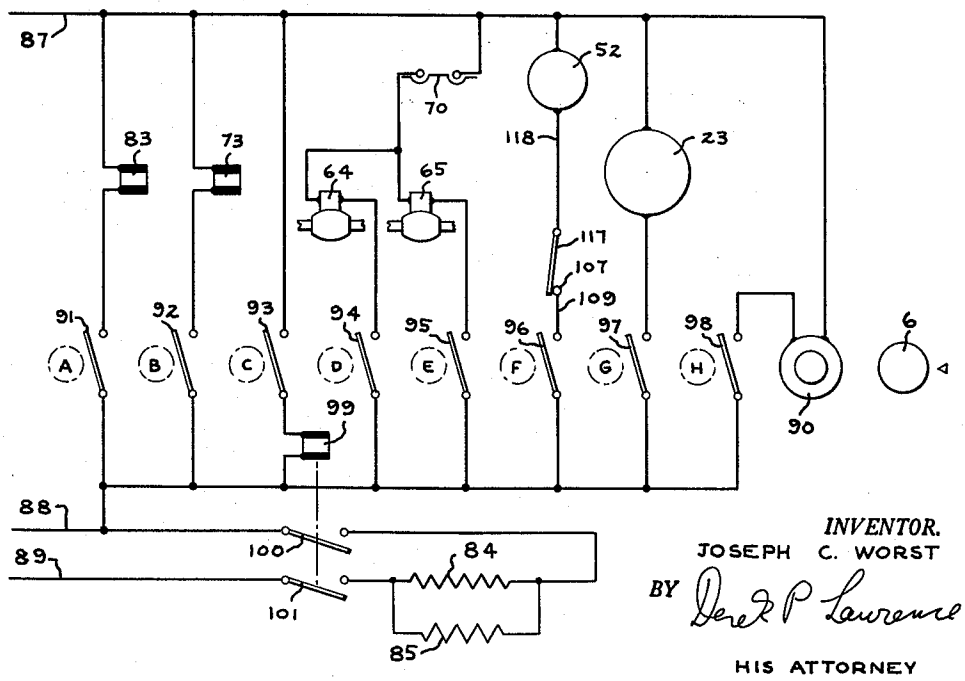


FIG.7



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CENTRIFUGAL EXTRACTION MACHINE HAVING SPEED CONTROL MEANS RESPONSIVE TO UNBALANCED WEIGHT DISTRIBUTION

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FIG.8

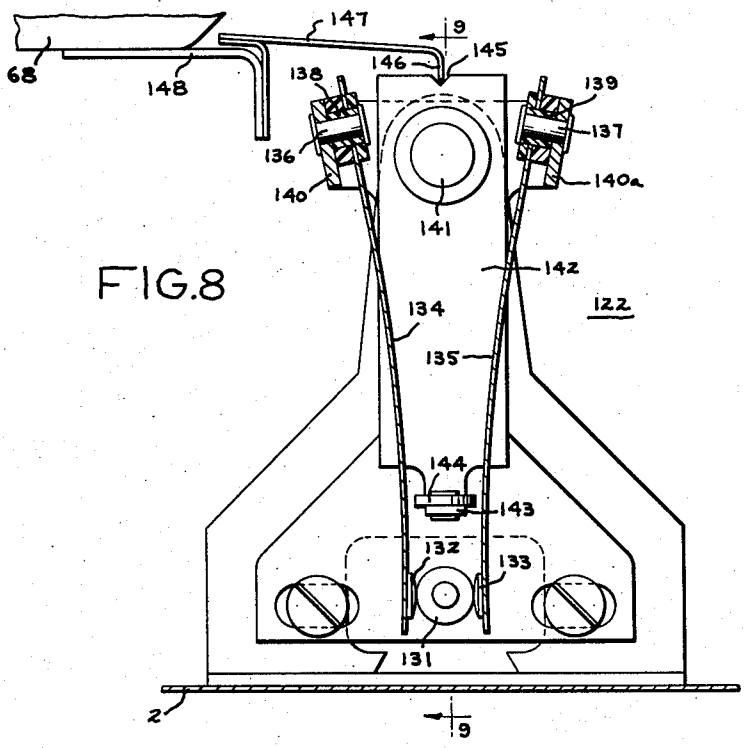
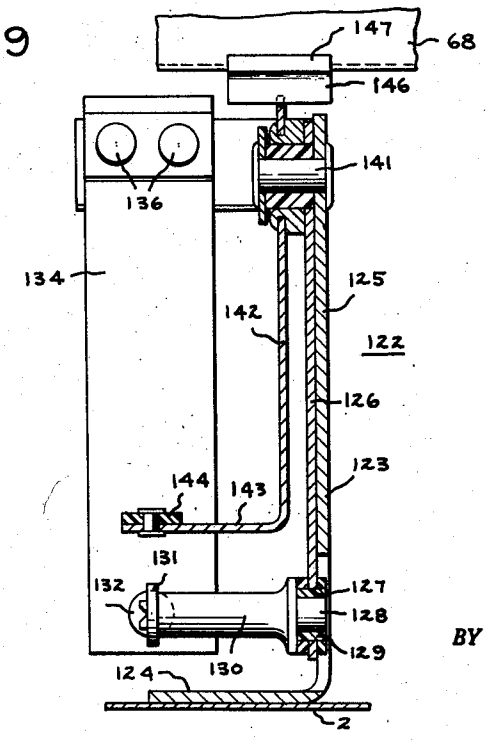


