DIRECT MOTOR DRIVE FOR AGITATOR AND SPIN TUB

Filed July 8, 1963 4 Sheets-Sheet 1

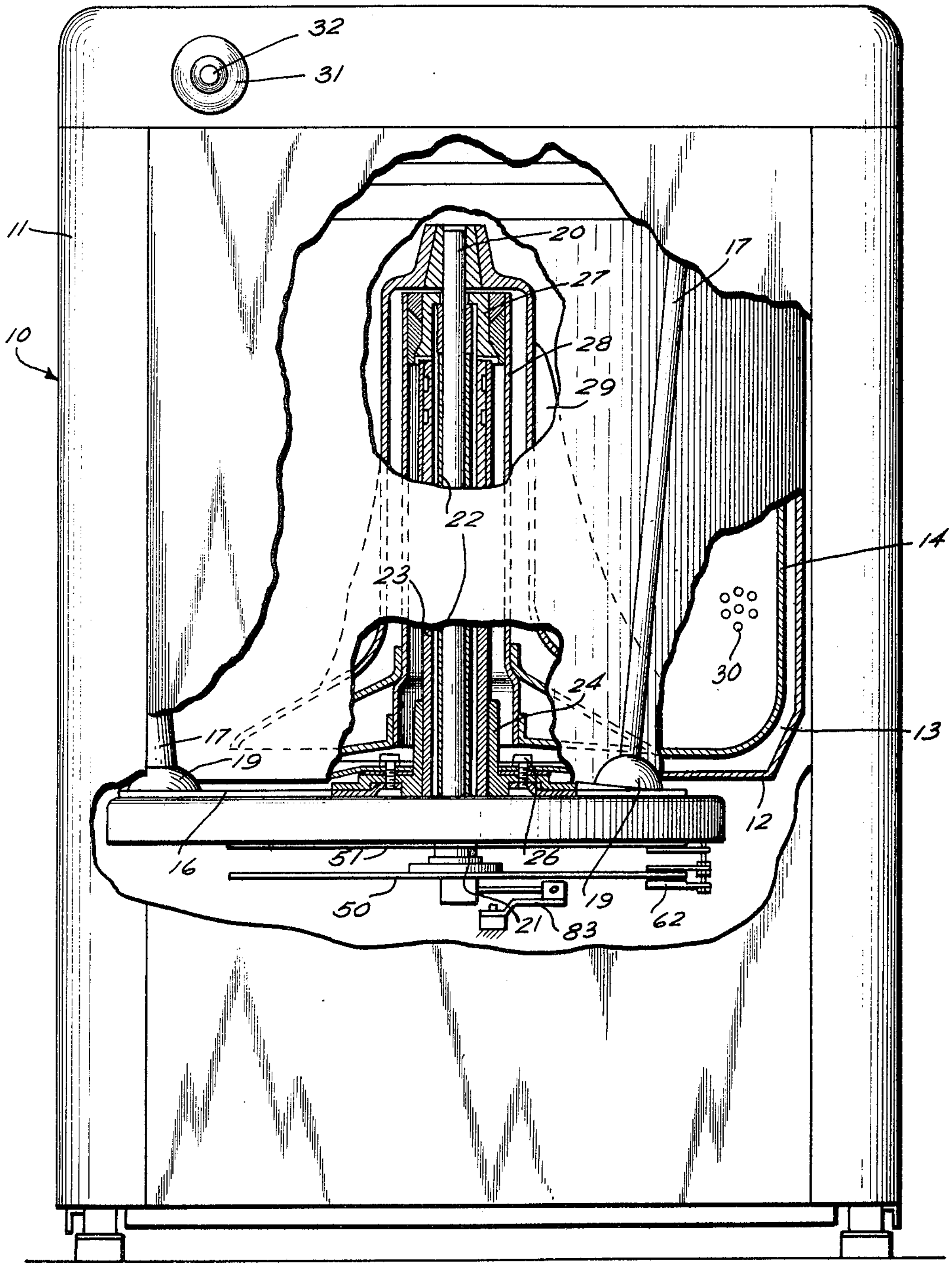

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FIG. 1

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FIG. 2

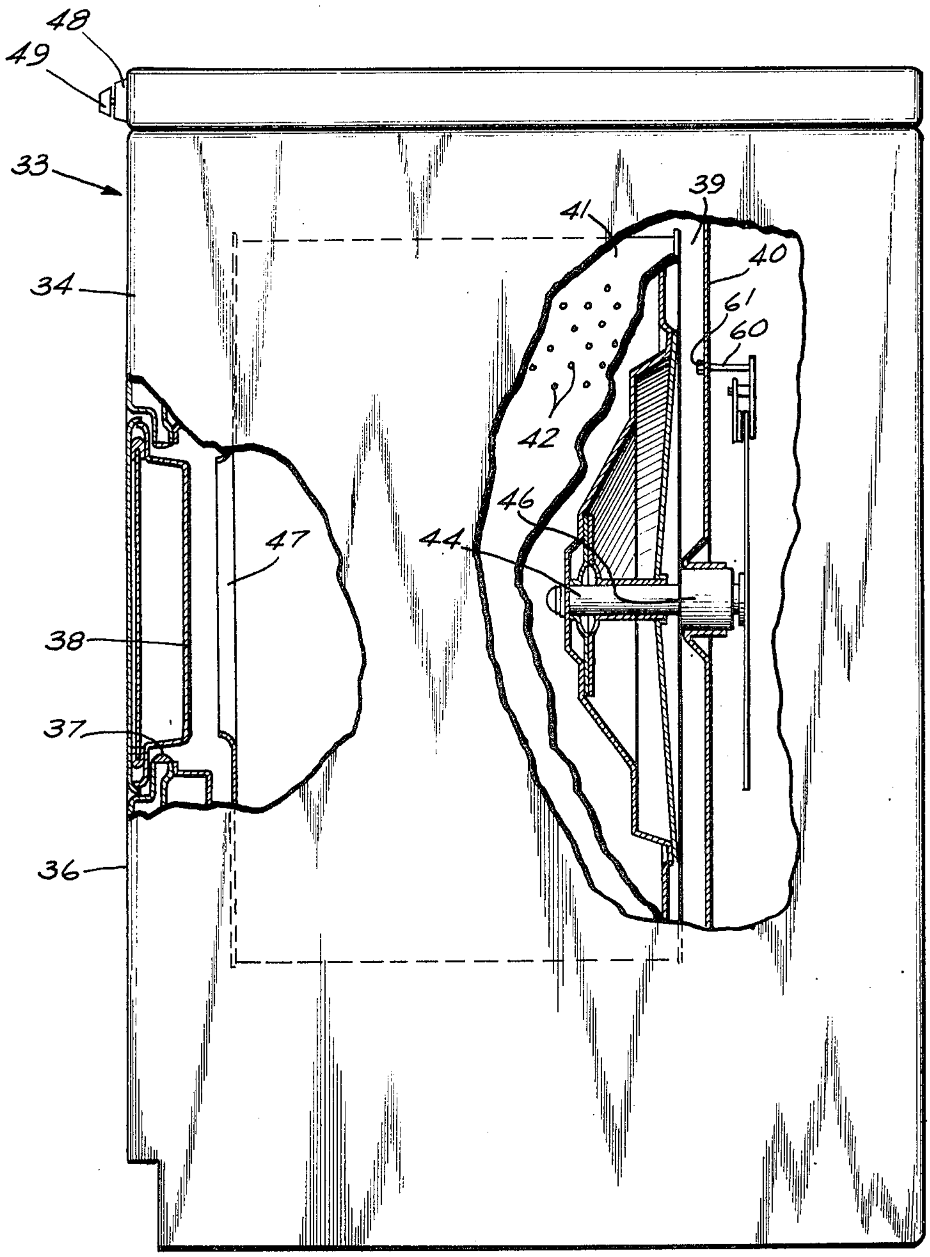

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FIG. 3

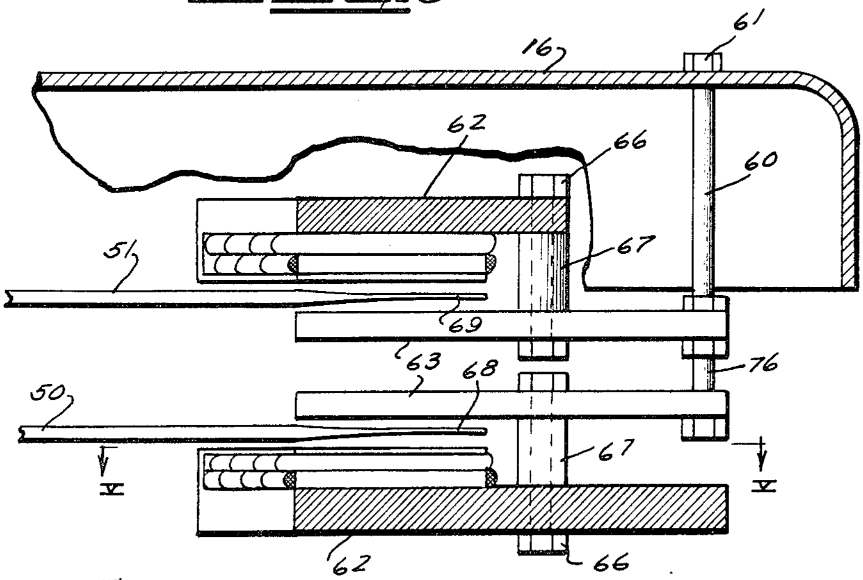


FIG. 4

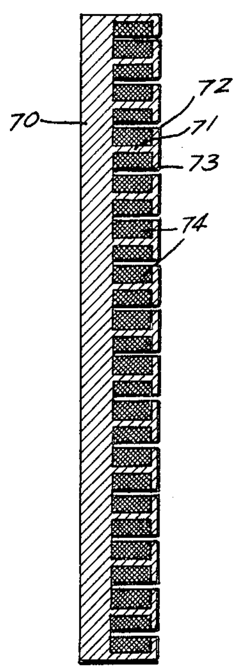
