

April 17, 1951

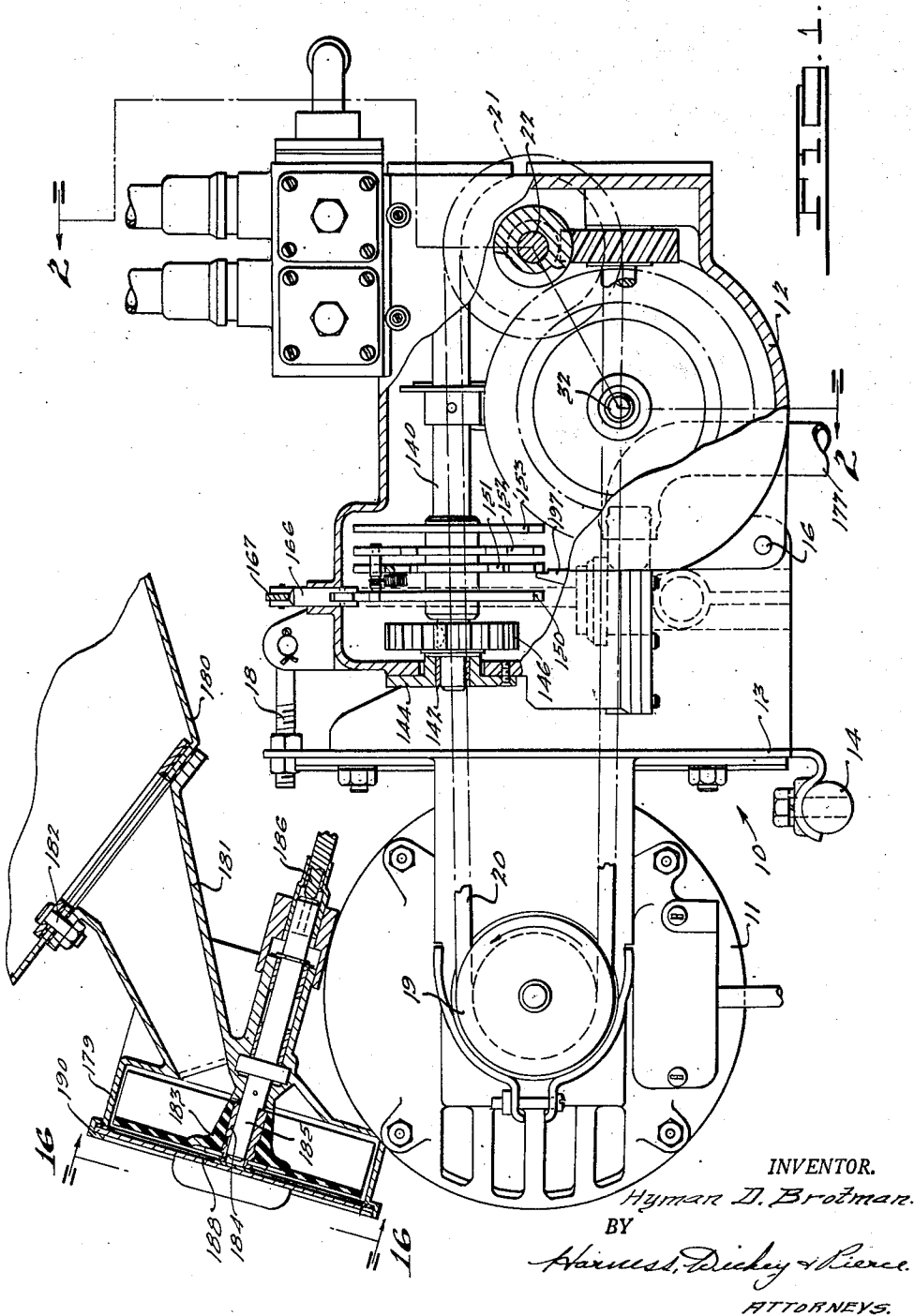
H. D. BROTMAN

2,548,940

DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

Filed May 29, 1947

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April 17, 1951

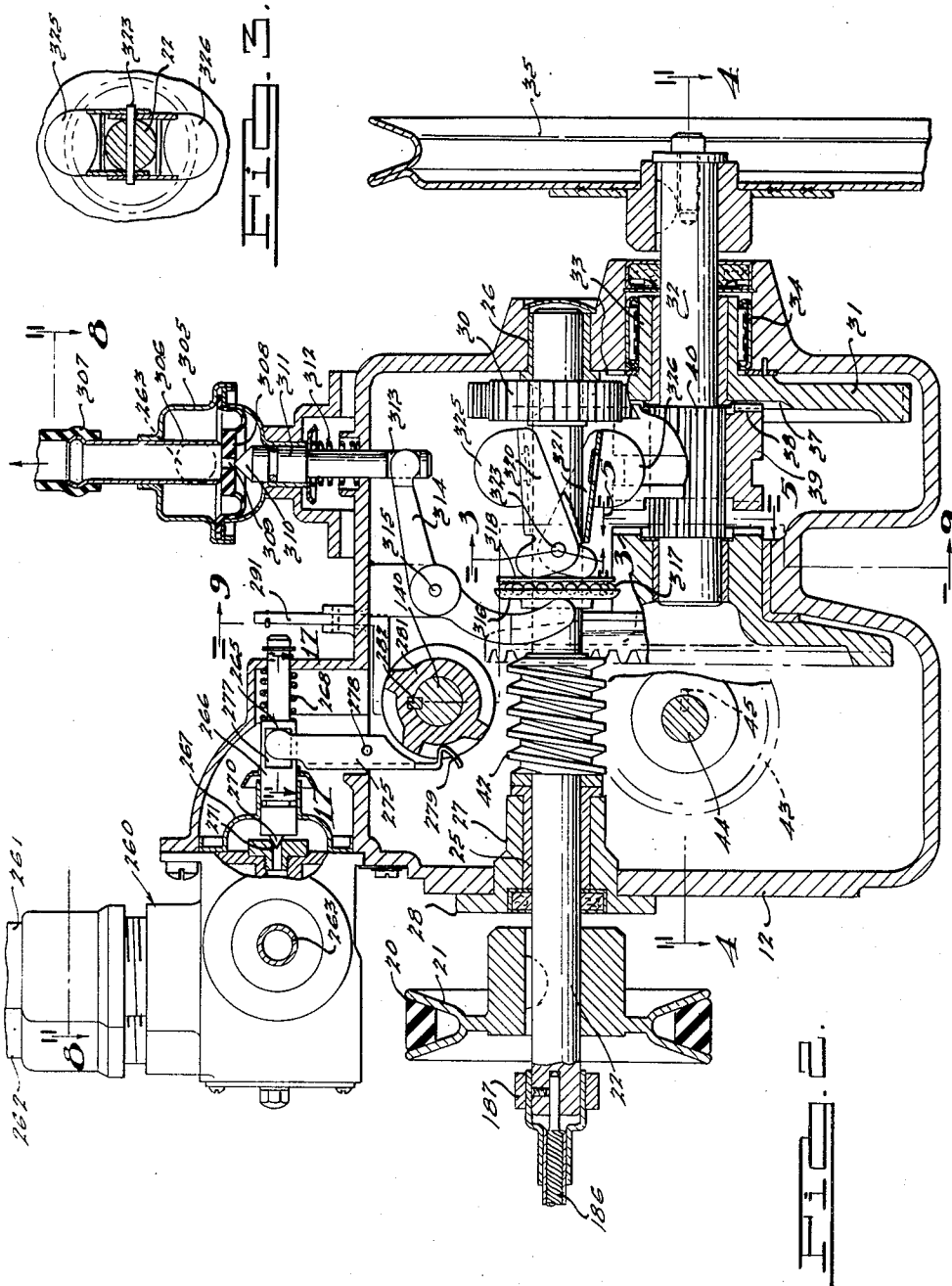
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DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