FIG.9



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United States Patent Office

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Patented Mar. 9, 1965

3,172,848

CENTRIFUGAL EXTRACTION MACHINE HAVING SPEED CONTROL MEANS RESPONSIVE TO UNBALANCED WEIGHT DISTRIBUTION

Joseph C. Worst, Louisville, Ky., assignor to General Electric Company, a corporation of New York

Filed Apr. 27, 1961, Ser. No. 105,928
4 Claims. (Cl. 210—144)

This invention relates to centrifuging machines for extracting liquid from articles by centrifugal force, and more particularly to such machines which incorporate vibration sensitive arrangements for preventing operation at speeds capable of causing vibrations harmful to the machine.

Machines which effect an extraction of liquid from articles by high speed rotation of the container in which the articles are held are subject to high centrifugal forces as a result of the high speed rotation, particularly when the load is unbalanced within the container. Typical of such machines are domestic clothes washers, wherein the clothes container is spun at the end of washing and rinsing operations to extract the wash and rinse water from them. To prevent the occurrence of unbalance-caused vibrations large enough to cause damage to the machine, centrifuging machines may be provided with unbalance mechanisms which may operate in a variety of ways to preclude harm to the machine through excessive vibration. For instance, in some cases controls are actuated by an unbalance switch to return the article receptacle to a low speed (at which the articles move about in the container) or zero speed for a brief period of time to give the articles a chance to be redistributed, the machine thereafter again attempting high speed rotation. Another approach is to shut the machine off if an excessive unbalance is sensed by the unbalance switch. In the first of the two foregoing possible approaches, there is, of course, some degree of liquid removed from the articles, regardless of what happens. However, if the unbalance should be such that it continues to remain uncorrected through the time allotted for the centrifuging operation (such as where one or two large shag rugs are to be spun damp-dry in a washing machine) the articles will still retain a very substantial amount of liquid at the end of the centrifuging operation. If the machine is shut off completely, as in the second possibility as set forth above, then, of course, the operator has to return to the machine and start it up again.

A third approach has therefore evolved wherein the centrifuging machine is formed so that it will continue to centrifuge at the maximum speed at which the vibrational forces are within the permissible limit. This may, if so desired, be provided after a certain number of attempts at high speed spin so as not to preclude the provision of high speed spin until it appears the load is one difficult to balance.

It is an object of the present invention to provide an improved centrifugal liquid extraction machine wherein electrical means causes acceleration of the machine to full speed, by causing the electrical means to accelerate the machine toward full speed only as long as unbalance-caused vibrations are below a predetermined amplitude, and to cause deceleration of the machine—if the vibrations exceed a predetermined amplitude—during the period of each vibration when the predetermined amplitude is exceeded.

In accordance with my invention, I provide a centrifugal extraction machine where the article receiving container is flexibly and rotatably secured on a frame by approporiate support means so that it vibrates relative to the frame in response to rotation of the container with an unbalanced load therein. The container may be driven at a maximum centrifuging speed, generally several hundred r.p.m., by electrically controlled driving means wherein a first electrical condition causes acceleration of the driving means toward the maximum speed and a second condition of the electrical means causes deceleration toward a minimum speed. The electrical arrangement includes a control circuit with a switch having an actuator connected to be moved in response to vibratory movement of the container. The switch may assume a first position in which container acceleration is provided, or a second position in which container deceleration is provided. The actuator, as moved in response to vibratory movement of the contatiner, provides the first switch position during vibratory movement below a predetermined amplitude, but moves the switch to its second position during any part of a vibration which is above the predetermined amplitude. This arrangement causes the driving means to rotate the contatiner at a speed which is generally proportional to the fraction of the total time of each vibration that the electrical means is in the first condition; since the vibrations are a result of both unbalance and speed, the less the unbalance the greater the speed at which the container is allowed to rotate by my invention.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. My invention itself however, both as to organization and method of operation together with further objects and advantages thereof, 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 centrifugal extraction machine, specifically a combination clothes washer-dryer, of the type which incorporates my improved speed control arrangement;

FIGURE 2 is a rear elevational view of the combination washer-dryer of FIGURE 1, with the rear panel removed and certain surfaces broken away to illustrate details;

FIGURE 3 is a side elevational view of the combination washer-dryer of FIGURE 1, partly in section and with certain surfaces broken away to show details;

FIGURE 4 is a fragmentary view along line 4—4 in FIGURE 2, with the clothes basket and tub of the machine removed in order to illustrate details of the drive of the machine;

FIGURE 5 is an enlarged fragmentary plan view of the machine showing the improved vibration controlling arrangement of my invention;

FIGURE 6 is a view along line 6—6 in FIGURE 5;

FIGURE 7 is a schematic illustration depicting a circuit which incorporates my invention;

FIGURE 8 is a fragmentary enlarged plan view of a second embodiment of the improved vibration controlling arrangement of my invention;

FIGURE 9 is a view along line 9—9 in FIGURE 8; and

FIGURE 10 is a fragmentary enlarged, and partly schematic, plan view of a third embodiment of my invention.

