Jan. 31, 1967 T. R. SMITH 3,301,024

LAUNDRY APPARATUS

Filed July 12, 1965 6 Sheets-Sheet 1

Fig. 1

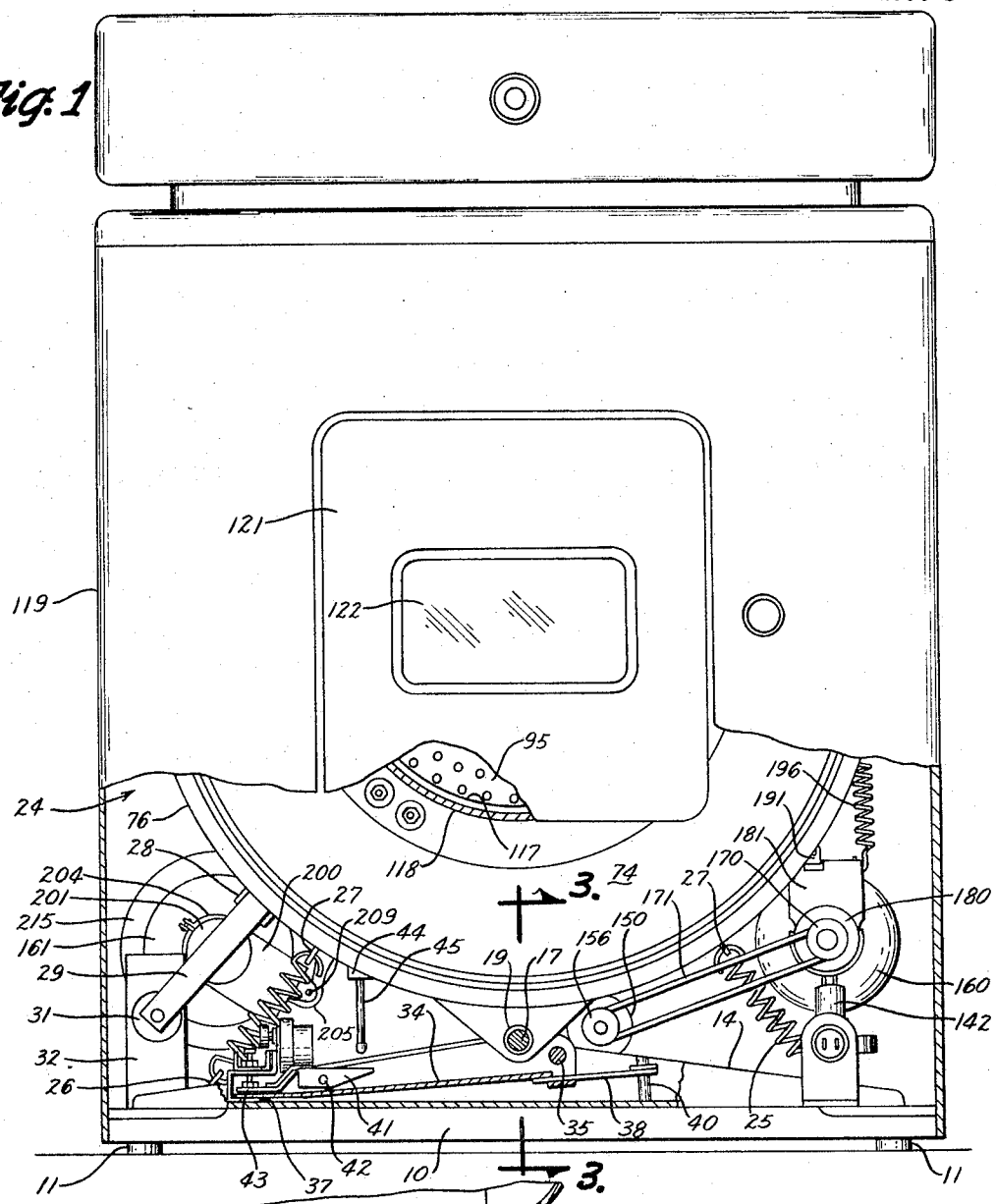
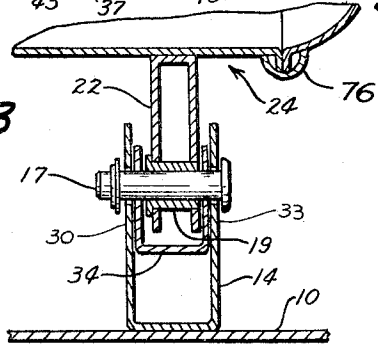


Fig. 3



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LAUNDRY APPARATUS

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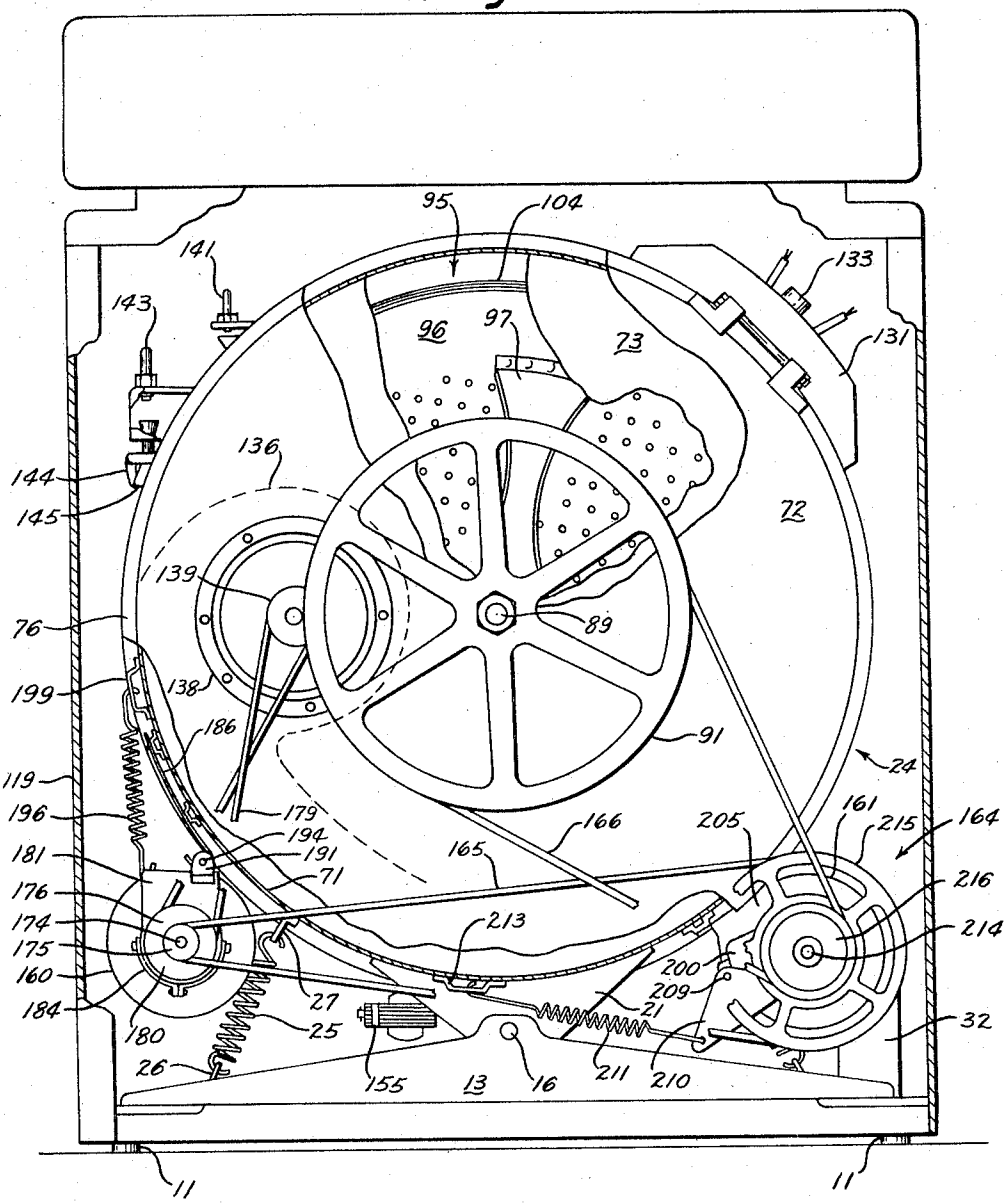
Fig. 2