Filed May 29, 1947

8 Sheets-Sheet 2



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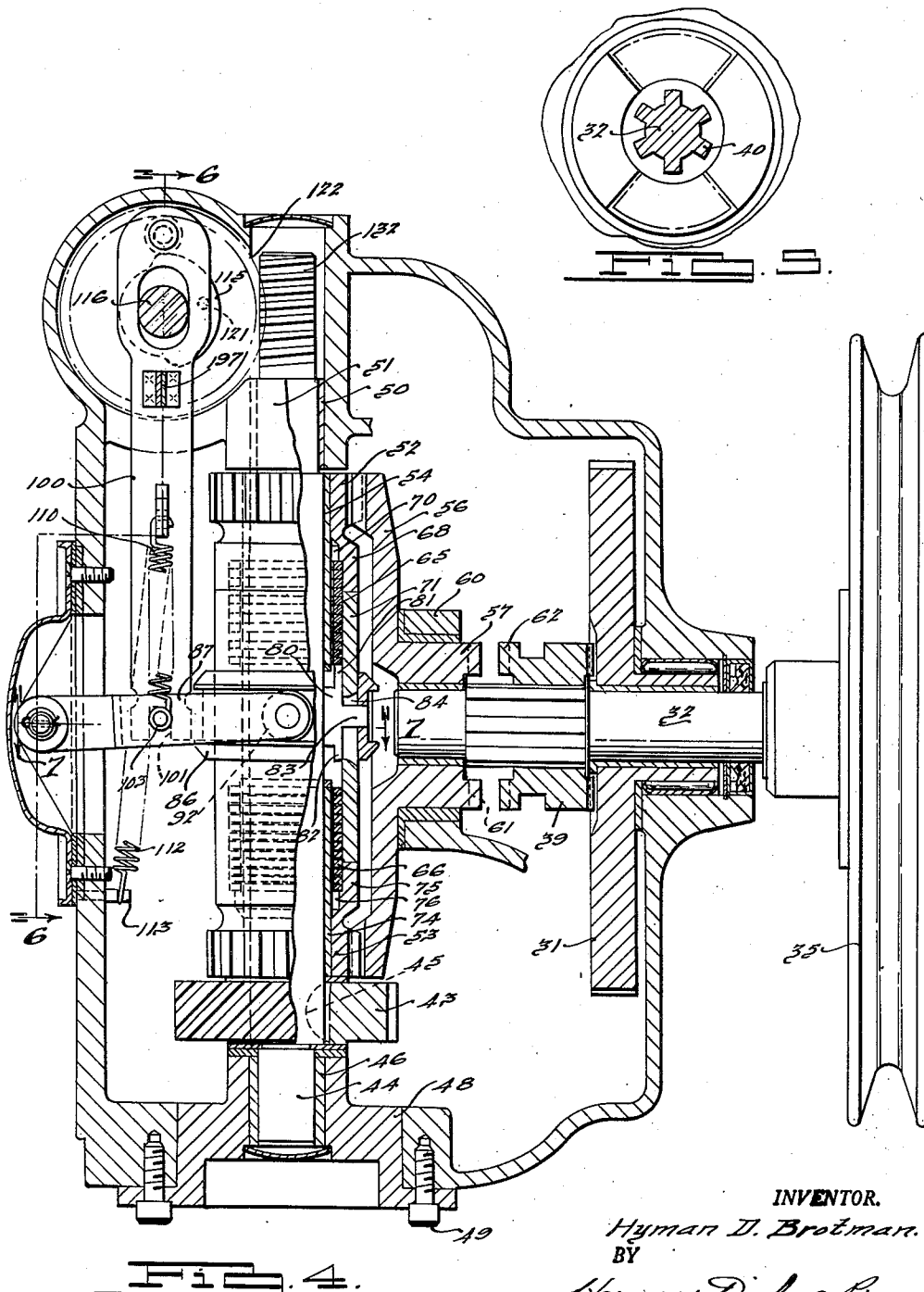
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DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

Filed May 29, 1947

8 Sheets-Sheet 3



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DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