Referring now to FIGURES 1, 2 and 3 of the drawings, there is shown, by way of illustration, a combination clothes washing and drying machine. It will, of course, be understood that the invention is not restricted to this particular type of laundry machine, but that to the contrary the invention has broad application in the field of centrifugal extraction machines. However, the invention finds particularly suitable application in this type of machine because the use of centrifuging machines in the home requires efficient operation in a small amount of space.

In the machine shown, the operating elements of the machine are included within an outer cabinet structure having a central wrap-around section 1. Section 1 is

supported on a base and toeboard assembly 2 with which it provides a stationary frame for the machine, and carries a separate top 3 on which is supported a backsplash panel 4 which may, as shown, be mounted on posts 5. Control panel 4 is provided with appropriate control devices such as for instance dials 6 which may be provided for controlling various types of washing and drying sequences, and various drying temperatures, and such as buttons 7 which may control various other functions such as water temperature, omission of dryer function, etc. Access to the machine is provided by a door 8 formed in section 1, mounted on concealed hinges and opened by means of a latch control 9.

As best shown in FIGURE 3, the machine is of the horizontal axis type, that is, it has a substantially cylindrical foraminous clothes basket or receptacle 10, mounted for rotation on a generally horizontal axis, and provided with a number of inwardly extending vanes 11 which help to tumble clothes in the basket during slow rotation of the basket, and also to circulate air during drying. Basket 10 is mounted within an imperforate tub structure 12 which encloses it on all sides. The basket is rotatably supported from the tub structure by a horizontally extending shaft 13 which is mounted in an elongated bearing 14 hung between the two sections 15 and 16 which form the rear wall of the tub structure. The shaft 13, 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 17 and 18 in the front walls thereof, with the openings being aligned with the door in the front wall of cabinet 2, so that by opening the door clothes may be placed into or removed from the basket 10. Door 8 seals against a gasket 19 around the tub opening 17 to close off the tub completely during operation of the machine.

The assembly of tub 12 and basket 10 is flexibly supported by means of a plurality of brackets or arms 20 which are mounted on an upstanding plate 21 fixedly attached to the base 2. Four of these arms are provided, two of them being secured to each side of the tub. Although the arms 20 can be secured directly to the wall of the tub, I prefer to attach them, as shown, by means of suitable brackets 22. With tub 12 supported in the manner shown, the support of the system including the tub and the basket on the base 2 within wrap-around frame 1 is flexible in that the tub and basket may vibrate back and forth parallel to the front of the machine if the basket 10 should be unbalanced during high speed rotation thereof. However, for vibrations in the front to rear directions and in the vertical direction the arms 20 have little flexibility and prevent any substantial vibration in those directions.

Referring now particularly to FIGURE 4, and also to FIGURES 2 and 3, during the operation of the machine the basket 10 is driven from an electric motor 23. The drive from the motor to the basket includes a pulley 24 which is secured to the motor shaft so as to rotate therewith, and over which passes a belt 25 which drives an adjustable sheave assembly 26. The adjustable sheave assembly includes a shaft 27 to which are rigidly secured two sheave plates 28 and 29. An intermediate sheave plate 30 is keyed on shaft 27 so as to be movable along the shaft 27 to varying distances from sheaves 28 and 29. It will be observed (FIGURE 3) that sheave plate 28 has a sloping surface 31 which, in cooperation with a sloping surface 32 on movable sheave plate 30, forms a groove 33 of adjustable width. Similarly, on its other side, movable sheave plate 30 is provided with a sloping surface 34 which cooperates with sloping surface 35 of rigidly secured sheave plate 29 to form a second groove 36 of adjustable width. Since belt 25 has a predetermined width, it can be seen that movement of sheave plate 30 relative to sheave plate 28 will cause the belt 25 to seat in groove 33 at a distance from the center of shaft 27 which is determined by the distance of sheave plate 30 from sheave plate 28.

The linear speed of belt 25 is constant, assuming the speed of motor 23 to be substantially constant, and therefore the rotational speed of the adjustable sheave assembly 26 is dependent upon the sheave diameter provided by the cooperation of sheave plates 28 and 30. When the sheave plates 28 and 30 are in the position shown in the figures, sheave assembly 26 is rotating at a relatively low speed. As sheave plate 30 is moved to the left, as viewed in FIGURE 3, away from sheave plate 28, then belt 25 will move in radially toward shaft 27 as groove 33 widens, and will cause a greater rotational speed of the sheave assembly 26 for a given rotational speed of pulley 24 by motor 23.