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LAUNDRY APPARATUS

Filed July 12, 1965 6 Sheets-Sheet 3

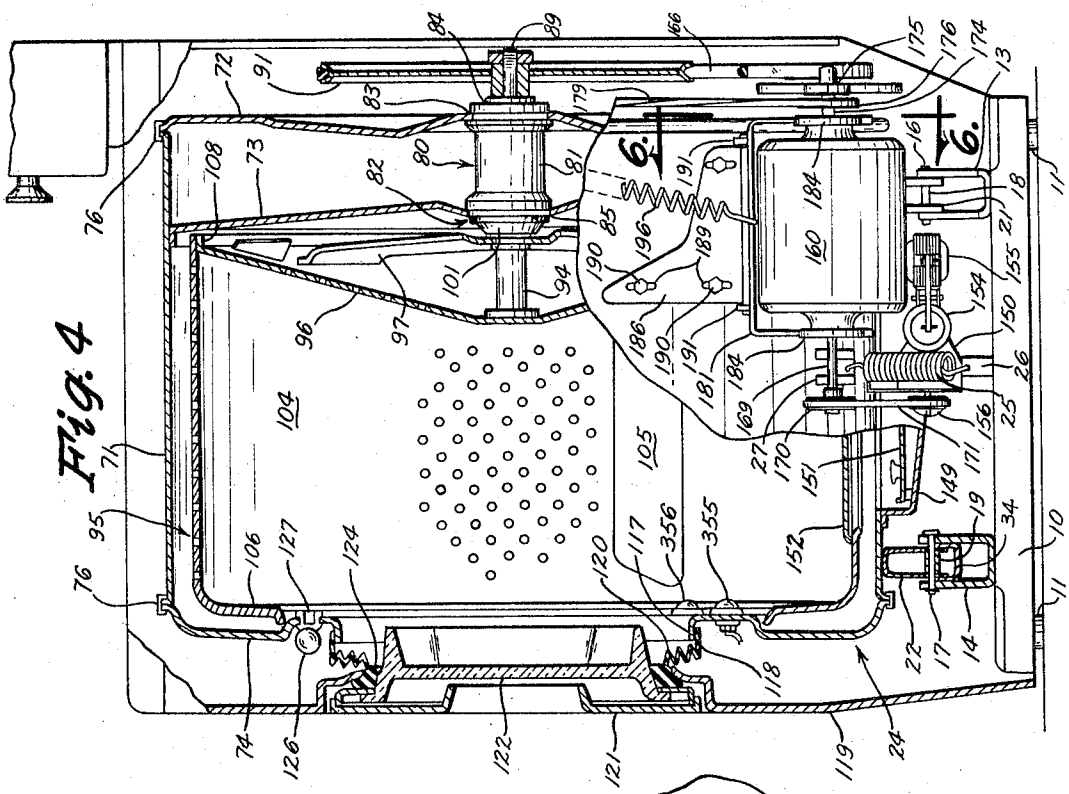

Fig. 4

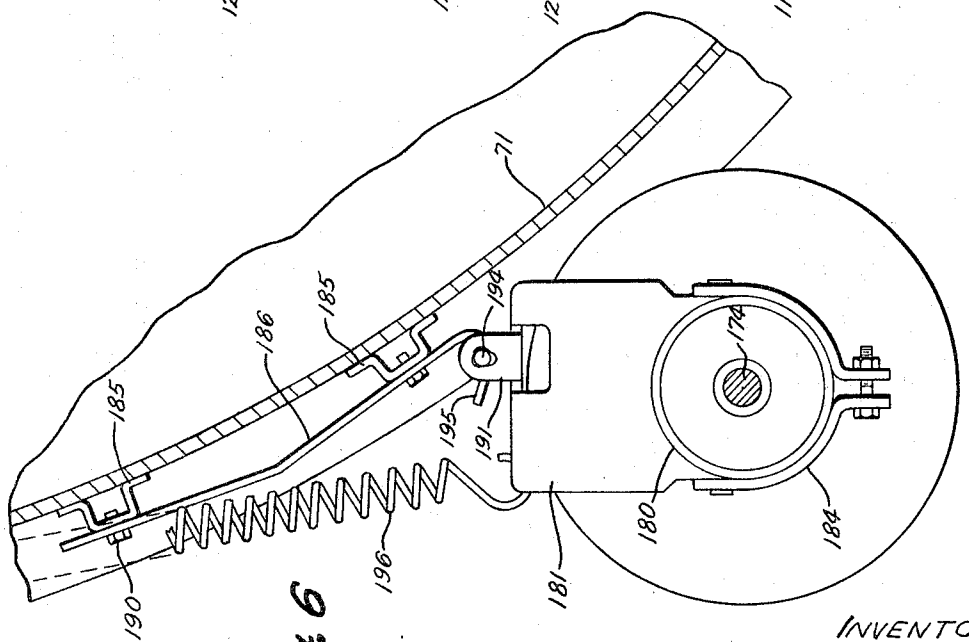

Fig. 6

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LAUNDRY APPARATUS

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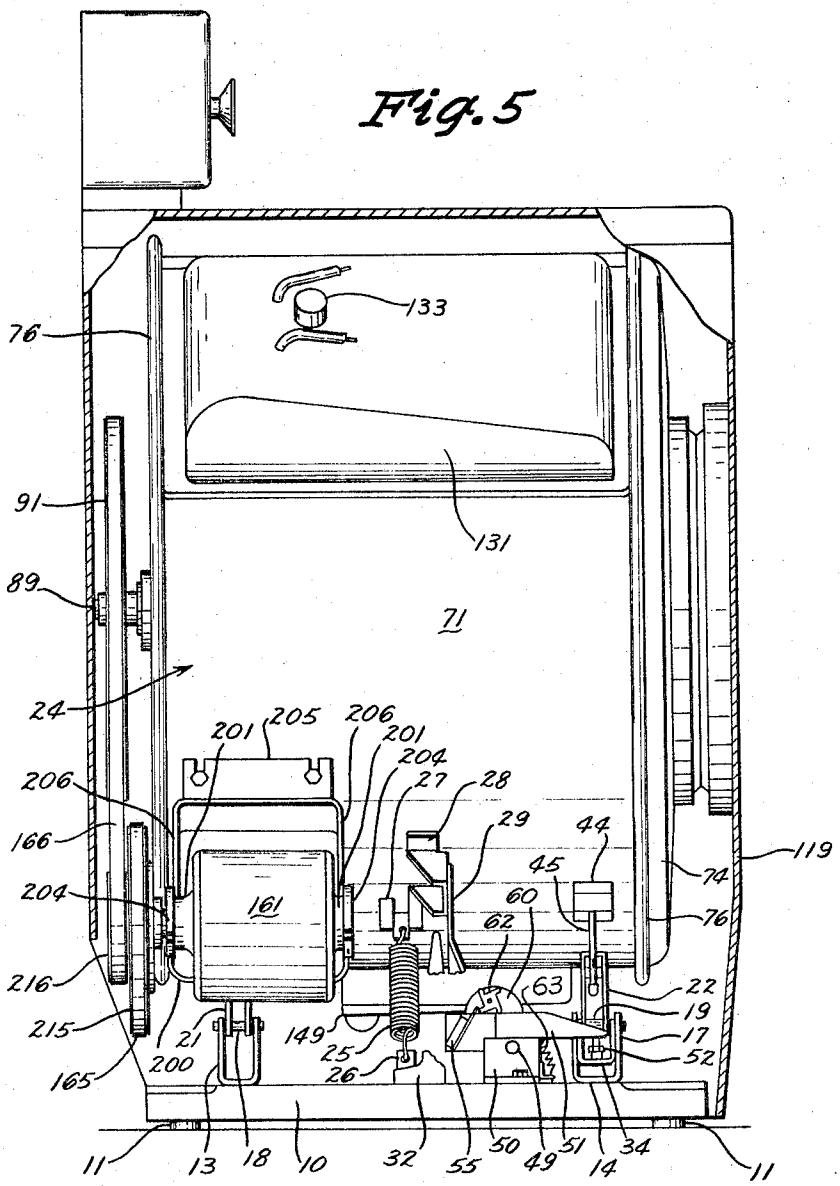
Fig. 5



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LAUNDRY APPARATUS

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Fig. 9

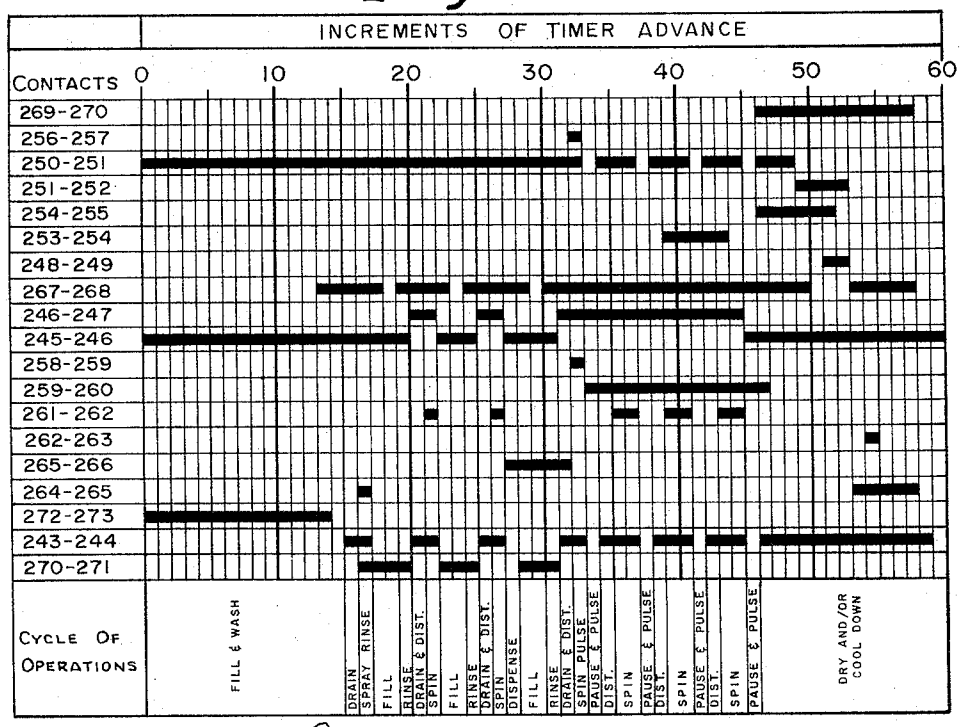
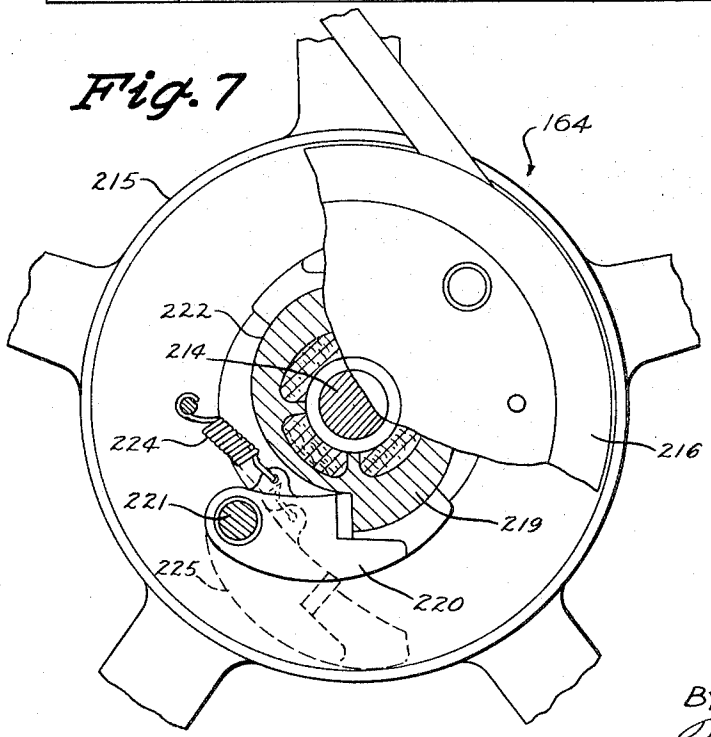