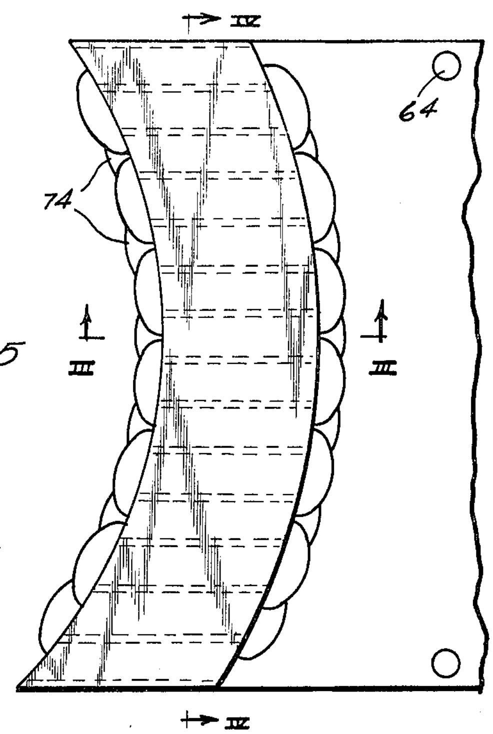


FIG. 5



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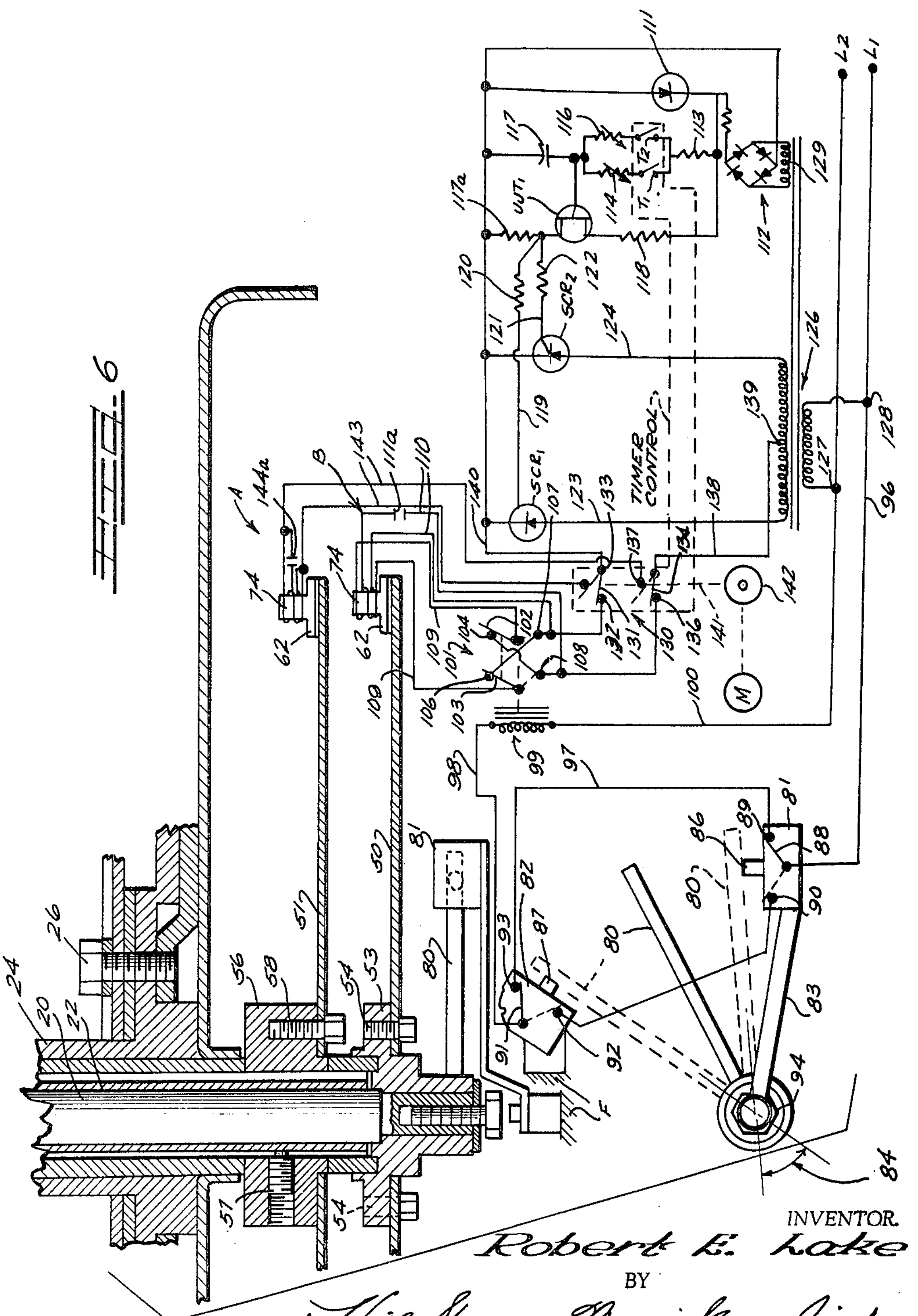

FIG. 6

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DIRECT MOTOR DRIVE FOR AGITATOR AND SPIN TUB

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Int. Cl. D06f *33/02, 37/04, 23/04*
U.S. Cl. 68—12 **3 Claims**

This invention relates generally to a method and apparatus for cleaning or drying articles to be laundered or dry cleaned, such as clothes, wherein rotatably or oscillatably operable components of the apparatus are driven by an induction-type motor having a plurality of poles terminating in a plane adjacent the surface of a member or part disposed radially of the axis and in circumferentially spaced relation, thereby producing a moving magnetic field for inducing the required movement of the member.