A second belt 37 is driven in groove 36 by the sheave formed by the cooperation of the sheave plates 30 and 29. When adjustable sheave plate 30 is in the position shown so that groove 36 is quite wide, belt 37 has to move in radially toward shaft 27 a substantial amount before it seats on the surfaces 34 and 35 of sheave plates 30 and 29 respectively. This means that for a given rotational speed of the adjustable sheave assembly (as imparted to it by belt 25), belt 37 will be travelling at a relatively low rate of linear speed. As sheave plate 30 is moved to the left so that belt 37 is forced outwardly in groove 36, then for a given rotational speed of the sheave assembly a relatively high linear speed of belt 37 is provided. Thus, by controlling the position of sheave plate 30, an infinite variety of speeds between the two limits of position of the sheave plate may be provided, with the arrangement shown in FIGURE 3 providing the lowest output speed to belt 37 since belt 25 is causing the lowest rate of rotation of sheave assembly 26, and rotation of the sheave assembly 26 is causing the lowest linear speed of belt 37. The highest rate of speed will be provided when sheave plate 30 is moved as far as possible to the right (FIGURE 2), in which case belt 25 moves inwardly as far as possible to provide the highest rotational speed of the assembly 26 for a given linear speed of belt 25, and the output linear speed of belt 37 is the highest possible for a given rotational speed of assembly 26.

Belt 37 passes over a sheave 38 which forms a unitary assembly with a sheave 39 which drives the belt 40. Referring now primarily to FIGURES 2 and 3, it will be seen that belt 40 drives a sheave 41 which is rigidly secured to the end of shaft 13 so as to rotate basket 10.

Returning now to the adjustable sheave assembly 26, and with particular reference to FIGURE 2, it will be observed that the assembly is mounted on an arm 42 which is pivotably secured on a pin 43, the pin being held in a bracket 44 secured to the base 2 of the machine. A spring 45 has one end 46 secured to the machine base and has its other end 47 secured to an arm 48 which is also secured on pin 43 and to shaft 27 so as to bias assembly 26 to the left. At the outer end 49 of arm 48 there is secured a chain member 50. At its other end (FIGURE 4) 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 48, will move the entire adjustable sheave assembly to the right causing arm 42 to pivot to the right as viewed in FIGURE 2. Since belt 25 cannot stretch, it will be apparent that when this occurs belt 25 will move inwardly within groove 33 forcing sheave 30 to the left, as viewed in FIGURE 3, to effect an increase in the speed transmitted to sheave 41 and basket 10. When motor and gear train assembly 52 is shut off, the spring 45 overcomes the motor and pulls the adjustable sheave assembly 26 back to the position shown in the figures to reduce the speed.

The assembly of sheaves 38 and 39 is also movably mounted, on a linkage arrangement 53 pivotably secured

on a pin **54** mounted within a bracket **55** secured to the base. 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 member **21** adjacent base **2** of the machine, is secured at its other end **61** to the assembly of sheaves **38** and **39** so as to bias them downwardly and to the right, as viewed in FIGURE 2, in order to effect a belt tensioning function for belts **37** and **40**.

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 their position as shown, a tumbling speed of approximately 46 r.p.m. may be provided to the basket **10** while in the other extreme position a centrifuging speed of approximately 400 r.p.m. is provided to the basket.

In order to admit water to the machine for washing operations, connections **62** and **63** are provided through which hot and could water may be supplied to the machine for the washing operation. A valve controlled by a solenoid **64** admits hot water to the machine and a valve controlled by an opposed solenoid **65** admits cold water to the machine. The hot and cold water valves controlled by solenoids **64** and **65** discharge through a common outlet **66**, through a suitable air gap, and into a funnel **67** which leads to a pump **68** formed at the bottom of tub **12**. The connection may be made through a suitable conduit **69**, part of which is shown leading from the funnel **67** and part of which is shown extending from the sump **68**. The air gap provided by the funnel **67** makes it impossible, as is well known, for water to be siphoned from the machine and thereby contaminate the incoming water supply line. A pressure actuated sensing device or water level control **70** may be provided to control both solenoids **64** and **65** so as to provide the proper water level in the machine during the washing operation. Sensing device **70** may be connected to the interior of tub **12** by a suitable conduit **71** which connects with the tub adjacent the bottom thereof at **72** 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 **73** which is energized during the drying operation so that the valve passes water at a suitable rate sufficient to condense from the air the moisture vaporized from the clothes. As shown, the condenser water valve discharges into a conduit **74** which leads through an appropriate air gap to a funnel **75** connected by a downwardly extending conduit **76** to an opening **77** in the side of the tub **12**. The condenser water than flows from opening **77** in a thin sheet down the lower left wall **78** of the tub so as to cool a substantial portion 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 portion of the operation, and the condenser water and the moisture extracted from the clothes during a heat drying operation, are discharged from the machine through the sump **68** formed at the bottom of the tub. A suitable discharge hose **79** leads from the sump to a pump **80** (FIGURE 4) continuously driven by motor **23**, and from pump **80** an outlet **81** (FIGURE 2) extends upwardly to a valve **82** which is suitably controlled by a solenoid (shown only schematically at **83** in FIGURE 7). Valve **82** is suitably formed in a conventional manner so that when the solenoid is energized the valve **82** is closed and when the solenoid is not energized the valve **82** is opened. In other words, for water to be retained in the tub **12** the solenoid must be energized to close the valve **82** so that the continuous operation of the pump will not be effective to drain the tub.