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8 Sheets-Sheet 4

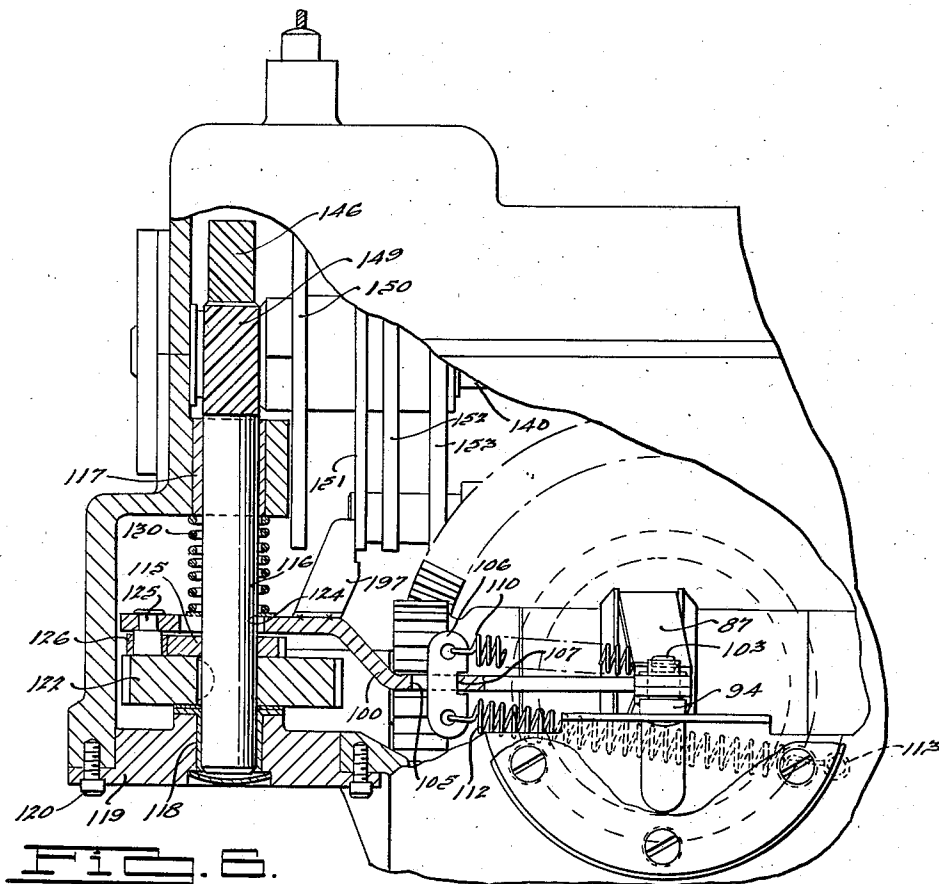


FIG. 6.

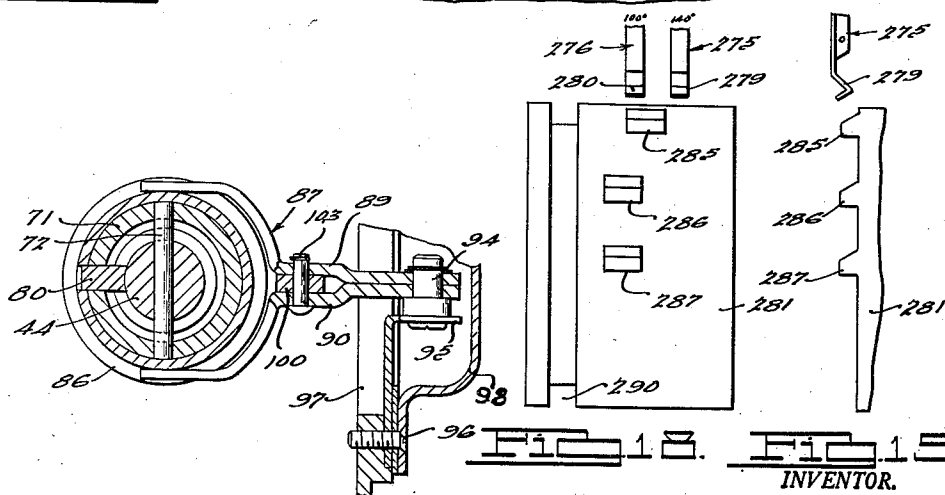


FIG. 7.

FIG. 18. FIG. 19.

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8 Sheets-Sheet 5

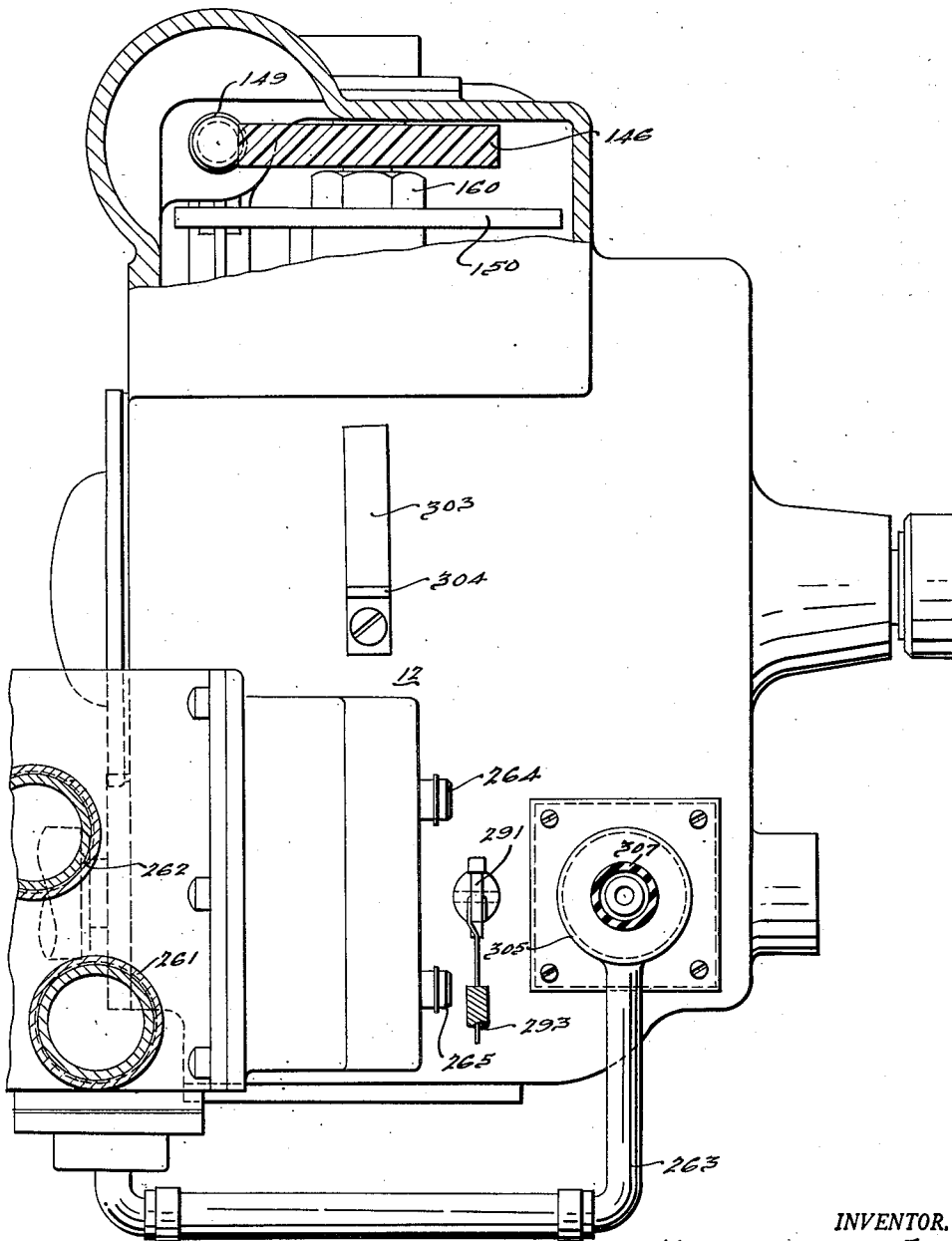


FIG. 5.