In cleaning appartaus heretofore provided it is customary to provide a treatment zone in which materials to be cleaned are mechanically agitated in the presence of a cleaning agent such as a laundry liquid. In vertical axis machines, the agitation is customarily provided by an agitator which oscillates within a basket or receptacle and in such apparatus, the basket or receptacle is frequently made rotatable so that an extraction operation can be effected with respect to the materials being cleaned in the same container.

In horizontal axis machines, a rotatable basket or container is generally provided which can be rotated either at a tumbling speed in order to subject the materials to a cleaning or drying action or at a higher centrifuging speed for extraction purposes.

With such prior art apparatus, it is customary to include some form of a driving motor linked to the movable parts of the apparatus by a speed-changing means. Oftentimes the speed-changing devices are complicated and cumbersome and may include complex gear trains and transmissions or a multiplicity of pulleys and other devices which permit a single driving motor to deliver the motive power for effecting the multiple speed driving actions required for either actuating an agitator or operating a drum at tumbling speed and for spinning a container or basket at a centrifuging speed.

In accordance with the present invention, it is contemplated that the customary electric motor as conventionally employed and the usual speed-changing means would all be eliminated, and the motive power for effecting the necessary movement of the movable components is provided by a so-called arcuate or linear induction motor wherein a plurality of poles terminate in a plane adjacent the surface of a driving part or member in circumferential or arcuate spaced relation and radially outwardly of the axis of the movable part. Thus, a moving magnetic field is produced which induces a corresponding movement of the surface and hence of the part.

A very important advantage of this arrangement is that the required drive power can be produced at a very low operating speed without substantially increasing the physical size or mass of the field structure of the motor and without any substantial decrease in efficiency. Thus no speed reducing mechanism is required. The low operating speed arises from the fact that the synchronous speed of operation in revolutions per minute is equal to the product of the effective angular spacing of poles in degrees and the frequency in cycles per second, divided by a constant which is 3 in the case of a single phase motor, and with the linear induction motor, it is possible to have a very small angular spacing between poles to thus produce a correspondingly low synchronous speed of operation. The actual speed is somewhat less than the synchronous speed due to the slip which obtains in the normal operation of an induction type motor. An additional advantage is in a compact physical relationship of the motor structure to the agitator and receptacle structure of the cleaning apparatus. Another advantage is that a reciprocating action can be readily produced, through the use of reversing circuitry of a relatively simple nature. Further, by electronically controlling the energization of the motor, infinitely variable speeds may be afforded.

It is, therefore, an object of the present invention to provide a cleaning apparatus wherein a movable part thereof is driven by a so-called linear induction motor.

It is a further object of the present invention to provide a laundry machine of either the vertical or horizontal axis type wherein the rotatable or oscillatable members thereof are driven in a rotary or oscillatory motion by **a** disk motor of the linear induction type.

A further object of the present invention is to provide a laundry machine wherein agitator means are driven by a linear induction-type motor.

A still further object of the present invention is to provide a laundry machine using as its prime mover for the agitating and centrifuging components thereof a linear induction-type motor and wherein electronic control of the motor will afford variable operating conditions as required in a cleaning cycle.

Yet another object of the present invention is to provide a laundry machine wherein a conventional motor and speed-changing means such as a gear case or pulley means is eliminated in favor of a linear induction-type motor.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of a cleaning apparatus such as a vertical axis machine or a horizontal axis machine is shown by way of illustrative example and which is capable of practicing the inventive methods contemplated by the present invention.

On the drawings:

FIGURE 1 is an elevational view of an automatic laundry machine constructed in accordance with the principles of the present invention with parts of the cabinet therefor broken away and with certain other parts in vertical section;

FIGURE 2 is a side elevational view of a horizontal axis type laundry machine with parts of the casing broken away to illustrate features of the invention;

FIGURE 3 is an enlarged fragmentary view of a portion of the subject matter shown in FIGURE 1 partly in section showing additional details of construction of the arcuate linear induction-type motor utilized in accordance with the principles of the present invention and parts are shown in section taken in the plane of line III—III of FIGURE 5;

FIGURE 4 is a fragmentary cross-section taken on line IV—IV of FIGURE 5 and illustrates additional details of the stator;

FIGURE 5 is a fragmentary elevational view taken in the plane of line V—V of FIGURE 3 and showing additional details of the stator; and

FIGURE 6 is a schematic view showing a portion of the structure of FIGURE 1 in cross section and illustrating a portion of the structure in bottom plan and further illustrating a circuit diagram for the electronic control circuitry associated with the linear induction motor of the present invention.

As shown on the drawings:

It will be understood that the principles of the present invention are applicable to any cleaning apparatus wherein movable components are actuated or driven such as domestic and commercial laundry apparatus, drycleaning machines, dishwashers and other forms of cleaning appliances. For purposes of illustration, however, the present invention is shown as embodied in a laundry appliance such as a vertical axis washing machine, shown generally in FIGURE 1, or a horizontal axis laundry machine, as shown in FIGURE 2.