It will be understood that from valve **82** connection is made to a suitable drain (not shown).

To heat the clothes during the heat drying portion of the cycle, there is provided in the machine a suitable heater assembly which, as shown in FIGURE 2, may include a pair of heaters **84** and **85**. When the heaters are energized during the drying cycle they operate to heat the basket **10** which, through its rotation, then contacts the clothes to transfer its heat to the clothes. In addition, since the outer cylindrical wall of the basket is foraminous, i.e., perforated by a great many small spaced openings **86**, the heating elements also heat the clothes directly by radiation and convection. The heat thus transferred to the clothes causes vapor migration out of the clothes so as to effect drying thereof.

Referring now to the schematic circuit diagram of FIGURE 7, there is shown a simplified control arrangement for the machine of FIGURES 1, 2, 3 and 4 in which the electrical system of the machine is energized across a suitable source of power through conductors **87**, **88** and **89**. Generally, in commercial practice, 220 volts are impressed across conductors **88** and **89**, with 110 volts appearing between each of them and the neutral conductor **87**.

Directly connected to neutral line **87** is a timer motor **90** of any conventional well known type. The timer motor forms a part of a conventional sequence control assembly wherein a number of cams A, B, C, D, E, F, G, and H control a number of switches such as those indicated by the numerals **91** through **98**. The timer motor, the cams and the switches generally form a unitary assembly which may be positioned within the backsplasher **4** of the machine behind one of the dials **6** so that the one dial may be used for manual control of the position of cams A through H. When the timer motor **90** is energized, cams A through H are rotated slowly to cause the switches **91** through **98** to open and close in a suitable sequence so as to effect the desired operation in the machine. This occurs when the dial **6** is used to advance the cams from an Off position, which they normally attain at the end of a cycle, to a Start position when another cycle of operation is desired. Positioning the cams in their Start position causes the switch **98** to be closed by cam H so as to complete an energizing circuit for the timer motor **90** across conductors **87** and **88**. Thus, when the one dial **6** is relased after having been put in the Start position, the operation of the timer motor will cause the switches which it controls to open and close in a suitable sequence.

For illustrative purposes, the switches have been shown as controlling various components of the machine. Thus, switch **91** controls the drain valve solenoid **83**, switch **92** controls the condenser valve solenoid **73**, switches **94** and **95** respectively control the hot and cold water solenoids **64** and **65**, switch **96** controls energization of gear motor assembly **52**, and switch **97** controls the drive motor **23**. The other timer switch **93** controls energization of a relay **99**, and relay **99** in turn controls a pair of switches **100** and **101** both in series with the heaters **84** and **85** so that when relay **99** is energized the switches **100** and **101** are closed to provide energization of the heaters **84** and **85** across the 220 volt source through conductors **88** and **89**.

It will be recognized that, in the conventional manner, the switches control the components so as to provide a suitable sequence of stops in the machine to effect a laundering operation. For purposes of brevity, a particular sequence in which the switches are opened and closed will not be fully described, such sequences being relatively conventional features and susceptible of many modifications. In general, water is initially introduced into the machine with the drain valve closed for a washing step; then the water is drained out at the end of the washing step, and several rinses are provided with warm, hot or cold water, each rinse being followed by drain-

ing; all washing and rinsing operations are provided with the basket **10** being rotated at tumbling speed, that is, with the gear motor assembly **52** de-energized so that the movable sheave assembly **26** is pulled into the position shown in FIGURE 2 by the spring **45**. After the last rinse (and after wash and intermediate rinses also, if so desired), a high speed spin is provided in the machine so as to remove as much liquid as possible from the clothes by centrifuging prior to the heat extraction of the remainder of the liquid in the clothes. The high speed spin operation is effected by closure of switch **96** by cam F so as to energize the gear motor assembly **52** which then overcomes the spring **45** and starts winding up the chain **50** on pulley **51** to pull assembly **26** to the right (FIGURE 2), it being understood that the gear motor assembly **52** is of the type which may remain stalled without adverse effect once it has wound the chain up.

Completing the description of a laundering operation, at the end of the high speed spin the timer motor **90** may close the switch **93** to cause energization of the heaters **84** and **85**, as described above. This drying operation, conducted at tumbling speed, is continued for a suitable period at the end of which the clothes have been fully laundered including washing, rinsing, spin extraction of liquid, and heat drying; the timer motor **90** then opens all its associated switches to de-energize the machine and terminate the operation.

As mentioned above, during the spin operation the gear motor assembly **52** is energized and this energization causes the chain **50** to be wound up on pulley **51**. It will be understood that, in the structure shown, the gear motor assembly **52** takes a period of several seconds to move the sheave assembly **26** over to its far right hand position (FIGURE 2), that is, to accelerate the basket from tumble speed to its maximum spin speed. It will further be understood, as has been stated above, that unbalanced distribution of clothes in the basket **10** may occur, and that as a result vibrations of the machine may be induced which, if the machine is permitted to accelerate to its maximum speed of 400 r.p.m., might be injurious to the machine.