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8 Sheets-Sheet 6

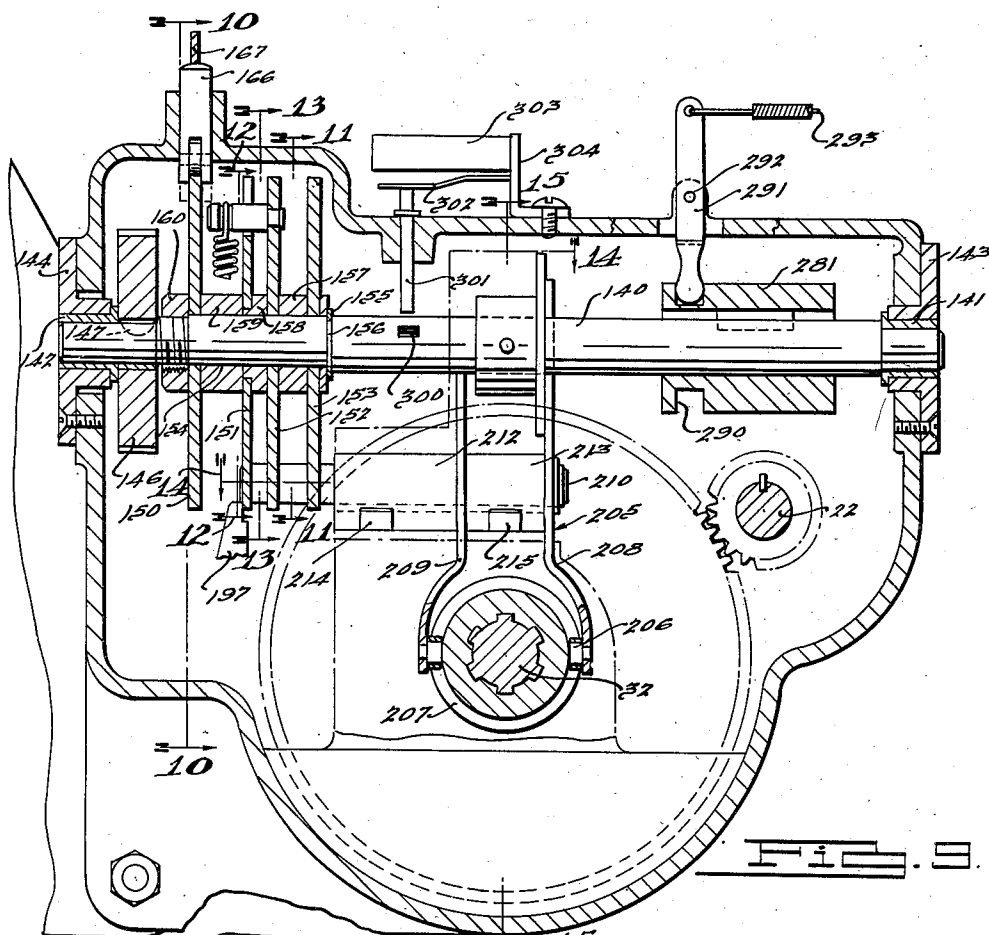


FIG. 9

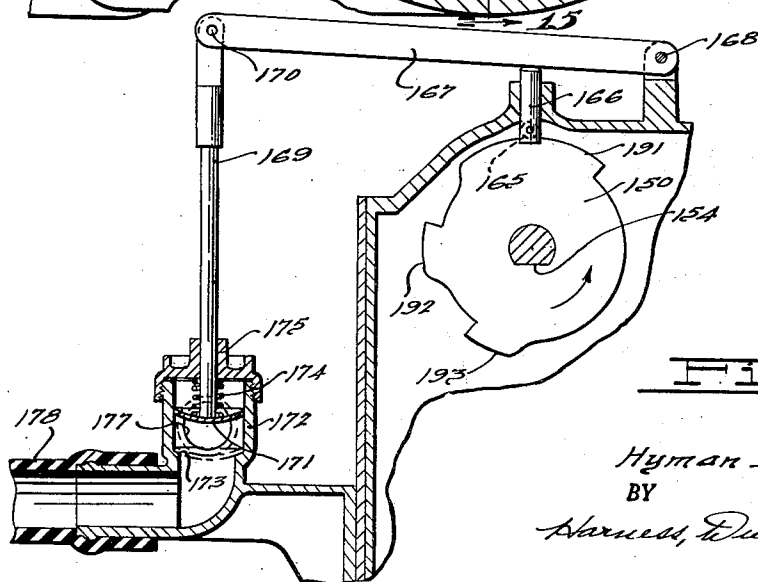


FIG. 10

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DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

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8 Sheets-Sheet 8

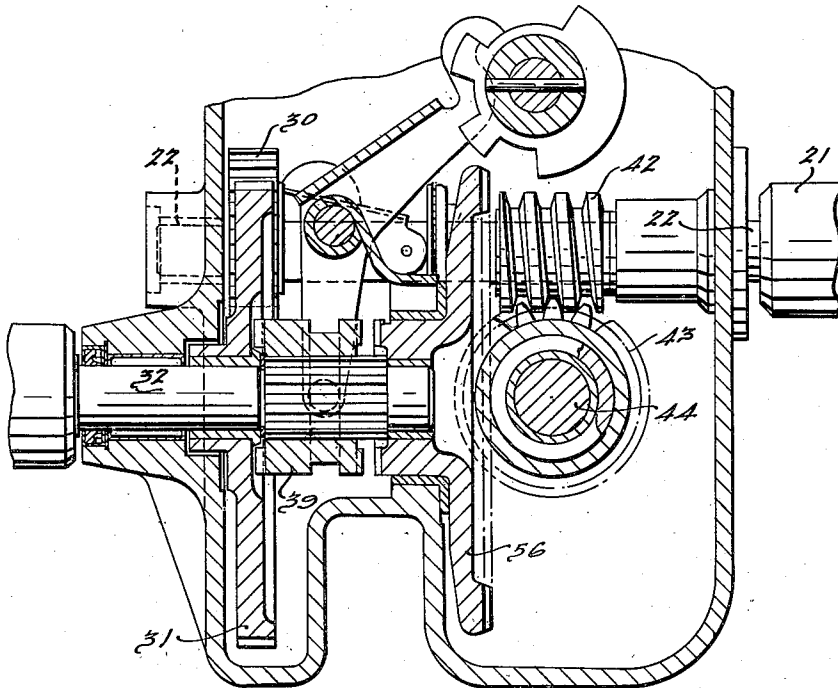


FIG. 15.