Fig. 7



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LAUNDRY APPARATUS

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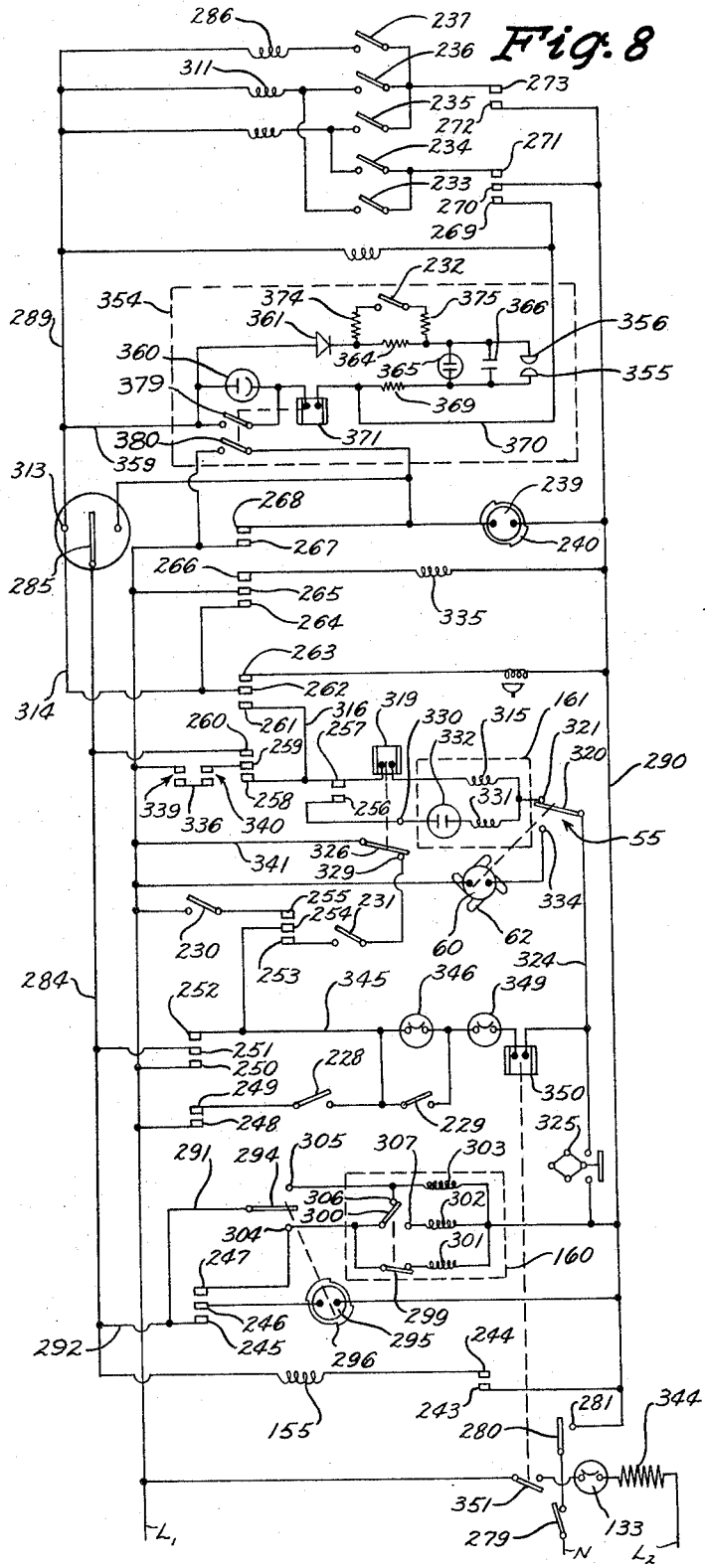
Fig. 8



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United States Patent Office 3,301,024
Patented Jan. 31, 1967

3,301,024

LAUNDRY APPARATUS

Thomas R. Smith, Newton, Iowa, assignor to The Maytag Company, Newton, Iowa, a corporation of Delaware

Filed July 12, 1965, Ser. No. 471,346
12 Claims. (Cl. 68—12)

This invention relates to an improved laundry apparatus incorporating means for driving a revoluble fabric container at a plurality of speeds and further including improved controls and mode of operation for effectively and efficiently washing and drying fabrics.

The provision of a laundry apparatus operable for washing and drying fabrics in the same container requires consideration of many factors. The unit should be fully operable for automatic sequencing through a cycle of operations to provide a complete fabric treatment from the placement of soiled fabrics in the container to the removal of clean dry fabrics at the end of the cycle without intermediate attention of the operator. A drive system should be devised which is operable for providing at least three speeds of operation as best suited to provide wash, distribution, and extraction operations. The unit should be efficient in operation and should operate with a high degree of reliability and not require frequent service calls to adjust or make operable. Further, the unit should be operable in a quiet and vibration-free manner.

It is, therefore, an object of the present invention to provide an improved laundry apparatus capable of performing a complete laundry operation including washing and drying.

It is a further object of the invention to provide an improved combination washer-drier operable through a washing operation having tumble, distribution, and extraction portions followed by a tumble dry operation for achieving an improved fabric treatment including drying to a preselected condition of fabric dryness without intermediate attention by the operator.

It is a further object of this invention to provide an improved drive system for a laundry apparatus operable for driving the fabric container at at least three output speeds including tumble, distribution, and extraction while also driving pump and blower means.

It is a further object of the present invention to provide an improved combination washer-dryer operable through a washing operation including tumble, extraction, and tumble dry portions and further including a portion for avoiding adhesion of fabrics to the container wall.

It is still a further object of the present invention to provide an improved combination washer-dryer operable through a washing operation having tumble, extraction, and tumble dry portions and which is operative for substantially eliminating adhesion of fabrics to the container wall but as a safeguard is further operative for terminating the drying operation if abnormal loads remain adhered upon initiation of the drying operation.

The present invention achieves the above objects in a combination washer-drier unit having a drive system including two electric motors which are drivingly connectable to a revoluble fabric container by a pair of selectively engageable drive paths. The first motor is operable for driving a fabric container at either a tumble speed through pulsing energization of the motor or at a distribution speed through steady energization of the motor at its higher speed. The first motor is connected to the fabric container through an overrunning clutch associated with the second motor. The second motor is energizable for driving the fabric container at a relatively high extraction speed. The combination washer-drier is equipped with sequence control means for automatically controlling the machine through a complete cycle of operations including a washing operation and a drying operation. Means are provided for obtaining even distribution of materials within the fabric container and for preventing adhesion of the fabrics to the container following termination of the extraction operation. Automatic termination means are provided for controlling the drying operation so as to interrupt energization of the fabric treating apparatus at the proper condition of dryness of the fabrics being treated.

Operation of the device and further objects and advantages thereof will become evident as the description proceeds and from an examination of the accompanying drawings which illustrate a preferred embodiment of the invention and in which similar numerals refer to similar parts throughout the several views, wherein;

FIGURE 1 is a front view of a combination washer-drier having a lower portion of the cabinet removed to expose the tub supporting means and the unbalance control system;

FIGURE 2 is a rear view of the combination washer-drier of FIGURE 1 with the cabinet back removed to show the drive system of the present invention;

FIGURE 3 is shown below FIGURE 1 and is an enlarged sectional view showing a portion of the supporting means for the drum as taken along lines 3—3 of FIGURE 1;

FIGURE 4 is a side view showing a portion of the drive system of the present invention and further including a fragmentary section view showing the drum and hub structure of the combination washer-drier;

FIGURE 5 is a side view of the combination washer-drier with the cabinet side panel removed for showing a portion of the drive system and the unbalance control system of the present invention;

FIGURE 6 is shown beside FIGURE 4 and is an enlarged fragmentary view showing the details of mounting of one of the motors of the drive system of the present invention as taken along lines 6—6 of FIGURE 4;

FIGURE 7 is shown below FIGURE 9 and is an enlarged fragmentary view showing the overrunning clutch device for the drive system of the instant invention;

FIGURE 8 is an electrical schematic diagram showing the circuit for the combination washer-drier embodying the present invention; and,

FIGURE 9 is a chart showing the sequential operation of the switches comprising the sequential control for the combination embodying the instant invention.

Referring now to the accompanying drawings in detail, it will be seen that the combination washer-drier unit shown in these drawings includes a substantially flat surfaced base frame **10** mounted on legs **11**. Mounted upon base frame **10** are a pair of support members **13** and **14** which are welded, or securely affixed in some suitable manner, to the base frame **10** to form the two major supports for the washer-drier unit illustrated in the accompanying figures.

As apparent from an inspection of FIGURES 1 through 5, support members **13** and **14** have a channel cross section and substantially triangular elevational configuration with the apex of these members receiving pivot pins **16** and **17**. Pivot pins **16** and **17** are journalled in the flanged bearing sleeves **18** and **19** and form a two-point support for the tub brackets **21** and **22**, respectively. This allows the tub or casing, which is generally indicated by the arrow **24**, and which is fastened to brackets **21** and **22**, to oscillate back and forth on pins **16** and **17** in an arcuate movement in response to various forces generated within tub **24**.