In the embodiment of the invention illustrated in FIGURE 1, there is shown an automatic washing, rinsing and drying machine designated generally at **10** having a cabinet **11** forming an enclosure for a tub **12** constituting a treatment zone **13** for clothes or other fabrics to be laundered in fluid retained in tub **12**.

In order to retain clothes within the treatment zone **13**, there is provided a receptacle or basket forming a clothes container **14** which is rotatably mounted within the tub **12** and which is closed at its top by the cabinet **11** which also forms an enclosure for the entire control and driving mechanism of the apparatus.

The tub **12** is shown as being carried on a floating base **16** suspended from the top portion of the cabinet on three suspension links **17** incased in rubber at their ends and carried in sockets **19** in the base **16**.

An oscillatable drive shaft **20** is shown as being journaled in a bearing **21** and extending upwardly through the base **16** and into the interior of the tub **12** wherein the shaft **20** is journaled within a rotatable drive sleeve **22**. The sleeve **22** extends within a stationary sleeve **23** which extends upwardly from a hollow center post **24** secured in firm and sealed assembly with the bottom wall of the tub **12** by a plurality of fasteners **26**.

The hollow center post **24** not only forms a closure for the center part of the bottom of the tub **12**, but also extends upwardly from the bottom of the tub **12** and supports the stationary sleeve **23** which provides a support for the basket or container **14**. The top support means is indicated generally at **27** and it will be noted that the inner upstanding portion of the container or basket **14** is shown at **28**. An agitator **29** is carried on the upper end of the shaft **20** and is suitably secured thereto so as to be driven in unison with any movements imparted to the shaft **20**.

The sleeve **22** extends downwardly along the length of the shaft **20** and is adapted to be rotatably driven, thereby to correspondingly drive the basket or container **14**.

Although the principles of the present invention are applicable to any vertical axis laundry machine such as a vertical axis machine of the so-called overflow rinse type, the present embodiment shows a perforated basket **14** having foraminous walls with openings **30** embodied therein. Thus, although the features of the plumbing arrangements are not necessary to the understanding of the present invention, it will be appreciated that fluid can be pumped to and from the treatment zone **13** and will be confined by the tub **12**.

In order to automatically operate the machine **10** through a programmed sequence of washing, rinsing and drying periods, a presettable sequential controller is shown generally at **31** and includes a presettable adjustment knob **32** which may be manipulated by the operator of the machine in order to preselect the desired program, thereby to automatically operate the machine **10** through a cleaning sequence.

Turning now to FIGURE 2, a horizontal axis laundry machine **33** is illustrated comprising a casing **34** having a front wall **36** in which is formed an opening **37** closed by an axis door **38**.

The casing **34** provides an enclosure for a tub forming a treatment zone **39** and having a rear bulkhead **40**.

In order to confine a batch of materials to be laundered or processed within the treatment zone **39**, there is provided a drum or receptacle **41** having a foraminous outer cylindrical wall formed with openings **42** and carried by means of a cantilever support arrangement on the end of a shaft **44** journaled in a bearing assembly **46**.

The drum **41** has an opening **47** formed in register with the door **38** through which the materials to be laundered may be inserted and removed.

The machine is provided with a presettable sequential control means **48** having a presettable adjustment knob **49** by means of which the machine may be automatically operated through a programmed sequence of washing, rinsing, extracting and drying operations since it will be appreciated that the machine **33** may constitute either an ordinary laundry machine or a so-called combination washer-extractor or combination washer-dryer wherein clothes may be selectively washed, rinsed and dried, or merely dried or merely washed.

In accordance with the principles of the present invention, the movable components of the apparatus exemplified by the machines **10** and **33** are to be driven by a linear induction-type motor. In this regard, the structural components and the principles involved are generally similar and for ease in convenience in understanding the principles of the present invention, common reference numerals will be applied to illustrate like components on both machines **10** and **33**.

The ordinary induction motor, of course, is the most common type of electric motor in commercial use on cleaning apparatus and generally consists of an outer case surrounding a stator wherein the magnetic poles terminate in a circle radially outwardly of a rotor connected to a driven shaft. By supplying the windings of the poles with alternating current the current supply permits the various electrical field magnets to reach maximum strength in a sequence and the magnetic field inside the set of magnets effectively rotates through one complete revolution in every cycle of the A.C. supply. Thus, when the rotor is placed inside of the magnetic system, the moving magnetic field induces a current in the electrically conducting metal and the current is then itself acted upon by the same field which produced it so that a torque is exerted on the cylinder and rotation is produced. The rotating field has the effect of exerting a torque on the rotor which is rotatably disposed therewithin. Where the rotor consists of bars firmly assembled between end pieces, the rotor is sometimes referred to as a "squirrel-cage."

In accordance with the principles of the present invention, an induction-type motor is utilized; however, the stator is, in effect, opened up so that a plurality of poles terminate in a plane rather than in a circle as in a conventional motor.