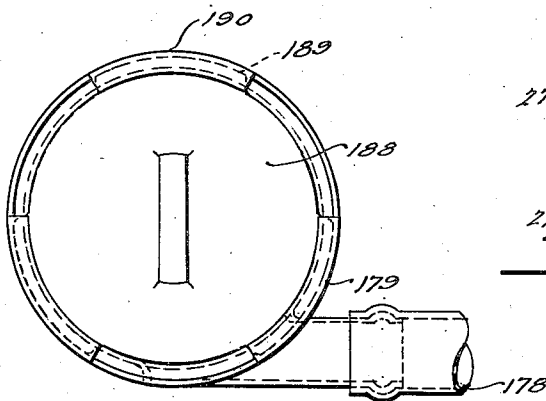


FIG. 16.

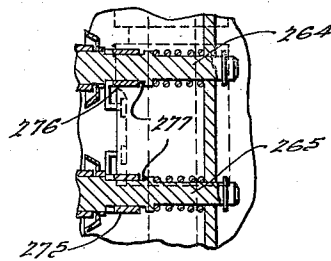


FIG. 17.

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UNITED STATES PATENT OFFICE

2,548,940

DRIVE UNIT FOR AUTOMATIC WASHING MACHINES

Hyman D. Brotman, Detroit, Mich., assignor, by mesne assignments, to Horton Manufacturing Company, Fort Wayne, Ind., a corporation of Indiana

Application May 29, 1947, Serial No. 751,424

24 Claims. (Cl. 74—318)

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The invention relates to machines for washing clothes and it has particular relation to an automatic type of machine which has a predetermined cycle of operations.

In certain respects the invention is related to those embodied in my copending applications for patent Serial No. 573,362, filed January 18, 1945, and Serial No. 639,065, filed January 4, 1946, now Patent No. 2,468,919, which are also directed to automatic washing machines. In those cases, the washing machine includes a clothes receiving cylinder which is rotated in one direction through a plurality of revolutions and then in the other direction through a plurality of revolutions and this operation is continued through the washing and rinsing stages. After completion of the last rinsing operation, the cylinder is rotated at a relatively high speed in one direction for the purpose of drying the clothes. The same principle of operation is embodied in the present invention in that the cylinder is first rotated in one direction and then in the other through the washing and rinsing stages and then is rotated in one direction only at a relatively high speed for drying the clothes.

One object of the present invention is to provide an improved washing machine of this type wherein an improved drive unit is provided for effecting the periodic reversing rotation of the cylinder.

Another object of the invention is to provide an improved construction of drive unit having improved means for causing the driven shaft of the cylinder to be reversely rotated during a certain period of the machine operation and then to be rotated in one direction at high speed for drying the clothes.

Another object of the invention is to provide an improved clutching arrangement for shifting from the slower reversing rotation to the drying higher speed in a quick and rapid manner and to shift from the high speed to the reversing rotation in a slower manner.

Another object of the invention is to provide an improved cam control means for governing the flow of water to the tub of the machine and the temperature thereof so that there will be less wear on the cams.

Another object of the invention is to provide an improved means for preventing the flow of water into the washing machine tub except when the motor driven drive shaft is rotating at a predetermined speed.

Other objects of the invention will become apparent from the following specification, from the

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drawings relating thereto and from the claims hereinafter set forth.

For a better understanding of the invention reference may be had to the drawings wherein:

Figure 1 is a side elevational view, with certain parts broken away and other parts shown in section, of a washing machine drive unit and associated parts constructed in accordance with one form of the invention.

Fig. 2 is a cross-sectional view taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is a cross-sectional view taken substantially along the line 3—3 of Fig. 2.

Fig. 4 is a cross-sectional view taken substantially along the line 4—4 of Fig. 2.

Fig. 5 is a cross-sectional view taken substantially along the line 5—5 of Fig. 2.

Fig. 6 is a cross-sectional view taken substantially along the line 6—6 of Fig. 4.

Fig. 7 is a cross-sectional view taken substantially along the line 7—7 of Fig. 4.

Fig. 8 is a cross-sectional view taken substantially along the line 8—8 of Fig. 2.

Fig. 9 is a cross-sectional view taken substantially along the line 9—9 of Fig. 2.

Fig. 10 is a cross-sectional view taken substantially along the line 10—10 of Fig. 9.

Fig. 11 is a cross-sectional view taken substantially along the line 11—11 of Fig. 9.

Fig. 12 is a cross-sectional view taken substantially along the line 12—12 of Fig. 9.

Fig. 13 is a cross-sectional view taken substantially along the line 13—13 of Fig. 9.

Fig. 14 is a cross-sectional view taken substantially along the line 14—14 of Fig. 9.

Fig. 15 is a cross-sectional view taken substantially along the line 15—15 of Fig. 9.

Fig. 16 is a cross-sectional view taken substantially along line 16—16 of Fig. 1.

Fig. 17 is a cross-sectional view taken substantially along the line 17—17 of Fig. 2.

Fig. 18 illustrates a development of the water control cam and fingers adapted to cooperate therewith.

Fig. 19 is an end view of the developed cam as shown by Fig. 18.

Referring to Figs. 1 and 2, the drive unit illustrated is indicated at 10 and this unit generally includes a motor 11 and a casing 12 secured to a bracket 13. This bracket at its lower end is supported on a rod 14 which in turn is pivotally anchored in the lower part of the washing machine cabinet so that the entire drive unit may swing about the axis of the rod. It will be observed that the casing 12 is pivotally connected as indicated

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at 16 to the lower part of the bracket 13 and that it is adjustably connected as indicated at 18 to the upper part of the bracket. The motor 11 has a pulley 19 engaged by a belt 20 and this belt in turn is trained about a similar pulley 21 drivingly connected to a shaft 22 extending into the casing 12.