Tub **24** is normally maintained in an upright position on pins **16** and **17** by the two centering springs **25** each of which is connected between base **10** and tub **24** by

the spring anchor brackets 26 and 27 fastened to the base 10 and tub 24, respectively. FIGURES 1 and 5 show the tub 24 as being provided with a tub damper bracket 28 which forms the support for the damper leaf spring 29 carrying the damper pad 31 in a ball and socket joint at the end of damper spring 29. Base frame 10 is provided with an upstanding damper plate 32 which is frictionally engaged by the damper pad 31. The energy imparted to tub 24, which in turn causes tub 24 to oscillate on the supporting pivot pins 16 and 17, is absorbed and dissipated by the relatively movable, frictionally engaged, damper pad 31 and damper plate 32.

While the rear channel member 13 actually receives and supports directly the rear pivot pin 16, inspection of FIGURE 3 indicates that the same is not true as to the connection between front channel 14 and the front pivot pin 17. The cross sectional view of FIGURE 3 shows that the front pivot pin 17 is actually suspended in a floating pivot in front channel member 14 and, in practice, has a clearance of approximately 1/16 of an inch from the closest point of the clearance holes in the upstanding legs 30 and 33 of channel 14. The front end of tub 24 is supported on the front tub bracket 22, which is mounted on the front bearing sleeve 19, which is in turn carried on the front pivot pin 17. Pivot pin 17 is supported by a lever arm 34 nested within front channel 14 and supported on the pivot pin 35 penetrating channel member 14.

Three forces acting on lever arm 34 establish a condition of equilibrium about pin 35 in order to produce the described floating pivot about front pivot pin 17. With reference to FIGURE 1, the first of these three forces is applied upwardly through the supporting foot 37 located at the end of arm 34. The weight of tub 24 and the parts supported by that tub provide the second force which is applied directly to lever arm 34 through pin 17. The third force acting upon member 34 is exerted by a leaf spring 38 which is inserted into an opening of lever arm 34 so as to form an extension of the latter member. Adjusting means, such as machine screw 40 which is attached between base frame 10 and the end of leaf spring extension 38, provide means for varying the force exerted downwardly on leaf spring 38. It may also be seen that movement of the front pivot pin 17 caused by movement of the front end of tub 24 in turn causes pivotal movement of lever arm 34 about pivot pin 35.

Lever arm 34 supports lever member 41 on pivot pin 42 with lever member 41 positioned so as to be pivotally responsive to actuation by plunger member 45 which depends from a bracket 44 attached to tub 24. It is therefore seen that arcuate movement of tub 24 about its supporting pins 16 and 17 will cause plunger 45 to engage lever 41 and move it in a clockwise direction about its pivot pin 42. Likewise, an upward movement of the left end of lever 34 will lift lever 41 upwardly.

Referring now to FIGURE 5, a mounting bracket 50 is shown attached to base frame 10 for supporting, at pivot point 49, a lever 51 which carries a plunger 52 at one end thereof and a switch 55 at the other end thereof. Also fixed to bracket 50 is a timing motor 60 which drives a star wheel 62.

Upon movement of lever 41, as previously explained, plunger 52 is moved upwardly to pivot lever 51 in a counterclockwise direction about pivot point 49 to move switch 55 downwardly away from star wheel 62 so as to allow switch 55 to operate for energizing timing motor 60 by a circuit as will be described more fully hereinafter. Timing motor 60 remains energized until decreased tub movement allows spring 63 to return lever 51 to its normal position and until star wheel 62 is driven to the position at which it again actuates switch 55 to the closed position. From the above description, it may be understood that whenever an unbalance load condition exists within tub 24 the unbalance sensing mechanism will be actuated by either an arcuate movement of tub 24 or a small substantially vertical movement of the front end of tub 24 to effect a change in the condition of energization of the washer-drier combination unit as will be more fully described hereinafter.

Tub or casing 24 includes a generally cylindrical side wall 71, a pair of spaced rear walls 72 and 73, and a front wall 74. The front and outer rear walls 74 and 72, respectively, are connected to cylindrical side wall 71 by means of the encompassing flanged hoop-like members 76 while the partition wall 73 positioned between walls 72 and 74 is secured, as by welding, to side wall 71. It will be seen from an inspection of FIGURE 4 that the spaced rear walls 72 and 73 support the tub bearing assembly generally indicated by the reference numeral 80.

The bearing assembly 80 includes a spacer hub 81 which is located between and which abuts the rear walls 72 and 73, and a tubular clamp member 82 located concentrically within hub 81. Clamp member 82 is formed with a shoulder 85 at one end thereof and has a threaded portion 84 at the other end thereof for receiving clamp nut 83 which, when tightened on member 82, produces a rigid support with respect to tub 24 for two bearings (not shown), one of which is located adjacent each of walls 72 and 73 within hub 81 for supporting drive shaft 89.

The rear end of drive shaft 89 is rigidly connected to the large drive pulley 91 whereas its front end is threaded into hub 94 of the fabric container 95. Container 95 includes a perforate rear wall 96 which is rigidly affixed to and cooperates with spider-like member 97 to form a double cone support connected to the hub 94 and providing a rigid support for the fabric container 95 on drive shaft 89. A sealing member 101 is biased against the rear surface of this revoluble hub structure 94 to prevent water from tub 24 from entering bearing assembly 80.

As apparent from FIGURE 4, container 95 also includes a perforate cylindrical side wall 104 carrying clothes elevating vanes 105. Side wall 104 merges into the short front wall 106 and joins flanged rear wall 96 in an overlapping relationship to form a protruding flange 108 which, while not touching wall 73, cooperates with that wall 73 to form an effective air barrier to prevent the short circuiting of heated air around the rear peripheral edge of container 95.

Tub 24 also includes a circular loading opening 117 which is encircled by one end of the bellows seal 118 which has its opposite end fastened to a similar opening formed in the cabinet 119. Sealing member 118 includes a number of convolutions 120 permitting movement of tub 24 relative to cabinet 119. A rectangular door 121 hinged on cabinet 119 carries a transparent glass window 122 having a cylindrical portion extending rearwardly through the bellows seal 118 which is provided with a flexible annular sealing lip 124 engageable with the periphery of the glass window 122. This arrangement seals the unit while enabling the operator of the machine to observe operations taking place within tub 24 during the washing and drying processes. Lamp 126, fastened to the exterior of tub 24, shines through a transparent member 127 carried in the front wall 74 of tub 24 for illuminating the interior of the container as during the loading or unloading operations thereof.

Tub 24 also includes a heater housing 131 which may be formed separately or as a part of the tub wall 71 and which supports a heating element (not shown) capable of radiating heat energy into tub 24 through an opening located in the cylindrical tub wall 71 and covered by the heater housing 131. Heater housing 131 also mounts a thermostat 133 which is connected in series with the heater.

A combination blower-condenser unit capable of moving air through tub 24, scrubbing lint from this air, and condensing out the moisture from hot vapors formed within the tub 24 during the drying operation, is positioned within the compartment formed by and between portions of the spaced walls 72 and 73. The compart-

ment for the blower-condenser unit is produced by co-operation of walls 72 and 73 with an imperforate scroll-shaped side wall 136, shown by dotted lines in FIGURE 2 and which bridges the space between walls 72 and 73, to enclose the vapor condenser and blower unit.

Water for the condensing operation is directed onto the impeller which, though not shown, is positioned behind plate 138 and is driven by blower pulley 139. Plate 138 is bolted to the rear wall 72 of tub 24 and provides convenient access to the blower housing. The action of the rotating impeller upon the stream of water produces a cool mist spray or fog for condensing out moisture from hot vapors entering the blower-condenser unit during the drying operation. Water for the vapor condensing process is supplied through the external conduit 141 and is directed into the blower-condenser compartment by a conduit (not shown) connected between the cylindrical side wall 71 and the scroll-shaped wall member 136. Vapor laden air is moved from the interior of tub 24 by the action of the impeller and is moved through the blower-condenser compartment before being directed again toward the heater compartment or vented to the atmosphere.

More specific details of construction of this blower-condenser unit, and also of the aforementioned bearing assembly 80, may be found in U.S. Patent 2,986,917 issued to H. R. Smith on June 6, 1961 and assigned to the assignee of the instant invention.

Water for the washing operation is supplied through inlet 143 which directs fluid through conduit 144 into the interior of tub 24. Conduit 144 includes a trap portion 145 which prevents suds from escaping from tub 24 during the washing operation and prevents steam vapors from escaping from tub 24 during this drying operation. Inlet 143 is connected to a water valve 142 by a conduit (not shown).

Referring now to FIGURE 4, tub 24 includes a lower recessed portion which forms a sump 149 communicating with the drain pump 150. Positioned in sump 149 is a perforate tray 151 for preventing foreign particles, which have passed through the perforate drum 95 into tub 24, from entering and damaging pump 150. Tray 151 is removable from its position through the drum access door 152 provided in the side wall 104.

Sump 149 receives the washing fluids discharged into casing 24 and also receives from the blower-condenser compartment the condensing fluid and the condensate and line removed from the air entering the blower-condenser unit. The fluids and lint entering sump 149 are discharged through pump 150 to an external drain (not shown). A valve 154, controlled by solenoid 155, is positioned between pump 150 and the external drain to control the periods of time during which fluids are discharged to the external drain. Pump 150 is driven during washing operations by a pulley at 156; however, solenoid 155 is de-energized during the washing operations to maintain valve 154 closed and fluids within the tub 24.

Power to rotate container 95 is supplied by a drive system which includes a two-speed motor 160, a second motor 161, an overrunning clutch device 164, and belt transmission means including belts 165 and 166. As will be more fully explained hereinafter, this drive system is operable for providing a plurality of speeds of operation of the container 95 so as to achieve an optimum fabric treatment cycle. Specifically, this drive system is operable for providing a relatively slow tumble speed for accomplishing the washing action, a distribution speed for effecting arrangement of the fabrics in a substantially even pattern around the inner periphery of the container and becoming plastered thereto, and a relatively high speed spin for accomplishing fluid extraction.

Two-speed motor 160 includes a four-pole winding and a six-pole winding for operation of motor 160 at 1725 and 1150 r.p.m., respectively. The motor is further identified as a split-phase, unidirectional, fractional-horsepower motor of the type commonly used on laundry appliances.