To prevent this occurrence, I provide the switch assembly shown in FIGURE 1 by the numeral **102** and which appears enlarged and in full detail in FIGURES 5 and 6 to which reference is now made. It will be observed from FIGURES 5 and 6 that the assembly **102** includes a bracket member **103** having an upstanding portion **104** and a horizontal portion **105**. Portion **105** is secured to base **2** of the machine so that the assembly **102** is for the main part rigidly secured to the stationary parts, or frame, of the machine. A sheet of insulating material **106** is secured to the front of part **104** and may, as shown in FIGURE 5, extend substantially across the full width of the part **104**. At the center of sheet **106**, there is provided an insert **107** of conductive material such as metal; this insert forms the stationary contact which is shown in series with switch **96** in FIGURE 7, being connected thereto by a suitable conductor **109** insulated from the frame by the conventional covering **110**.

A pin member **111** is secured near the top of member **104** and acts as a support pivot for a member **112**. Member **112**, in turn, is rigidly but adjustably secured to a member **113** by suitable threaded members such as screws **114** which fit through a slot **115** in member **113** so that it can be slipped up and down relative to member **112**; this permits correct adjustment of member **113** after assembly, the screws **114** then being tightened. At the lower end of member **113** there is secured an insulating member **116** which holds a contact member **117** insulated from the remainder of member **113**. Contact **117** constitutes the movable contact shown in FIGURE 7, and is connected in series with assembly **52** by an appropriate conductor **118**.

As stated, the assembly of members **112** and **113** is pivotable on pin **111** so that the contact **117** may slide across the face of member **106** and its insert **107**. At the top end of member **112** there is formed a clip **119** within which a generally spherical end portion **120** of a member **121** is secured. The member **121** in turn is fastened to the bottom of sump **68** which is, as previously stated, formed on the bottom of tub **12** and is positioned so as to vibrate with basket **10** on legs **20** when such vibrations occur as a result of an unbalanced load within the basket during high speed rotation. The vibrations occur primarily in a horizontal plane parallel to the front of the machine so that the member **121** moves substantially horizontally as shown in FIGURE 5.

This horizontal movement of member **121** causes the end portion **120** thereof to pivot the member **112** about pin **111** in a clockwise direction. Until the vibrations reach a predetermined amplitude, the movement of contact **117** is not great enough to prevent it from having continuous engagement with contact **107**. However, when the amplitude of the vibrations reaches the predetermined level, the contact **117** no longer engages insert **107** of member **106** at the end of its vibrational movement, but instead is in engagement only with the insulating material forming the remainder of sheet member **106**. In other words, the members **112** and **113** together form an actuator which is secured to be moved by the vibrations of the flexibly supported parts of the machine, the amplitude of movement of the actuator assembly being proportional to the amplitude of the vibrations, and the amplitude of the vibrations in turn being proportional to the combination of unbalance and speed.

It can be seen that during vibrations within the predetermined amplitude the contact **117** always engages contact **107**. When the vibrations increase above this predetermined amplitude as a result of an increase in speed, then the contact **117**, above the predetermined amplitude, passes out of engagement with contact **107** so that the switch represented by assembly **102** is opened. In effect, when switch **96** is closed to cause a spin operation to be provided, the switch assembly **102** then becomes the controlling factor in the energization of gear motor assembly **52**. As long as the vibrations are within the predetermined amplitude, switch **102** is continuously closed and the gear motor **52** is energized to cause acceleration toward the maximum spin speed of the basket.

If the load is properly balanced, this state of affairs will continue to the maximum spin speed and the centrifuging will take place at that speed. However, in the event that the load of clothes should be unbalanced, the suspended system will vibrate, the amplitude of the vibration increasing as the speed of rotation of the container increases because of the increase in the centrifugal force of the unbalance. In this connection, it will be recognized that the greater the unbalance the greater the amplitude of the vibrations will be for any given spin speed. When the vibrations reach the point at which an additional increase in basket speed would cause undesirable vibrations, the amplitude of movement of the actuator assembly is such that contact **117** moves out of engagement with contact **107** at each end of each vibration. During this period of separation of contact **117** and **107**, the gear motor assembly **52** is de-energized and spring **45** consequently pulls the sheave assembly **26** slightly to the left as viewed in FIGURE 2. This arrangement has the result that the unbalanced the load the lower the speed at which the accelerating effect of the energized gear motor and the decelerating effect of the spring **45** during de-energization of the gear motor set each other off so that the speed is at a substantially constant level. To put it differently, the greater the unbalance, the lower the speed which is reached by the rotating basket at the time the unbalances cause the set-off between the gear motor and the spring to occur. Thus, the desired result is achieved of providing the maximum speed which is permissible without vibrations of dangerous proportions occurring.

For highly unbalanced loads, a low spin speed will be

provided since it will be at that low speed that the predetermined amplitude of vibration at which contacts **107** and **117** are separated occur, while for slightly unbalanced loads a relatively high speed will be reached before the separation of the contacts occurs and for generally balanced loads no separation will occur, the contacts **107** and **117** remaining in engagement to complete the circuit energizing the gear motor **52** throughout the spin operation.