Now referring to Fig. 2 in particular, the shaft 22 is journaled in bearings 25 and 26 in opposite walls of the casing 12 and the bearing 25 is held in a removable retainer 27 which is of sufficient size that the entire shaft assembly may be withdrawn along with the retainer from the casing. This retainer has a flange 28 on its outer end which may be suitably secured by screws to the casing. Within the casing the shaft 22 has a pinion 30 keyed thereto and this pinion meshes with a large gear 31 loosely journaled on a driven shaft 32 extending through the casing wall. It will be noted that the gear 31 has a hub 33 and that this hub is journaled in a bearing 34 located in the wall of the casing. The outer end of the shaft 32 is drivingly connected to a large pulley 35 and this pulley is adapted to engage a belt, which in turn is to be trained about a pulley on the shaft of the washing machine cylinder.

The gear 31 on its inner face has circumferentially arranged teeth 37 adapted to be engaged by teeth 38 on one end of a clutch element 39 having a splined connection with the shaft 32 as indicated at 40. From this it is evident that if the clutch element 39 is so moved as to cause the teeth 37 and 38 to engage, the pulley 35 will be driven whereas if the clutch is shifted so as to disengage the teeth, the gear 31 will turn idly on the shaft 32. It might be mentioned at this time that when the gear 31 is driving the shaft 32 the washing machine cylinder is being rotated at its high or clothes drying speed.

Now directing attention to Figs. 2, 4 and 15 the shaft 22 within the casing has a worm portion 42 which meshes with a worm wheel 43 keyed to a shaft 44 as indicated at 45. Directing attention particularly to Fig. 4, one end of the shaft 44 is journaled in a bearing 46 located in a retainer element 48 secured by screws 49 to the casing. The other end of the shaft is journaled in a bearing 50 mounted in an integral boss portion 51 of the casing. The arrangement is such that upon removing the retainer 48, the shaft assembly can be installed or removed as the case may require.

A pair of gears 52 and 53 are journaled on the shaft 44, although preferably a bronze sleeve or bushing 54 will be located on the shaft within each gear. The two gears 52 and 53 mesh with the teeth of a ring gear 56 which has a hub portion 57 journaled on the inner end of the driven shaft 32. This hub portion is also journaled in a bracket portion 60 integral with the casing and therefore the inner end of the shaft 32 is supported in this manner. The end of the hub portion 57 has teeth 61 adapted to engage similar teeth 62 on the inner end of the clutch element 39 and from this it follows that if the clutch element 39 is shifted out of engagement with the large gear 31, so as to cause the teeth 61 and 62 to engage, the ring gear 56 will be placed in driving relation to the driven shaft 32. It is also evident that if the gear 52 drives the ring 56, the shaft 32 will be driven in one direction, whereas if the gear 53 drives the ring gear, the shaft 32 will be driven in the opposite direction.

In order to connect gears 52 and 53 to the shaft 44, spring clutches 65 and 66 are provided respectively and these are disposed on the shaft be-

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tween the gears. The gear 52 has a portion of smaller internal diameter which is journaled on the bearing sleeve 54 on the shaft and a portion 68 of larger internal diameter which receives several convolutions of the spring 65. The end of the spring within the portion 68 of the gear is bent to provide an axial projection 70 which extends into a keyway or axial slot in the gear so that the spring as an entity always rotates with the gear. The remainder of the spring is disposed within a sleeve 71 having an internal diameter corresponding to the internal diameter of the gear portion 68 and this sleeve, as best shown by Fig. 7, is pinned to the shaft 44 by a pin 72 so that the shaft positively drives the sleeve at all times. Similarly the gear 53 is journaled on a bearing sleeve 54 on the shaft 44 and has an enlarged portion 75 receiving several end convolutions of the spring 66. This spring also has an axial projection which extends into a keyway or slot in the gear so that the spring and gear rotate together. The remainder of the spring is disposed within the sleeve 71.

Between the two springs a reciprocatory key 80 is disposed within the sleeve and this key has projections 81 and 82 on its ends which are adapted to move respectively into end engagement with the springs 65 and 66. If the projection 81, for instance, is moved against the end convolution of spring 65 the extreme end of the spring wire will be engaged by the projection 81 and this will cause the spring to unwind or expand into frictional engagement with both the sleeve and the gear portion 68. This will drivingly connect the sleeve and gear portion and then the sleeve, spring and gear will rotate together. If the key 80 is shifted in the other direction, the projection 82 will correspondingly engage the end of the wire in spring 66 and will cause this spring to unwind and expand and in this way the gear 53 will be driven by the sleeve. It is to be understood that the end of the wire in each spring will be cut substantially in the plane of the spring axis so that the end face of the wire will engage the projection in a substantially full surface manner.

The key 81 has a leg 83 which extends outwardly through an axial slot 84 in the sleeve and the outer end of this leg is connected to the base of a clutch shifting ring 86 encircling the sleeve. Shifting of the clutch ring along the sleeve thus will cause one spring or the other to drive its respective gear and it follows that reversing rotation may be imparted to the shaft 32 by shifting the clutch ring.

In order to shift the clutch ring 86, a swingable arm 87 is provided and this arm, as best shown by Fig. 7, is formed from laminations 89 and 90. At one end the two laminations are spread apart and straddle the clutch ring and the ends of the straddling portions have rollers 92 disposed between the annular ribs on the ring. The arm 87 is pivoted at its opposite end on a pin 94 supported on a bracket element 95, which in turn is secured by screws 96 to the casing. It might be noted that the casing has an access opening 97 which also accommodates the arm and bracket and that this opening is normally closed by a cover 98 also secured by screws 96 to the casing.

In order to swing the arm 87 about its pivot 94 a reciprocatory member 100 extends between the laminations 89 and 90 and has an open end slot 101 straddling a pin 103 connecting the laminations. This slot allows relative movement between the arm and the reciprocatory member

while still holding them in assembled relationship. As shown by Fig. 6, the reciprocatory member 100 intermediate its ends has a slot 105 which receives a bridge element 106 having a slot 107 in its edge embracing the edge of the reciprocatory member at that end of the slot next to the arm 87. One end of the bridge 106 is connected to one end of a coil spring 110 and the other end of this spring is connected to the pin 103 on the arm 87. The opposite end of the bridge 106 is connected to one end of spring 112 and the opposite end of this spring is connected to a pin 113 which is fastened to the casing. It should be evident in viewing Fig. 6, that if the member 100 is shifted to the left, the arm 87 will swing about its pivot through tensioning of the spring 110 and that return movement of the member 100 and arm will be effected by the spring 112.