As best shown in FIGURE 4, motor 160 is provided with shaft extensions at both ends for driving a plurality of components included in the combination washer-drier of the instant invention. Shaft extension 169 which extends from the left end of motor 160, as viewed in FIGURE 4, supports a pulley 170 which is drivingly coupled by belt 171 to pulley 156 for driving pump 150. Pump 150 will therefore be driven during each period of operation of motor 160 but will be operative for pumping fluid from tub 24 only during those periods when solenoid 155 is energized for opening valve 154.

Belt 171 is a round stretch belt and may be formed of a polyurethane material so as to possess the necessary characteristics for adjusting to variations in pulley center distances as will be more fully explained hereinafter.

Shaft extension 174 extending from the right end of motor 160, as viewed in FIGURE 4, carries pulleys 175 and 176 fixedly mounted thereon. As best shown in FIGURE 2, pulley 175 drives belt 165 which is drivingly connected to clutch device 164. Pulley 176 is drivingly engaged by belt 179 which in turn engages blower pulley 139. Belt 179 is assembled between pulleys 176 and 139 in a crossed pattern so as to operate blower impeller (not shown) in a direction opposite to that of motor 160.

Motor 160 is adjustably and pivotally mounted on tub 24 so as to provide for proper belt tensions in belts 179 and 165. As best seen in FIGURES 4 and 6, motor 160 is secured at a mounting ring 180 at each end thereof to an inverted U-shaped bracket 181 by a pair of adjustable clamps 184. U-shaped bracket 181 is formed with a pair of upturned tabs 191 for receiving pivot pin 194. Pivot pin 194 is supported by flange 195 of adjustable bracket 186. Bracket 186 is provided with a pluarility of slots 189 which receive screw members 190 for attaching bracket 186 to brackets 185 which are in turn secured to tub wall 71. Means are thereby provided for adjustably supporting motor bracket 186 to allow positioning of motor 160 along an arcuate path consisting of substantially vertically related positions. Tabs 191 are formed with substantially triangularly-shaped pivot holes for receiving pivot pin 194. This pivot hole is effective for reducing vibration resulting from intermittent operation of motor 160 as will be more fully defined hereinafter.

Motor 160 is biased in a clockwise direction about pivot pin 194 by a coil spring 196 connected between motor bracket 181 and bracket 199 which is in turn fixed to the outer wall 71 of tub member 24. Though not specifically shown, bracket 199 is provided with a plurality of notches to facilitate the proper tensioning of spring 196.

The second motor 161 included in the drive system of the preferred embodiment of the instant invention is a single-speed, unidirectional, split-phase motor of the fractional-horsepower type commonly used in laundry appliances. This motor 161 is also adjustably and pivotally supported relative to drum or tub member 24. A generally U-shaped bracket 200, similar to bracket 181, is secured to a pair of clamping rings 201 at the ends of motor 161 by the adjustable clamps 204. Bracket 200 is pivotally supported by a bracket 205 having depending arms 206 which receive a pivot pin 209 for thereby pivotably supporting a U-shaped bracket 200.

Attached to bracket 200 is a pivot arm 210 which pivots with bracket 200 around pivot pin 209. Spring 211 is connected between the end of pivot arm 210 and bracket 213, which is attached to wall 71 of tub 24, for biasing motor 161 in a clockwise direction about pivot pin 209 to maintain proper tension on belt 166 as will be more fully described hereinafter. Bracket 213 includes a plurality of notches so as to provide means for increasing or decreasing the tension on spring 211 to

maintain the proper positioning of motor **161** for controlling belt tension.

Mounted on shaft **214** of motor **161** is an overrunning clutch device generally indicated by numeral **164**. Clutch device **164** includes a first pulley member **215** which is rotatably mounted upon shaft **214** and which is driven by belt **165**. A second pulley **216** is mounted on shaft **214** for rotation therewith. Means are provided for normally effecting engagement between pulley **215** and pulley **216** so as to effect rotation of pulley **216** at the same speed as pulley member **215**. Formed as a part of pulley **215** is an upstanding lug **219** which is engageable with a pawl member **220** pivotally supported by pulley member **216** through pivot pin **221**. Pawl **220** is biased in a counterclockwise direction about pivot pin **221** by spring **224** to maintain pawl **220** engaged with lug **219**.

It may thus be seen that rotation of pulley **215** in a clockwise direction, as viewed in FIGURE 7, will effect rotation of pulley **216** through engagement of lug **219** with pawl **220**.

As previously indicated pulley **216** is fixed to shaft **214** for rotation therewith. It has also been indicated that motor **161** is operable at a speed in excess of that of pulley **215**. Thus upon energization of motor **161**, pulley **216** will rotate at a speed in excess of that of pulley **215**. This overrunning operation will cause lug **219** to become drivingly disengaged and to fall behind pawl **220**. As lug **219** falls behind pawl **220**, cam surface **222** moves pawl **220**, for example, will have increased to a level at ally outward positions, the centrifugal force acting upon pawl **20**, for example, will have increased to a level at which the biasing force of spring **224** will be overcome whereby pawl **220** will pivot in a clockwise direction about pivot pin **221** and assume a fully disengaged position as indicated by broken line **225** to effect a fully disengaged overrunning condition for clutch device **164**.

Keeping in mind the overrunning clutch device of FIGURE 7, the drive system of the instant invention is best shown in FIGURE 2 and is basically a belt drive transmission having a pair of alternate drive paths. The first path includes a two-stage speed reduction obtained through pulleys **175** to **215** and **216** to **91** driven by motor **160** and including the overrunning clutch device **164** for providing at least one relatively slow speed of operation. The second drive path includes a second motor **161** which is operable for driving the second pulley **216** directly and bypassing clutch device **164** for driving pulley **91** through belt **166** at a substantially higher speed.

Means are included in this belt transmission drive system for maintaining proper tension in each of the belts. The adjustable and pivotable mounting of motor **160** provides means for maintaining proper belt tension in blower belt **179** and drive belt **165**. As best seen in FIGURE 2, 4 and 6, the adjustable feature of bracket **186** provides means for increasing or decreasing the centerline distance between the blower pulley **139** and pulley **176** while effecting little change in the center distance between pulleys **175** and **215**. The adjustable spring biasing feature of the pivotable motor mount provides means for adjusting the biasing of motor **160** around pivot pin **194** to maintain proper belt tension on drive belt **165**. It is further noted that changes in the positioning of motor **160** will effect a change in the center distances between pulley **170** and **156** for driving pump **150**. For this reason, a stretch belt **171** may be provided to compensate for the variations in center distances.

As previously indicated, spring means **211** provides means for biasing motor **161** in a clockwise direction about pivot point **209** to maintain proper belt tension on drive belt **166**.

The previous description indicates that two speeds of operation may be directly provided by the drive system of the instant invention. A first speed may be obtained through the following drive path: motor **160** energized in its four-pole windings, a first speed reduction between pulleys **175** and **215**, pulley **216** driven by pulley **215** through lug **219** and pawl **220**, and a second speed reduction between pulleys **216** and **91**. This drive path is operable for transmitting the torque of motor **160** to container **95** and for reducing the speed from a previously indicated motor speed of 1725 r.p.m. to a desired container speed of 60 r.p.m.

A second speed may be obtained by selectively energizing motor **161** for driving pulley **216** at a higher speed than that of pulley **215** to rotate basket **96** at a relatively high extraction speed through the single speed reduction between pulley **216** and **91**. With motor **161** operating at 1725 r.p.m., container **95** will be driven by pulley **91** at a speed of approximately 300 r.p.m.

The third speed, which in this embodiment may be a relatively slow speed for achieving a tumble washing action, may be obtained by cyclically energizing motor **160** for predetermined periods of time in each of the four or six-pole windings to obtain a speed of operation relatively slower than that achieved by steady energization on the four-pole winding. This pulsing of motor **160** for predetermined time periods may be controlled to provide a relatively constant speed tumble action or may be spaced so as to provide a varying speed tumble action within the speed range of 40 to 60 r.p.m. as will be more fully described hereinafter.

It is also contemplated and within the scope of the instant invention to use a single speed motor instead of the two speed motor **160**. The single speed motor might then be pulsed, or alternately energized and deenergized, for predetermined periods of time to effect acceleration and deceleration to provide a tumble speed.

Means other than the pulsing of motor **160** for obtaining another speed which is relatively close to a first speed are also available. A split, variable pulley with associated shifting means, for example, could also be used. In addition, a double grooved pulley with a belt shift device could be used.

Referring now to FIGURE 8, an electrical schematic diagram shows the components and circuitry included in the preferred embodiment of the instant invention.

Provided across power lines L_1 and L_2 is conventional 220 volt 60 cycle alternating current with 110 volt 60 cycle alternating current available across power lines L_1 and N.

Basic to the electrical circuit of FIGURE 8 are groupings of manually operable switches including switches **228** and **229**, **230** and **231**, **232**, and **233** through **237** which are operable prior to initiation of the cycle of operations for selecting and establishing such variables as water temperatures, drying temperatures, and cycle termination points. Upon selection of the variables and initiation of the desired cycle of operations, operation of the washer-drier combination unit is controlled by a sequence control mechanism which includes a timing motor **239** for advancing a plurality of cams, or other switch operating means as represented by cam **240**. These cams are operable for sequentially operating a group of switches through a programmed series of operations comprising a washing and drying operation. The switches of the sequential timing device are represented in the electrical circuit of FIGURE 8 by the group of contacts **243** through **273** which operate in pairs between the open and closed positions under the control of one of the cam members, such as cam **240**, to energize and deenergize the various electrical components of the circuit of FIGURE 8.

Referring to FIGURE 9 there is shown a chart in which the above referenced contacts **243** through **273** are listed as cooperating pairs and in which shaded portions indicate that portion of the cycle during which each pair is closed. The sequential control mechanism is operable through a cycle including 60 increments having a six degree spacing and one minute duration. FIGURE 9 also shows a specific series of operations corresponding to the switching as shown by the shaded portions therein.