To characterize such basic difference, the motor of the present invention as utilized in the cleaning apparatus of the present invention will be referred to as a "linear induction motor." Thus, in the linear induction motor arrangement of the present invention, the movable component of the cleaning equipment has a driven portion thereof disposed in a plane perpendicular to the axis of movement. Such portion may constitute a disk-like member which is connected in corotatable assembly with the movable part or with the shaft thereof. Depending upon its use as an oscillatory or rotary drive system, this disk portion may be of a segmental configuration or of a circular shape. The plural poles of the stator are then terminated adjacent the surface of the driven disk in circumferentially or arcuately spaced relation to one another and perpendicular to the axis of rotation or oscillation. Thus, the windings on the stator will produce a moving magnetic field which induces a current in the electrically conductive metal of the disk and since the current is then acted upon by the same field which produced it, a torque will be exerted on the disk and since such torque acts through a moment arm by virtue of being spaced radially outwardly of the axis, a movement of the movable oscillatable or rotatable member will be produced.

As shown in FIGURE 1, the shaft **20** associated with the agitator **29** has connected therewith a disk **50** which is disposed in the radial plane perpendicular to the axis of rotation of the shaft **20**. The sleeve **22** likewise has a disk **51** attached thereto which is disposed in a radial plane perpendicular to the axis of rotation of the sleeve **22** which rotates in unison with the tub or container **14**.

For details of such construction, reference may be made to FIGURE 6 wherein the shaft **20** is shown connected to a hub **53** which in turn is connected to the disk **50** by a plurality of fasteners **54**.

The sleeve **22** has a hub **56** connected thereto by a set screw **57** and the disk **51** is connected in corotatable assembly with the hub **56** by a plurality of fasteners **58**.

A stator for each linear induction motor unit is carried by a bracket assembly including appropriate hanger bars indicated at **60** which may be fastened, in the case of the machine **10**, to the base **16** as at **61** (FIGURE 3) and, in the case of the machine **33**, to the rear bulkhead **40** (FIGURE 2) by similar parts **60*a*** and **61*a***. Other parts of the illustrative structure in FIGURE 3 which correspond in general function to structure in FIGURE 1 are also designated by the suffix "*a*."

Each motor unit includes a magnetic field structure **62** having poles and windings thereon, and a member **63** of magnetic material on the opposite side of the disk, for producing a moving field of high intensity in the disk. The structures **62** and members **63** are provided with openings **64** through which suitable fastening means **66** extend to hold the parts in firm assembly with one another. Spacer sleeves **67** are inserted between the first and second parts to facilitate the proper spacing relationship.

The disks **50** or **51** are preferably made of nonmagnetic electrically conductive material such as aluminum, and the disks **50** and **51** are particularly characterized by a reduced peripheral portion shown at **68** and **69**, respectively, In the case of a domestic laundry appliance having the proportions of the machines **10** and **33**, the thickness of the peripheral portions **68** and **69** would be in the range of about .030–.040 inch.

Details of the field structure **62** are shown in FIGURES 4 and 5 and it will be noted that each structure **62** has a body portion **70** and a plurality of pole pieces which are T-shaped in cross section, each including a major leg **71** and laterally extending minor legs **72** and **73**.

Field windings are wound around the leg **71** of the poles as at **74**. All of the legs **72**, **73** are disposed in coplanar relation and are arranged to extend in a circumferential row in closely spaced relation to the reduced portion **68** or **69** of the respective disks **50** and **51**.

Where two linear induction motor units are provided, the support rods **60** may be provided with extensions as at **76** in FIGURE 3, thereby to dispose the units in a stacked relation.

As illustrated by the plan elevation of FIGURE 5, the plurality of poles is arranged in a circumferential row, thereby forming, in effect, a circumferential row of electromagnets. By using a single-phase alternating current supply for the windings **74**, the magnetic field adjacent the planar surfaces of the pole pieces moves in a plane and in an arcuate direction. By placing the electrically conductive disk **50** or **51** adjacent the magnetic system, the moving magnetic field induces a current in the disk **50** or **51** and this current is then acted upon by the same field which produced it so that a force is exerted on the disk tending to move it in the same arcuate line.

Thus, it will be appreciated that each of the field structures **62** and its associated member **63** produces a traveling magnetic field through its corresponding disk **50** or **51** so that the respective disk **50** or **51** constitutes the "rotor" of the machine and a uniformly distributed force will be exerted over a comparatively large area of the disk **50** or **51** without direct mechanical contact so that the drive is independent of any mechanical speed changer or of any friction between belts and rollers used in conventional equipment. Accordingly, it is possible by effecting a suitable electric or electronic control of the magnetic system of such a motor to accomplish the functional demands required of cleaning equipment without utilizing the more complex conventional type mechanisms of machines heretofore provided.

In this regard, reference may now be advantageously made to the schematic circuit diagram of FIGURE 6. In FIGURE 6, two induction motor units are contemplated indicated generally at A and at B, the induction unit A being associated with the disk **51** for the drum or basket **14** and the unit B being associated with the disk **50** and the agitator shaft **20**.

At the lower left-hand side of the drawing of FIGURE 6, there is shown connected to the hub **53** in comovable assembly a radially extending arm **80**.