Movement of the reciprocatory member 100 in a direction which tensions the springs 110 and 112 is effected by a cam 115 disposed on a shaft 116 journaled in bearings 117 and 118 in the casing. The latter bearing is disposed in a retainer 119 secured by screws 120 to the casing and this arrangement permits insertion and removal of the shaft and part thereof. The cam 115 is secured by a pin 121 to a worm gear 122 keyed to the shaft and consequently if the shaft rotates the cam turns. The reciprocatory member 100 has an elongated opening 124 through which the shaft 116 extends and the end of the member has a pin 125 provided with a cam engaging roller 126. The cam is so shaped as to cause, at each half revolution thereof, a reverse movement of the member 100 so that it is shifted first in one direction and then in the other direction, with the understanding of course that the member is shifted positively by the cam in one direction and returned by the spring 112 in the other direction. A coil spring 130 on the shaft between the bearing 117 and the member 100 serves to hold the member in proper position on the shaft. Rotation of the shaft 116, as best shown by Fig. 4, is effected by means of a worm thread 132 on the end of the shaft 44 which engages the worm gear 122.

With respect to controls in general, it has been mentioned heretofore that the driving shaft 32 carrying the pulley 35 is adapted to be driven first in one direction and then in the other in the event the clutch element 39 is in one position and then to be driven in one direction only at high speed when the clutch element is in its other position. Shifting of the clutch element at predetermined times will be effected automatically so that the cylinder in the tub will be rotated reversely at certain times and then in one direction at high speed at other times. Furthermore, with respect to shifting of the clutch element, it is desirable that it not be shifted to effect high speed rotation of the cylinder except at a time when the cylinder in its phase of reversing rotation is turning in the same direction it is to turn in the high speed rotation. Again the tub must be drained of water at predetermined times and fresh water must be introduced at predetermined times. It is necessary also to enable varying the temperature of the water so that with different kinds of clothes, a different temperature of water may be used. Finally, it is necessary to stop the machine automatically at the end of its cycle. These various controls are effected by means of cams mounted on a cam shaft which is driven at a very slow rate of speed, approximately one revolution in 40 minutes, and this part of the mechanism now will be described.

Referring to Fig. 9, the cam shaft is indicated at 140 and the ends of the shaft are journaled in bearings 141 and 142 disposed in retainer plates 143 and 144 fastened by screws to opposite walls of the casing. This shaft has a worm wheel 146 keyed thereto as indicated at 147 and this worm wheel as shown in Fig. 6, particularly, meshes with a worm 149 on the shaft 116 and is driven by this worm. The shaft 140 has a drain cam 150, a cam 151 which may be called a synchronizing cam, a high speed control cam 152 and a low speed control cam 153. The cams 150, 152 and 153 have openings fitting a portion of the cam shaft having a flat 154 so that these cams are directly driven by the shaft. The cams are held in assembled relation on this portion of the shaft by means of a snap ring 155 disposed in a groove 156 in the shaft, spacing sleeve elements 157, 158 and 159, and a nut 160 on a threaded portion of the shaft and engaging the cam 150. The cam 151, however, is turnable relative to the shaft and is adapted to be driven through a play-permitting, resilient connection as will be described hereinafter.

Directing attention now to Fig. 10, the cam 150 engages a roller 165 provided on the lower end of a plunger 166 projecting through the casing wall and the external end of this plunger engages an arm 167 pivoted on the casing as indicated at 168. This arm is pivotally connected to a rod 169 at a point indicated at 170 and the rod at its lower end carries a disk type valve 171. The valve is disposed in a valve casing 172 having a valve seat 173 and normally the valve is urged to valve seating or closed position by a spring 174 which encircles the rod and at one end engages the valve. At its other end, the spring engages cap 175 threaded on the valve casing and having an opening through which the valve rod slidably extends.

Above the valve the valve casing is connected to a conduit 177 which leads to a drain. Below the valve the casing is connected to a conduit 178 and as best shown jointly by Figs. 1 and 16, the conduit is connected to a pump casing 179 which in turn is connected to the bottom of a washing machine tub 180. The pump casing has a funnel shaped portion 181 with its larger end coinciding with an opening in the tub and such larger end is suitably secured to the tub such as by bolts 182. Within the pump casing, a rubber rotor 183 is carried by a metal sleeve 184 and this rotor has rubber blades suitably spaced from the periphery and sides of the casing so that the rotor may turn idly when required. The sleeve 184 is slidably splined on one end of a shaft 185 journaled in the wall of the casing and this shaft in turn is connected to a flexible shaft 186 which leads to the main drive shaft 22, as seen in Fig. 2. At this point the flexible drive shaft is drivingly connected to shaft 22 by means of a screw 187.

The pump casing, as seen in Figs. 1 and 16, is normally closed by a disk 188 having spaced projections 189 at its outer edge and the pump casing has a turned over flange 190 forming a channel for receiving such projections. At spaced locations, the flange 190 has gaps so that the projections 189 may be inserted through the gaps and then the disk turned so as to bring the projections under the flange. In this way the disk may be locked in place and yet be moved by turning it until the projections 189 are disposed in the gaps in the flange 190. Removal

of the disk permits removal of the pump rotor and cleaning it as required.

It is evident from this description that the pump is driven at all times while the machine is in operation but that water will not drain unless the drain valve 171 is open. The latter is opened at predetermined times by high parts 191, 192 and 193 on the cam 150 and at other times it is closed, as will be considered presently in relation to other cam operations.

Now referring to Fig. 12, the cam 151 is shown as having a substantially long high part 194 and shorter high parts 195 and 196. These higher parts of the cam are adapted to interfere with or obstruct movement of an arm 197 which, as best shown by Fig. 6, is welded to the reciprocatory member 100. Viewing Fig. 6 with the high parts of the cam 151 in mind, it is evident that if the arm 197 is held at the left side of the cam 151 by a high part of this cam, the member 100 will be held in its left hand position, with the corresponding clutch spring 65 energized and driving the gear 52. Therefore, as long as any high part of the cam 151 is in a position obstructing movement of the arm 197 to the right or to its full line position as seen in Fig. 6, the spring 65 alone will be expanded.