It is believed that the electrical circuit of FIGURE

8 is best described by explaining operation of the device through the complete cycle of operations as shown in FIGURE 9. The operator may establish and/or initiate a specific series of operations by closing selected switches of the group **228** through **237**. If, for example, a full cycle wash and a regular automatic dry operation is desired switches **228, 229, 230, 231, 233,** and **237** will be closed. These may be individually operable switches but are preferably linked so that only one or two buttons, or other manually operable members having appropriate identifying indicia, are actuated to thereby operate the required switches to the closed position. Other preselectable alternate series of operations or variations include the following: a damp dry operation may be combined with a regular wash operation if switch **228** is not closed; a wash and dry operation for delicate fabrics may be obtained by allowing switch **229** to remain open to provide a lower temperature dry operation; a wash only operation is obtained if switch **230** is maintained in the open position; if heat is not desired in the final spin, as with delicate or bright colors, switch **231** is not closed. Other combinations of switches **233** through **237** may be closed to provide the desired wash and rinse water temperatures.

Following selection of the desired cycle or series of operations, the operator will initiate energization of the machine by operating switch **279** and closing door **121** to operate door switch **280** to contact **281**. The machine will commence to fill with washing fluid by a circuit from conductor L_1 through timer contacts **250, 251,** and through conductor **284** to pressure responsive switch **285**. Hot water solenoid **286** of fill valve **142** will be energized from pressure switch **285** through contact **313**, conductor **289**, switch **237**, timer contacts **272, 273,** and conductor **290** to contact **281** of door operated switch **280**, which in turn is connected to line N.

Motor **160** will also be energized to provide a tumbling speed for achieving a washing action. The circuit for energizing the motor includes power line L_1, timer contacts **250, 251,** conductors **284, 292,** and **291**. Conductor **291** is in turn connected to pulsing switch **294**. An auxiliary timing motor **295** is energizable between conductor **292** and conductor **290** through timer contacts **245, 246** to rotate cam member **296** for operating switch member **294**.

Motor **160** includes start windings **301** in series with centrifugal start switch **299**, six-pole run winding **302** in series with normally open switch **300**, and four-pole run winding **303**. Centrifugal switch **299** is operable to an open position at a predetermined speed of operation of motor **160** and is linked to switch **300** so as to operate switch **300** from contact **306** to contact **307** at that predetermined speed.

After acceleration of motor **160** to the predetermined switching speed at which switch **299** operates to the open position and switch **300** operates to close to contact **307** motor **160** becomes responsive to cyclic operation of switch **294** between contacts **304** and **305**. Throughout the tumble operation, auxiliary timing motor **295** remains energized for cycling switch **294** between contacts **304** and **305** at predetermined time intervals for alternately energizing four-pole winding **303** and six-pole winding **302**. Energization of four-pole run winding **303** for a period of approximately two seconds will allow motor **160** to accelerate under normal operating conditions to its higher operating speed of 1725 revolutions per minute and allow operation at that speed for a short period of time. This motor speed corresponds to a container speed of approximately 60 revolutions per minute. Upon movement of switch **294** to contact **304** and energization of six-pole run winding **302**, motor **160** will decelerate under the loading of container **95** and the material contained therein. Switch **294** is made to contact **304** for approximately three seconds, for example, to effect deceleration of motor **160** to approximately 1150 revolutions per minute. The three second period of time is normally sufficient to allow the motor to operate at this lower speed for a short period of time for driving container **95** at a below normal tumble speed of approximately 40 revolutions per minute.

For a more specific and detailed explanation of this pulsing of a two-speed motor to obtain an intermediate operational speed, attention is directed to United States Letters Patent No. 3,172,277, issued March 9, 1965 to Charles W. Burkland and assigned to the same assignee as the instant invention.

Following completion of the washing operation, drain solenoid **155** is energized between conductors **284** and **290** through timer contacts **243, 244** to permit draining and pumping of washing fluids from tub **24**. The tumbling and draining operation may continue while warm water fill solenoid **311** is energized through switch **233** and timer contacts **270, 271** to provide a spray rinse for dispelling any remaining suds within fabric container **95**.

With basket **95** continuing to operate under the control of the pulsing switch **294** and pulsing motor **295** and with fill solenoid **311** remaining energized, timer contacts **243, 244** are opened to deenergize drain solenoid **155** for filling tub **24** to provide water for rinsing the fabrics being washed. Following an increment of tumbling for rinsing fabrics within basket **95**, drain solenoid **155** is again energized for removing fluids from tub **24**. During this fluid draining period, timer contact **246** is opened at contact **245** and closed to contact **247**. With auxiliary timing motor **295** energized through pulsing switch **294** made to contact **304**, cam **296** will be advanced only to the position at which switch **294** is operated from contact **304** to contact **305**. Upon operation of switch **294** to contact **305**, timing motor **295** will be de-energized and four-pole run winding **303** will be energized. The steady energization of four-pole run winding **303** will accelerate basket **95** to the four-pole operating speed corresponding to a container speed of approximately 60 r.p.m. for distributing fabrics around the inner periphery of container **95** in a substantially balanced pattern.

After approximately one minute for draining the fluids and distributing the fabrics, timer contacts **261, 262** are closed to initiate a centrifugal extraction operation to remove retained fluids from the fabrics within container **95**. A circuit is completed to run windings **315** of motor **161** from power line L_1 through timer contacts **250, 251,** line **284**, pressure switch **285** made to contact **313**, line **314**, timer contacts **261, 262**, and conductor **316** to start relay coil **319**. The circuit continues through start relay coil **319**, run windings **315**, normally closed unbalance switch **320** made to contact **321**, and through conductor **324** and centrifugal switch **325** to line **290**. Centrifugal switch **325** is responsive to operation of motor **160** and is placed in this circuit to insure that motor **161** does not operate unless motor **160** is operating at speeds above that predetermined speed at which start winding **301** is de-energized. Completion of this circuit through relay coil **319** effects operation of switch member **326** from contact **329** to contact **330** for energizing start windings **331** through capacitor **332**. At a predetermined current level through relay coil **319**, which is achieved at a substantially less than normal operating speed for motor **161**, switch member **326** will open at contact **330** and close to contact **329** for de-energizing start winding **331**.

If an unbalance condition should occur during the extraction operation, the unbalance system, as previously described, would be actuated by plunger **45** to thereby operate switch **320** from contact **321** to contact **334**. Motor **161** would thereby be de-energized to effect a decrease in speed of container **95**. Auxiliary timing motor **60** is energized to advance start wheel **62** so that after a predetermined time the delay switch **320** will be operated from contact **334** to contact **321** for de-energizing auxiliary motor **60** and reenergizing spin motor **161**. This time delay may be of sufficiently long duration to allow the container speed to decrease to distribution or may

be of sufficiently short duration to allow only a small decrease in velocity so that as high a speed as possible is maintained.

Following completion of the above described spin operation, which may have a duration of approximately one minute, the cycle of operations may include at least one repeat of the fill, tumble rinse, fluid draining, fabric distributing, and centrifugal extraction operations. During this portion of the series of operations, means may also be provided to dispense various fluid conditioners into the machine which in this preferred embodiment would include a conditioner dispenser solenoid **335** energized through timer contacts **265**, **266** between power lines L_1 and N.

Instead of proceeding immediately into a fluid extraction operation following the final rinse operation, an improved antiadhesion operation including a spin impulse and a tumble impulse is provided to facilitate the release of fabrics from the inner wall of container **95** upon completion of the fluid extraction operation.

It has been found that when materials are evenly distributed around the inner periphery of the container and then submitted to high speed extraction for removing large quantities of fluids, the materials tend to stick to the walls of the container even after it has stopped or returned to tumble speed. To prevent this undesirable characteristic, which becomes more pronounced when a distribution operation is provided, an improved sequence of operations is instituted following the final rinse and drain operations, such as beginning in increment **33** of FIGURE 9. This procedure includes a short-duration, relatively high speed, spin impulse for removing substantial, but limited, quantities of fluids from fabrics.

As previously shown, motor **160** is operating to drive container **95** at a distribution velocity of approximately 60 r.p.m.; centrifugal switch **325** is thus in the closed position so that motor **161** is energizable for a spin operation. During the increment in which the spin impulse is desired, a subinterval switching mechanism, which is not specifically shown, but which is commercially available in sequence control mechanisms such as that driven by timing motor **239**, is operative for actuating switch **336** to close contact pairs **339** and **340** for a momentary period of time. In this embodiment, contact pairs **339** and **340** are closed for approximately two seconds of the total increment time of one minute. During this increment, timer contacts **258**, **259** and timer contacts **256**, **257** are closed to effect energization of spin motor **161** upon closing of contact pairs **339** and **340** by a circuit as follows: power line L_1 through contact pairs **339** and **340**, through timer contacts **258**, **259**, and through relay coil **319** to energize run winding **315**. Upon energization of relay coil **319**, starting switch **326** will close to contact **330** for energizing start winding **331**. Since contact pairs **339** and **340** remain closed for only approximately two seconds, run winding **315** will be maintained energized for the balance of the spin impulse through conductor **341**, switch **326** and timer contacts **256**, **257**. Start winding **331** is also energized through switch **326** made to contact **330**.

It may therefore be seen that when motor **161** reaches a speed at which the current through relay coil **319** is insufficient to maintain switch **326** closed to contact **330**, relay coil **319** will be deenergized for allowing switch **326** to close to contact **329** and for deenergizing motor **161**. This switching speed occurs at approximately 1350 r.p.m. and corresponds to a basket speed of approximately 250 r.p.m. It is noted that the basket does not reach top speed; however, the speed and duration of the spin is sufficient to insure that a large portion of the water is removed from the materials contained therein but limited to an amount which will avoid tightly plastering the materials to the inner wall of the container.