Attached to the frame of the washing machine, indicated diagrammatically in FIGURE 6 at F, there is provided two adjustably spaced limit switches **81** and **82**. The limit switches **81** and **82** may be carried on suitable brackets as indicated at **83**, thereby to effect an angular spaced relationship as indicated by the illustrative angle **84** and which angle is illustrated by the dotted line positions of the arm **80** wherein the arm **80** is shown in engagement with an actuator button **86** on the limit switch **81** and an actuator button **87** on the limit switch **82**.

The diagrammatically illustrated switch **81** has a movable switch element **88** movable between fixed contacts **89** and **90**, while the diagrammatically shown switch **82** has a movable switch element **91** movable between fixed contacts **92** and **93**.

It will be understood that the bracket **83** may be suitably adjusted through appropriate adjustment of an adjustment means **94**, thereby to vary the angle **84** and hence the length of the agitator stroke.

Electric power from a conventional source of supply is tapped as at L_1 and L_2.

A conductor wire **96** connected to the terminal L_1 leads to the movable switch element **88** of the limit switch **81**. In this regard, it should be noted that both of the limit switches **81** and **82** are of the single pole, double throw type and in the solid line position of FIGURE 6, current passes from the conductor wire **96** through the movable switch element **88**, through the contact **89** into a conductor wire **97**, through the contact **93**, the movable switch element **91**, and into a conductor wire **98** electrically connected to a relay shown generally at **99**. The conductor wire **100** connected to the other side of the relay leads back to the source terminal L_2.

As soon as the trip bar or lever arm **80** engages one of the actuator buttons **86** or **87** of a corresponding limit switch **81** or **82**, the relay **99** operates and thereby actuates a double pole, double throw switch indicated generally at **101**. The switch **101** has movable switch elements **102** and **103** and in the full line position of FIGURE 6 the elements **102** and **103** are shown engaged with contacts **104** and **106**, respectively. In the dotted line position, the switch elements engage contacts **107** and **108**.

It will be noted that the movable contacts **102** and **103** are connected by way of electrical conductors **109** to one set of the windings **74*a*** of the linear induction motor unit B associated with the agitator, the windings of the other set being connected through electrical conductors **110** to the fixed contacts of switch **101** with a capacitor **111*a*** being connected in series to provide a resultant voltage substantially out of phase with the line voltage.

The double pole, double throw switch **101** performs the function of reversing the polarity of the windings of the motor unit B, thereby reversing the action of the motor on the disk **50** and oscillating the agitator through a stroke determined by the size of the angle **84**.

The circuit leading from the switch **101** is a firing circuit which includes silicon controlled rectifiers identified as SCR_1 and SCR_2. There is also provided a voltage regulator identified at **111** which takes the form of a diode connected in circuit with a full bridge shown generally at **112**.

A timing control circuit including a unijunction transistor UJT_1 is provided for controlling the firing times of the silicon controlled rectifiers SCR_1 and SCR_2 to control the amount of current supplied to the motor units A and B and thereby control the speed of operation thereof. In particular, parallel with the voltage regulator **111** and the power source, there is provided a fixed resistor **113** operating as a safety resistor. In series with the resistor **113** are contacts of a timer control illustrated in dotted lines and including contacts T_1 and T_2. In series with the timer contacts are provided variable resistors designated at **114** and **116**, respectively.

In series with the variable resistors **114** and **116** the fixed resistance **113**, a capacitor shown at **117** is provided and which is adapted to be charged on each of the half cycles.

In parallel with the circuitry thus provided, there is included the unijunction transistor shown generally at UJT_1 having its emitter connected in series with the capacitor **117** and also in series with the resistance **113** and the timer contacts T_1 and T_2 and the variable resistors **114** and **116**. Resistances shown at **117*a*** and **118** are connected in circuit with the collector of the unijunctional transistor UJT_1.

Leading from that circuit, there are provided two separate lines including a conductor **119** and a series resistor **120** and a conductor **121** and a series resistor **122**. The conductors **119** and **121** supply control signals to the gate electrodes of the rectifiers SCR_1 and SCR_2. Conductors **123** and **124** are connected to the anodes of the rectifiers SCR_1 and SCR_2 and to the center-tapped secondary of a transformer **126** having a primary connected across the line L_1 and L_2 as at **127** and **128**. Another secondary **129** of the transformer **126** is connected to the bridge rectifier **112**.

In operation, when a voltage appears across the voltage regulator **111**, the capacitor **117** starts to charge according to a rate of charge determined by the variable resistors **114** or **116** as controlled through the sequentially controlled timer contacts T_1 and T_2. The variable resistors **114** and **116** are adjustable and by controlling the amount of time or frequency in which the capacitor **117** charges these resistors can be utilized to control the speed of agitation or centrifuging. By this method of frequency control, the agitation and centrifuging speeds can be effectively controlled.

When the capacitor **117** is sufficiently charged, it discharges through the emitter of the transistor UJT_1, thereby firing the transistor UJT_1 to develop a voltage pulse across resistor **117*a*** which is applied to the gate electrodes of the rectifiers SCR_1 and SCR_2. In accordance with the polarity of the alternating current at that instant, one or the other of the silicon control rectifiers will conduct to supply current through a double pole, double throw switch shown generally at **130** and to the switch **101** to the agitating motor unit B and then back through the switch **101** to the switch **130** and back to the transformer **126**. In this regard, note that the switch **130** has an upper blade **131** movable between contacts **132** and **133** and also a lower blade **134** movable between contacts **136** and **137**. The blade **134** is connected by means of a conductor **138** to a tap **139** on the secondary of the transformer **126**, while the blade **131** is connected by means of a conductor **140** to the other components of the firing circuit.