Referring now to FIGURES 8 and 9, there is shown a second embodiment of my invention wherein a modified switch assembly **122** is used to control the speed of rotation of basket **10**, it being understood that like parts are referred to by the same numerals already used. In switch assembly **122**, there is a member **123** having a horizontally extending portion **124** rigidly secured to base **2** of the machine and a vertically extending portion **125**. Rigidly secured to portion **125** is a substantially coextensive member **126** which has an opening **127** therein within which is secured portion **128** of a contact member **130** having an insulating covering **129** around it where it joins member **126**. Contact **130** also has a portion **131** adapted to be engaged on opposite sides by a pair of contacts **132** and **133** respectively secured at the ends of flexible contact arms **134** and **135**. The contact arms are secured at their upper ends by any suitable means, such as rivets **136** and **137** having insulating coverings **138** and **139** around them, to extensions **140** and **140***a* of member **123** extending from part **125** at the top end thereof.

A rivet **141** provides a pivot support for an actuator member **142** having a lower end portion **143** to which is secured an insulating member **144**. Member **144**, upon pivoting of member **142** about rivet **141**, is arranged, as can be seen from a comparison of FIGURES 8 and 9, to engage arm **134** upon pivoting clockwise and arm **135** when pivoting counterclockwise. At the top end of member **142** there is provided a notch **145** into which extends the downwardly formed end **146** of a spring arm **147** rigidly secured by a bracket **148** to the sump **68**; thus, in effect, the spring arm **147** form a part of the flexibly supported system of the machine. The spring arm when positioned as shown is relatively rigid in a horizontal direction, but has enough spring so that its end **146** remains within notch **145** and thus remains in engagement with the actuator member **142**.

When the flexibly supported system vibrates as a result of unbalances within the basket **10** during high speed rotation thereof, pivoting of member **142** about rivet **141** is caused in substantially the same manner that, in connection with the structure of FIGURES 5 and 6, pivoting of member **112** on pin **111** is caused. This pivoting action is without effect as long as the vibrations remain small enough so that the member **142** does not move sufficiently for insulated portion **144** to engage either of the contact arms **134** or **135**. However, when the vibrations exceed a predetermined amplitude, the actuator member **142** will be oscillated back and forth by spring arm **147** with an amplitude sufficient to engage contact arms **134** and **135** and, thus, move contacts **132** and **133** alternately out of engagement with contact section **131**.

It will be understood at this point that the energizing circuit for the gear motor assembly **52** may be made to pass through the contact arm **134** and contact **132**, then through the stationary contact section **131**, and then through contact **133** and contact arm **135**. With this arrangement, separation of either of contacts **132** or **133** from contact section **131** de-energizes the gear motor assembly **52** with the result previously described in connection with FIGURES 5 and 6. It can thus be seen that the desired results of my invention may be achieved by a different structure from that shown in FIGURES 5 and 6, the main difference between the two structures being that in the first embodiment a sliding type of contact was provided in response to vibrations whereas in the structure of FIGURES 8 and 9 the sliding contact is obviated by the structure shown.

Referring now to FIGURE 10, there is shown a third embodiment of my invention, it being understood that this structure also is used in a machine having the drive system of FIGURE 4 together with the structural feature shown in FIGURES 2 and 3. The gear motor assembly **52** in this case includes a conventional reversible shaded pole motor having a main winding **149** and a pair of wound shading coils **150** and **151**, it being understood that the laminated core of the motor is indicated schematically at **152**. Shading coil **150** may be provided in a complete electrically conductive loop which includes a stationary contact **153** and a movable contact **154** of a switch generally indicated at **155**, and a conductor **156** connected to movable contact **154**. The shading coil **151** may be similarly connected in a closed loop through a stationary contact **157** which is engageable by movable contact **154** when button **158** is depressed. Normally, a spring **159** biases the movable contact **154** into engagement with stationary contact **153** so as to complete the loop for shading coil **150**.

In the conventional manner of shaded pole motors, the motor will start to operate when the main winding **149** is energized across a source of power and a loop is completed for one or the other of the shading coils. In this connection, it will be understood that winding **149** is connected in series with the timer switch **96** previously described in connection with FIGURE 7. Shading coil **150** is arranged so that, when its loop is completed by engagement of contacts **153** and **154**, the timer motor assembly **52** rotates in a first direction so as to wind up the pulley **51** (FIGURE 4). However, when the button **158** is depressed against the action of spring **159** to move contact **154** into engagement with contact **157**, the loop for coil **150** is opened and the loop for coil **151** is closed. Coil **151** causes the gear motor assembly **52** to rotate in the opposite direction thereby providing an unwinding operation insofar as the chain **50** and pulley **51** of FIGURE 4 are concerned.

Rigidly secured to the base of sump **68**, in the same manner as previously described, is a member which, in the present case, may be formed as an L-shaped bracket **160**. The bracket **160**, upon horizontal vibrations of the movable system of the machine as previously described, operates button **158**, when the vibrations reach a predetermined amplitude, through an intermediate actuator assembly generally indicated by the numeral **161**. Assembly **161** is fully described and illustrated in Patent 2,832,208, Stone, issued on April 29, 1958, and assigned to the General Electric Company, owner of the present invention. In general terms, the actuator assembly may include an adjustable scissors arrangement in which a pair of movable members **162** and **163** are formed as arms pivotably mounted on a pin **164** mounted on the base **2**. The one arm **162** of the scissors engages bracket **160** so as to be moved thereby, and the other arm **163** is moved by arm **162** through a spring **165** so as to depress button **158** upon a sufficient movement of the tub as fully described in the aforementioned Stone patent.