Following this spin impulse, the container returns to distribution speed for the remainder of the instant increment. The motor **160** is then deenergized to allow the container to come to a rest for one increment of timer advance and thereby allow the materials to fall free of the walls. During that increment of rest, however, means are provided for momentarily energizing motor **160** to rotate container **95** at least a portion of a revolution for providing an additional rest position to assist in removing the materials from the periphery of the basket and allowing them to fall free of their own weight. Motor **160** is energized by a circuit from power line L_1 through pulsing switch **336**, timer contacts **259**, **260**, conductor **284**, conductors **292** and **291** to pulsing switch **294**. Motor **160** is energized for a momentary period of time, such as the two second period of time during which contact pairs **339** and **340** are closed.

It may therefore be seen that following the first spin impulse, at which time the container is allowed to come to a rest, the container will be oriented in a first position to allow fabrics which remain in the upper portion of the container to fall toward the bottom of the container. With a high degree of probability, the container will assume a different position following the momentary energization or tumble impulse and allow an additional portion of the material to fall toward the bottom of the container. This antiadhesion system is disclosed in greater detail in the copending application Serial No. 471,035 filed by John C. Mellinger on July 12, 1965, entitled Method and Apparatus for Centrifugal Extraction and assigned to the assignee of the instant invention.

The fluid extraction operation may include additional spin operations separated by a redistribution of fabrics. The additional spin operations might include a distribution portion, a spin portion, and a pause and tumble impulse portion, but could exclude the spin impulse. In the instant embodiment three additional spin operations are included as indicated in FIGURE 9. During the final spin operation, means are provided for optionally applying heat to the fabrics within the container **95**. A heater **344** is energized only after motor **161** reaches switching speed for operating switch member **326** to contact **329**. Closing of switch **326** to contact **329** completes a circuit from power line L_1 through conductor **341**, switch **326** made to contact **329**, switch **231**, timer contacts **253**, **254**, conductor **345**, switch **229**, and through control thermostat **349** to relay coil **350**. Energization of relay coil **350** operates switch **351** to the closed position for energizing heater **344** between power lines L_1 and L_2. Since heater relay **350** is energized through the back contacts of starting relay switch **326**, which is responsive to speed of motor **161**, and through centrifugal switch **325**, which is responsive to speed of motor **160**, heater **344** is energized only when both motors **160** and **161** are above their starting speed to insure that current limits do not exceed safe levels. This heat during the final spin portion is advantageous for improving the efficiency of fluid extraction and for pre-heating the fabrics prior to the drying operation.

If a "wash only" operation is selected at the beginning, the machine would, following the final spin in which heat was applied, proceed into a "cool off" period and then stop. During the "cool off" period motor **160** is operable for tumbling the fabrics for a period of approximately three minutes, for example.

If, however, a complete wash and dry operation is selected at the beginning, the machine proceeds to dry the materials within container **95** following the final spin. Motor **160** continues to tumble the fabrics by the circuit as previously indicated. Heater **344** is energized upon energization of relay coil **350**, which has been energized by a circuit from power line L_1 through switch **230**, timer contacts **254**, **255**, conductor **345**, switch **229**, control thermostat **349** and through centrifugal switch **325** to conductor **290**. Energization of relay **350** closes switch **351** to energize heater **344** between power lines L_1 and L_2. After four minutes of heat on, for example, an automatic dry control termination means **354** is en-

ergized and timer motor **239** is deenergized. This dry control system is responsive to direct determination of the dryness or electrical conductivity of the fabrics so as to obtain reliable shutoff of the drying operation. This control system includes a plurality of sensing members such as electrodes **355**, **356** which are fastened to the front wall **74** of outer tub **24** openly facing and protruding into the interior of container **95**. They are positioned so as to be contacted by tumbling fabrics but are spaced from wall **104** of container **95** to prevent contact by the fabrics while they are plastered to container **95** as during the extraction operation.

Electrodes **355** and **356** may be connected in the circuit as shown in FIGURE 8. Electrodes **355** and **356** have opposite polarity so that upon contact by fabrics the circuit may be completed therethrough. The sensing device is energized from line **289** through conductor **359** to a photoelectric cell **360** and half-wave rectifier **361**. A D.C. circuit continues from rectifier **361** through resistor **364** to one side of neon tube **365**, capacitor **366**, and to electrode **356**. When electrodes **355** and **356** are contacted by wet fabrics, a circuit is completed therebetween and continuing through resistor **369**, conductor **370**, contacts **269**, **270**, and to conductor **290**. The conduction through the fabrics contacting electrodes **355** and **356** maintain the capacitor **366** discharged, neon tube **365** nonfiring, and photoelectric cell **360** nonconductive. As the fabrics become less wet the rate of discharge through the fabrics becomes lower and the net charge on the capacitor **366** increases toward that required for firing neon tube **365**. This condition continues until the fabrics between electrodes **355** and **356** reach a predetermined condition of dryness at which they are substantially nonconductive.

The dry fabrics do not, therefore, effect a discharging of the capacitor **366** and it thus becomes gradually charged to a predetermined level for causing neon tube **365** to fire. Photoelectric cell **360** in turn becomes conductive for energizing relay coil **371** to close switches **379** and **380** for maintaining coil **371** energized and for bypassing open timer contacts **267**, **268**. Timing motor **239** is thereby energized for initiating termination of the drying operation. After completion of a period of "cool-off" controlled by the timing mechanism, the washer-drier will become deenergized and the basket will be allowed to come to a rest.

If, however, a load of fabrics remains adhered to wall **104** of container **95** following the fluid extraction operation, because of an abnormal load, for example, the adhered fabrics will not contact the electrodes and in the absence of conductive fabrics shorting the electrodes the system will ignore the dryness condition of the fabrics and allow capacitor **366** to charge and relay coil **371** to energize for initiating termination of the drying operation. This premature termination will prevent the drying or "baking" of the adhered fabrics.

Also, if a portion of a load of fabrics remains adhered to the container wall, the dry control termination system will sense the dryness of that portion of the load which is freely tumbling and contacting the electrodes **355** and **356** and will initiate termination of the drying operation at the predetermined condition of dryness of the tumbling fabrics while ignoring the condition of the adhered fabrics. This operation thus insures proper drying of tumbling fabrics while preventing drying or "baking" of adhered fabrics.

If a damp dry cycle is selected at the beginning of the washing operation, switch member **232** would have been closed to place resistors **374** and **375** in the circuit to effect a more rapid firing of capacitor **366** with a result that the fabrics would be less dry. Also, if a lower temperature is desired for the drying operation, switch **229** may be opened to place thermostat **346** in the circuit.

In summary it is seen that the instant application describes a washer-drier combination unit which has improved features of operation including a unique two motor drive system for providing an improved cycle of operations to achive improved fabric treatments.

This laundry apparatus includes a new combination of elements which have a cooperative interrelationship that achieves a degree of efficiency and consistency of results in washing and drying fabrics not heretofore realized in a single unit. This is a unit in which maximum fluid extraction is achieved through the provision for an assured distribution operation yet reduces the problems of fabrics adhering to the wall of the washing container through the provision for an antiadhesion operation. There is greater assurance that fabrics will tumble freely during the drying operation so as to achieve optimum performance of the automatic dry termination system. If, however, fabrics remain adhered to the wall, operation will be automatically interrupted. The plurality of speeds required for these specialized operations as well as for the tumble and extraction operations are all provided by a drive system including only two motors, a two-stage belt transmission, and an overrunning clutch under control of a sequence control mechanism.

In the drawings and specification, there has been set forth a preferred embodiment of the invention and, although specific terms are employed, these are used in a generic and descriptive sense only, and not for purposes of limitation. Changes in form and the proportion of parts, as well as the substitution of equivalents are contemplated, as circumstances may suggest or render expedient, without departing from the spirit or scope of this invention as further defined in the following claims.

I claim:

1. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a wall member and an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations; control means including sequencing means and circuit means cooperable therewith for selectively energizing said drive means to effect a series of operations including a final fluid extraction operation, and a tumble dry operation; and means for terminating said tumble dry operation including electrode means positioned in said container means operative for interrupting operation of said apparatus responsive to the absence of wet tumbling fabrics contacting said electrodes.

2. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a non-vertical axis and having a wall member and an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations; control means including sequencing means and circuit means cooperable therewith for selectively energizing said drive means to effect a series of operations including a final fluid extraction operation, and a tumble dry operation; means for terminating said tumble dry operation including electrode means positioned in said container means for selective response to a predetermined dry condition of the tumbling fabrics and to a condition of nontumbling of said fabrics during said tumble dry operation for initiating termination thereof.

3. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a circumferential wall member radially disposed from said axis and further having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations; control means including sequencing means and circuit means cooperable therewith for selectively energizing said drive means to effect a series of operations including a final fluid extraction operation, and a tumble dry operation; said control means being further operative for energizing said drive means for first accelerating said container means toward a spin speed prior to said final extraction operation to remove limited quantities of fluids and then effecting stopping of said container in a first position and then a second position to improve releasibility of fabrics from said wall member; and means for terminating said tumble dry operation including electrode means positioned in said container means and inwardly spaced from said wall member thereof for contact by said fabrics when said fabrics are tumbling and responsive to noncontact by nontumbling wet fabrics for initiating termination of said tumble dry operation to achieve drying of said tumbling fabrics to a predetermined dry condition while substantially preventing drying of fabrics adhering to said container wall member.

4. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a circumferential wall member radially disposed from said axis and further having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means comprising belt transmission means including a first stage speed reduction means and a second stage speed reduction means, clutch means operatively located between said first and said second stage speed reduction means, first motor means drivingly connected to said first stage speed reduction means and operative for driving said container means at a relatively slow speed through said first and second stage speed reduction means and said clutch means, pulsing means for cyclically energizing said first motor means to drive said container means at a speed relatively close to said slow speed, and second motor means drivingly connected through said clutch means for driving said second stage speed reduction means and thereby said container means at at least one relatively fast extraction speed whereby said container means is operable at at least three speeds including tumble, distribution, and extraction; control means including sequencing means operative for programming said laundry apparatus through a predetermined series of operations including a tumble wash operation, a distribution operation, a final extraction operation, and a tumble dry operation; means included in said control means for energizing said second motor to accelerate said container toward a relatively high spin speed for removing limited quantities of fluids prior to said final extraction operation; and means for terminating said tumble dry operation including electrode means positioned for contact by said tumbled fabrics and responsive to noncontact by nontumbling wet fabrics for initiating termination of said tumble dry operation.

5. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a non-vertical axis and having a circumferential wall member radially disposed from said axis and further having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means including a first and a second motor connected to said container means by a pair of alternate drive paths; control means including sequencing means and circuit means cooperable therewith for selectively energizing said first and second motors to effect a series of operations including a timed distribution operation, a final fluid extraction operation, and a tumble dry operation, said circuit means further including switch means operable for initiating energization of said second motor prior to said final extraction operation for accelerating said container toward a relatively high spin speed for removing limited quantities of fluids; means responsive to operation of said second motor at said relatively high spin speed for interrupting energization thereof and effecting stopping of said container in a first position, said switch means being then operative for energizing said first motor for a short period of time to rotate said container means from said first position to a second position whereby said container means is stopped at a plurality of positions at which the fabrics may fall free from the upper portion of said container means; and means for terminating said tumble dry operation including electrode means positioned in said container means spaced from said wall member thereof for contact by said tumbling fabrics and spaced from said fabrics when said fabrics are positioned as during the extraction operation, said termination means being responsive to a predetermined condition of dryness of said tumbling fabrics for initiating termination of said drying operation.

6. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing on said base member; perforate container means rotatably mounted in said casing means and having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means comprising transmission means having a first stage speed reduction means and a second stage speed reduction means, clutch means operatively located between said first and said second stage speed reduction means, first motor means drivingly connected to said first stage speed reduction means and operative for driving said container means at a relatively slow speed through said first and second stage speed reduction means and said clutch means, means associated with said first motor means for cooperating therewith to selectively drive said container means at a speed relatively close to said slow speed, and second motor means drivingly connected to said second stage speed reduction means and operative for driving said container means at at least one relatively fast extraction speed; sequencing means operative for programming said laundry apparatus through a predetermined series of operations including distribution operation, a final extraction operation, and a tumble dry operation; means for energizing said second motor to accelerate said container to-

ward a relatively high spin speed and thereby remove limited quantities of fluids prior to said final extraction operation, said sequencing means being further cooperable with said energizing means for effecting a timed pause and a short timed energization of said first motor to stop said container at a first position and then a second position for providing a plurality of positions at which the fabrics may fall free from the upper portion of said container means; and means for terminating said tumble dry operation including electrode means positioned for contact by said fabrics when tumbled and for non-contact by said fabrics when said fabrics are positioned as during extraction, said termination means being responsive to a predetermined condition of dryness of said tumbling fabrics for initiating termination of said tumble dry operation and further responsive to a condition of nontumbling of said fabrics during said tumble dry operation for interrupting operation of said apparatus.

7. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a circumferential wall member radially disposed from said axis and further having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means comprising belt transmission means including a first stage speed reduction means and a second stage speed reduction means, clutch means operatively located between said first and said second stage speed reduction means, first motor means drivingly connected to said first stage speed reduction means and operative for driving said container means at a relatively slow speed through said first and second stage speed reduction means and said clutch means, pulsing means for cyclically energizing said first motor means to drive said container means at a speed relatively close to said slow speed, and second motor means drivingly connected to said clutch means for driving said second stage speed reduction means and thereby said container means at at least one relatively fast extraction speed whereby said cointainer means is operable at at least three speeds including tumble, distribution, and extraction; control means including sequencing means operative for programming said laundry apparatus through a predetermined series of operations, said series of operations including a tumble wash operation, a distribution operation, a final extraction operation, and a tumble dry operation; means included in said control means for energizing said second motor to accelerate said container toward a relatively high spin speed for removing limited quantities of fluids prior to said final extraction operation, said control means being further operable for deenergizing said second motor and after a timed pause energizing said first motor for a predetermined short period of time and then deenergizing it to effect stopping of said container at a first position and then a second position to provide a plurality of positions at which the fabrics may fall free from the upper portion of said container means; and means for terminating said tumble dry operation including electrode means positioned for contact by tumbling fabrics and responsive to a predetermined condition of dryness of said tumbling fabrics for initiating termination of said drying operation and further responsive to a condition of nontumbling of said fabrics during said tumble dry operation for deenergizing said laundry apparatus to prevent drying of fabrics adhering to said container wall member.

8. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means upon said base member; perforate container means rotatably mounted in said casing means and having an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; first drive means for rotating said container means at a plurality of relatively slow speeds, said first drive means comprising belt transmission means including a two-stage speed reduction means drivingly connected to said container means; second drive means operative for driving said container at a plurality of relatively fast extraction speeds; clutch means responsive to operation of said second drive means for effecting overrunning operation of said first drive means; control means including sequencing means operative for programming said laundry apparatus through a predetermined series of operations, said series of operations including a distribution operation prior to an extraction operation, and antiadhesion operation, a final fluid extraction operation, and a tumble dry operation; means for effecting a spin impulse to accelerate said container means to a relatively high spin speed for removing limited quantities of fluids prior to said final extraction operation; means for effecting a pause and a tumble impulse subsequent to said spin impulse to effect stopping of said container means at a first position and then following said tumble impulse at a second stopped position to provide a plurality of positions at which the fabrics may fall free from the upper portion of said container means; and means for terminating said tumble dry operation including electrode means positioned in said container means for contact by said tumbled fabrics and for noncontact by said fabrics when said fabrics are positioned as during extraction, said termination means being responsive to a predetermined condition of dryness of the tumbling fabrics for initiating termination of said tumble dry operation and further operative for terminating operation of said apparatus responsive to a condition of nontumbling of said fabrics during said tumble dry operation.

9. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a non-vertical axis and having a circumferential wall member radially disposed from said axis and further having an acess for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means comprising belt transmission means including a first stage speed reduction means and a second stage speed reduction means, clutch means operatively located between said first and said second stage speed reduction means, first motor means drivingly connected to said first stage speed reduction means and operative for driving said container means at a relatively slow speed through said first and said second stage speed reduction means and said clutch means, and second motor means drivingly connected to said second stage speed reduction means and operative for driving said container means at a relatively fast extraction speed; control means including sequencing means operative for programming said laundry apparatus through a predetermined series of operations including tumble wash, antiadhesion, fluid extraction, and tumble dry; and means for terminating said tumble dry operation including electrode means positioned in said container means and spaced from said wall member thereof so as to be contacted by said fabrics when said fabrics are tumbling, said termination means being responsive to a predetermined condition of dryness

of said tumbling fabrics and to a condition of non-tumbling of said fabrics during said tumble dry operation for interrupting operation of said laundry apparatus.

10. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a wall circumferential member and an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means including electric heating means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds to perform said complete washing and drying cycle of operations, said drive means including a first motor energizable for rotating said container means at at least one relatively slow speed for tumbling said fabrics and further including a second motor for rotating said container means at at least one relatively high speed for extracting fluids from said fabrics; control means included in said control means and including relay gramming said laundry apparatus through a series of operations including a distribution operation, a final fluid extraction operation, and a tumble dry operation, said control means including first circuit means for energizing said first motor to rotate said container means at a relatively slow speed and further including second circuit means having means responsive to operation of said first motor above a predetermined speed for effecting energization of said second motor; and third circuit means including in said control means and including relay means in parallel connection to said second motor and in series connection to said speed responsive means to insure operation of said electrical heating means only after said second motor is operating above a predetermined speed, means for substantially preventing fabric adhesion to said wall member; and means for terminating said tumble dry operation including electrode means positioned in said container means operative for interrupting operation of said apparatus selectively responsive to a condition nontumbling of said fabrics during said tumble dry operation and to a predetermined dry condition of tumbling fabrics for initiating termination of said tumble dry operation.

11. In a laundry apparatus for performing a complete washing and drying cycle of operations, the combination comprising: a base member; casing means; means for supporting said casing means on said base member; perforate container means mounted in said casing means for rotation about a nonvertical axis and having a circumferential wall member radially disposed from said axis and an access for receiving fabrics to be washed and dried therein; means for providing washing fluids to said container means; means for drying fabrics in said container means; drive means for rotating said container means at a plurality of speeds, said drive means comprising first motor means and including first pulley means drivingly fixed thereto, second motor means having a shaft member extending therefrom, second pulley means rotatably mounted on said shaft member, third pulley means drivingly fixed to said shaft member, clutch means for rotating said third pulley means with said second pulley means, first belt means drivingly coupling said first and second pulley means to form a first stage speed reduction means, and second belt means driven by said third pulley means and drivingly associated with said container means to form a second stage speed reduction means; first means for energizing said first motor means for driving said container means at a plurality of relatively slow speeds through a first drive path including said first stage speed reduction means, said clutch means, and said second stage speed reduction means; second means for selectively energizing said second motor means for driving said container means at at least one relatively fast speed through a second drive path including said second stage speed reduction means; means for substantially preventing fabric adhesion to said wall member; and means for terminating said tumble dry operation including electrode means positioned in said container means operative for interrupting operation of said apparatus responsive to a condition of nontumbling of said fabrics during said tumble dry operation and to a predetermined dry condition of said tumbling fabrics for initiating termination of said tumble dry operation.

12. In a laundry apparatus as defined in claim 11 and wherein said first energizing means is operable for controlling said first motor to effect operation at a first speed under steady energization and to effect operation at a second speed under pulsing energization.

References Cited by the Examiner

UNITED STATES PATENTS

2,307,254	1/1943	Bassett	68—20
2,760,639	8/1956	Haverstock	68—24 X
3,033,014	5/1962	Neyhouse et al.	68—19
3,055,203	9/1962	Toma	68—12
3,102,407	9/1963	Stilwell	68—19 X
3,172,277	3/1965	Brukland	68—12

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