On the next half cycle of the alternating current, the opposite silicon control rectifier will fire and a current flow will be produced through the corresponding silicon control rectifier in the manner described above.

In a centrifuging cycle the blades **131** and **134** of the switch **130** are moved to the dotted line position. To effect that function, a mechanical linkage is shown at **141** actuated by a control knob **142** which can be placed on the control console of the machine for ready access by an operator. In the dotted line position, one of the variable resistors **114** and **116** will determine the speed of the spinning motor unit A and the same general sequence of operating events will be provided except that the windings of the spin motor unit A will be energized through conductors **143** and **144** connected to the contacts **133** and **134**, with a capacitor **144*a*** being connected in series with one set of the windings to provide a resultant voltage substantially out of phase with the line voltage. In this circuitry, the reversing switch **101** is bypassed since operation of the spin motor unit A can be unidirectional.

As suggested hereinabove, the oscillatory motion of the agitator **29** is controlled by the corresponding movement of the lever arm **80** and the engagement therewith of the actuator buttons **86** and **87** of the limit switches **81** and **82**. For example, when the bar **80** engages the push button **87** of the limit switch **82** and causes the switch blade **91** to move to the dotted line position against the contact **92**, the relay **99** is deenergized and the reversing switch **101** will be positioned so that the polarity of the magnetic field of the motor unit B will be in one direction. When the disk **50** moves and the arm or bar **80** travels to engage the other button **86** of the limit switch **81**, the blade **88** will be moved to the dotted line position and will engage the contact **90**, thereby again energizing the relay **99** whereupon the switch **101** will be reversed to reverse the polarity of the magnetic field. The motion of the bar **80** within the confines of the limit switches **81** and **82**, therefore, affords an oscillating motion of the agitator.

In order to effect a completely automatic operation of the device, the mechanical linkage **141** shown connected to the manual adjustment knob **142** can be operated by the presettable sequential controller **31** as embodied in the machine of FIGURE 1 or **48** as embodied in the machine of FIGURE 2. To illustrate that alternative in the schematic circuit diagram of FIGURE 6, a program timer motor M is shown connected to the linkage **141** via the knob **142** and it will be understood that the motor M would be the motor of the presettable sequential control means **31** or **48**.

It is further contemplated by the present invention that speeds could not only be varied electronically in the manner described hereinabove, but the relative radial positioning of the motor units A and B with respect to the disks **50** and **51** would effect an adjustment since positioning either of the motor units A and B closer to the shaft axis by varying the radial spacing dimension would also vary the torque exerted on the moving part.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Laundry apparatus for washing and centrifuging fabrics in programmed sequence comprising, a rotary container for retaining the fabrics to be washed in the presence of a laundry fluid during a washing operation and to be centrifuged during a fluid extraction operation, agitating means positioned within said container for agitating said fabrics during said washing operation, a rotary disk of nonmagnetic, electrically-conductive material connected in driving relationship to said rotary container, an oscillatory disk of nonmagnetic, electrically-conductive material connected in driving relationship to said agitating means, arcuately shaped stators respectively positioned immediately adjacent each of said disks and having respective coplanar magnetic poles terminating in planes parallel to said disks, said disks including portions of reduced cross section immediately adjacent said arcuately shaped stators, circuit means for energizing said stators, said circuit means including polarity reversing switch means electrically connected to the stator positioned adjacent said oscillatory disk, a relay controlling actuation of said reversing switch means, a pair of limit switches electrically connected to said relay, a limit switch actuating arm rigidly connected to said oscillatory disk and engageable with said limit switches to thereby actuate said relay and said polarity reversing switches upon oscillatory movements of said oscillatory disk, agitate-centrifuge selector switch means connected to said circuit means and controlling the energizing of said polarity reversing switch means, a sequential program timer controlling the energization of said agitate-centrifuge selector switch means, circuit control means for supplying predetermined supply voltages to each of said stators, said circuit control means including a pair of silicon control rectifiers each having a gating control, a timing control circuit connected to said gating controls and including a unijunction transistor and a R-C circuit including a charging capacitor and a pair of adjustable resistors, a series switch respectively connected to each of said resistors and controlled by said program timer, said program timer selectively connecting one of said resistors in said timing control circuit during said washing operation and connecting the other of said resistors in said timing control circuit during said fluid extraction operation, a D-C voltage source supplying said timing control circuit with a D-C voltage, and means for varying the resistance values of said resistors to vary the charging rate of said charging capacitor to control the firing of said unijunction transistor and the voltage supplied to said stators by said silicon control rectifiers.

2. Laundry apparatus as defined in claim **1** and means for selectively adjusting the angular position of said limit switches, thereby to selectively vary the length of the agitating stroke.

3. Laundry apparatus as defined in claim **1** wherein said apparatus comprises a vertical axis machine having concentric shafts disposed on a vertical upright axis and interconnecting said rotary disk and said oscillatory disk to said agitating means and to said rotary container, respectively.

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