It will be observed that, as long as the vibrations do not reach the predetermined amplitude discussed hereabove in detail, the gear motor assembly **52** will be energized in the direction to cause acceleration of the basket **10** of the machine. However, when the predetermined amplitude of vibrations is reached because of high speed rotation with an unbalanced weight distribution, the actuator assembly **161** depresses button **158** to move contact **154** from the position to which it is biased so as to complete the loop for coil **150** to a second position in which it instead completes a loop for coil **151**. This particular arrangement permits the gear motor assembly to assist the spring **45** in decelerating the basket during the part of each vibration when the vibrational movement is in the excessive amplitude area. This structure may be de-

sirable in cases where the amount of inertia to be overcome is so substantial that the brief period of each vibration during which it exceeds the predetermined amplitude may not be sufficient to permit spring 45 to provide a large enough deceleration for the purposes of the invention.

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 modifications may be made therein without departing from the invention. As an example of such a modification, but without limitation as to other modifications, the drive arrangement may be formed so that deceleration is toward a stopped condition as a minimum speed rather than the tumbling speed of the illustrated machine; this would be a likely arrangement where centrifuging was the only function of the machine, i.e., it did not wash or heat-dry. As a further example, while a constant speed motor driving a variable speed transmission has been illustrated as the most likely structure to be used, it is readily conceivable that motors which have their speed variable by different means may also be used. In such a case, the electrical controlling means will naturally assume a different form from the precise type illustrated herein; thus, a resistance might be provided as a controlling means for the driving means, the resistance being included in series with the motor when vibrations became larger than they should and being excluded at other times. 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. A centrifugal extraction machine comprising: a frame; an article-receiving container positioned on said frame; support means flexibly and rotatably securing said container to said frame for vibratory movement relative to said frame in response to rotation of said container with an unbalanced weight distribution; driving means for rotating said container at a predetermined maximum centrifuging speed; electrical means controlling said driving means, said electrical means having a first condition wherein said driving means accelerates said container toward the maximum speed and having a second condition wherein said driving means decelerates said container toward a minimum speed; and a control circuit for said electrical means including a switch assembly, said switch assembly comprising a first member secured to said frame, an actuator movably secured on said support member, and means movable in vibration with said container engaging said actuator for moving said actuator in response to vibrations, said first member including a stationary contact, said actuator including a movable contact slidable across said stationary contact during vibrations and engaged with said stationary contact when there are no vibrations, said actuator sliding said movable contact past the edge of said stationary contact during the part of each vibration above a predetermined amplitude when said vibrations exceeds said predetermined amplitude, said switch assembly being arranged in said circuit to provide said first electrical means condition when said contacts are in electric engagement with each other, and to provide said second electrical means condition only when said contacts are out of engagement with each other, whereby said electrical means causes said driving means to rotate said container at a speed generally proportional to the fraction of the total time of each vibration that said electrical means is in said first condition.

2. The apparatus defined in claim 1 wherein said actuator is pivotably secured intermediate its ends to said first member, said actuator having said movable contact secured to it adjacent one end thereof and being connected to said container for vibratory movement thereby adjacent its other end.

3. A centrifugal extraction machine comprising: a frame; an article-receiving container positioned on said frame; support means flexibly and rotatably securing said container to said frame for vibratory movement relative to said frame in response to rotation of said container with an unbalanced weight distribution; driving means for rotating said container at a predetermined maximum centrifuging speed; electrical means controlling said driving means, said electrical means having a first condition wherein said driving means accelerates said container toward said maximum speed and having a second condition wherein said driving means decelerates said container toward a minimum speed; and a control circuit for said electrical means including a switch assembly having a first member with a stationary contact secured thereon, second and third movable contacts engaging said first contact on opposite sides thereof, flexible contact arms respectively secured at one end to said first member and respectively carrying said movable contacts adjacent their other ends, and an actuator movably secured on said first member and having a portion positioned between said contact arms, said actuator being connected to said container to be movable in response to vibrations of said container, said actuator portion between said contact arms engaging said contact arms at each end of its range of movement when vibrations exceed a predetermined amplitude whereby said actuator separates said movable contacts alternately from said stationary contact during a part of each vibration above said predetermined amplitude when said vibrations exceed said predetermined amplitude; said switch assembly being arranged in said circuit to provide said first electrical means condition when both movable contacts engage said stationary contact, and to provide said second electrical means condition only when either movable contact is out of engagement with said stationary contact, whereby said electrical means causes said driving means to rotate said container at a speed generally proportional to the fraction of the total time of each vibration that said electrical means is in said first condition.

4. The apparatus defined in claim 3 wherein said actuator is pivotably secured intermediate its ends on said first member, said actuator portion extending between the said contact arm adjacent one end of said actuator, said actuator being connected to said container for vibratory movement thereby adjacent its other end.

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