The cam 151 as previously stated rotates relative to shaft 140 and it is driven by means of a spring 200 connected at one end to a pin 201 on the cam 152 while the other end of the spring is connected to a pin 202 on the cam 151. The pin 201 is disposed in a slot 203 in cam 151 so as to permit a certain amount of play or relative rotative movement between the two cams. If it be assumed that the arm 197 is in its right hand position as seen in Fig. 6 so that it is projecting axially past cam 151 and is thus disposed between two of the high parts of the cam, the cam will be driven through the spring 200 without any interference from arm 197. During this time the arm 197 will shift axially back and forth with the reciprocatory member 100 and the cylinder in the washing machine will be reversed periodically. Now if the cam 151 in its forward movement engages the arm 197 at a time when the latter is projecting axially past the cam, the cam will stop although the cam 152 will continue moving since the spring 200 and play will permit this. Then as soon as the arm 197 shifts to the left and clears the cam, the energized spring 200 will quickly advance the cam 151 a short distance so as to throw the high part of the cam in front of the arm 197. From this time on the arm 197 cannot return until the high part of the cam moves past it.

It will be brought out hereafter that the high part of the cam will thus interfere with return movement of the arm 197 only at a time when cam 152 is about to shift the clutch element 39 into its high speed position. In other words, just before the clutch element 39 is to be shifted into its high speed position, the arm 197 will be held in its left hand position by a high part of cam 151 so that the spring clutch 65 will be driving gear 52. The direction of the drives are such that when the spring 65 is driving gear 52 the shaft 32 is rotating in the same direction as it will rotate when the high speed gear 31 is driving the shaft 32. From this it follows that the cam 151 and the arm 197 act to hold the clutch spring 65 in operative condition just before the clutch element is shifted so that the high speed rotation will be a continuation of the low speed rotation which occurred through this spring 65.

It might be mentioned further that the high part of the cam holds the spring 65 in operative position until after the clutch element is again shifted to interrupt high speed rotation so that the low speed drive, effected when the high speed drive is interrupted, will be in the same direction as the direction of cylinder rotation.

Referring to Figs. 9 to 14, the means for shifting the clutch element 39 comprises a yoke 205 straddling the clutch element and having rollers 206 at opposite sides disposed in the channel of such element as indicated at 207. This yoke includes arms 208 and 209 which are keyed to a rocker shaft 210 by means of a flat 211 and such shaft is journaled in bearing brackets 212 and 213 secured by screws 214 and 215 to the casing. It may be noted that the two arm portions are journaled on the shaft at opposite ends of the bracket 213 so that the clutch shifting yoke is axially positioned on the rocker shaft in this way.

As best shown by Fig. 11 in conjunction with Fig. 14, a bifurcated arm 218 is journaled on the shaft 210 so that it turns relative thereto and this arm has a cam roller 219 engaging the periphery of the cam 153. Intermediate its ends, the arm 218 has a hump 220 which abuts a head 221 of a plunger 222 extending through a cup-like sleeve 223. This sleeve is secured in the folded portion of a bifurcated arm 224 keyed to the shaft 210 by the flat 211. A coil spring 225 on the plunger and abutting the base of the sleeve and the head 221, urges the head 221 into engagement with the hump 220 at all times. A pin 217 extending through the plunger is adapted to engage the base of the sleeve and limit outward movement of the plunger.

A like arm 226 journaled on the rocker shaft 210 carries a roller 227 engaging the periphery of cam 152. This arm has a hump 228 engaging a spring pressed plunger 229 on an arm 230 which is also keyed to the rocker shaft by the flat 211. The arm 226 and the arm 230 are the same as the arm 218 and arm 224 except that they are disposed at diametrically opposite sides of the rocker shaft and therefore pressure on the plunger 229 tends to turn the rocker shaft and shift the clutch element 39 into its high speed position, whereas pressure on the plunger 221 tends to turn the rocker shaft in the opposite direction to shift the clutch element into its low speed position. By compressing one spring plunger or the other, the clutch element thus can be shifted between those two positions. The cam 152 has a long high part 240 and shorter high parts 241 and 242 and these represent respectively a long period where the cylinder is being rotated at high speed in the drying of the clothes and two shorter high speed spins used in rinsing the clothes. The cam 153 has a long high part 244 and shorter high parts 245 and 246 and these represent respectively periods when the low speed reversing operation of the cylinder is occurring. The longer high part 244 represents the main or principal washing stage while the shorter high parts 245 and 246 represent the stages when rinsing occurs. Between these high parts, the cam has lower parts for allowing the roller 219 to drop thereinto and this is true of the cam 152 and its roller 227. The cams are so arranged that generally speaking the high part of one cam is in contact with its roller while the other cam has a low part, in engagement with its roller. As the parts are shown in Figs. 11 and 13, the clutch is in its high speed position with the roller 227 engaged by the

high part 240 of the cam 152 and the roller 219 engaged by a low part of the cam 153.

The arm 205 has an extension 250 which as best shown by Fig. 14, has a bent over end or projection 251 disposed in the plane of an escapement disk 252 which is pinned to the shaft 140 by a pin 253. As shown by Fig. 11, this escapement disk has a long high part 255 and smaller high parts 256 and 257 and between such high parts the disk has lower parts allowing the projection 251 to drop thereinto. It might be observed that while the projection 251 is on a high part of the disk the clutch shifting arm 205 will have to remain in its low speed position and that it cannot leave this position until the projection reaches a lower part of the disk. The purpose of the escapement disk and finger 251 is to prevent shifting of the clutch element 39 from the low to the high speed position until the cam roller 227 is fully on a high part of cam 152 and the spring pressed plunger 229 is fully loaded so that the clutch element may be shifted rapidly. As shown in Figs. 11 and 13, the machine is in the final drying and the clutch element is in its high speed position, with roller 219 on a low part of cam 153 and roller 227 on high part 240 of cam 152. Thus the plunger 229 is loaded while the plunger 221 is relatively unloaded. If the cams continue to turn in the direction indicated by the arrows, the roller 219 begins to ride up upon the incline approaching the high part 244 of cam 153 and thus the plunger 222 becomes gradually loaded. As the loading of plunger 222 builds up, the clutch element 39 slowly shifts towards its low speed position and then as soon as roller 219 is on the high part 244 of cam 153, the roller 227 drops off of the high part 240 of cam 152 and the clutch element completes its shifting movement into its low speed position. As this occurs, the finger 251 is lifted and then is travelling over the high part 255 of the escapement disk 252.

As will be described presently the machine stops automatically after this drying operation at high speed and after the clutch element is shifted back to low speed position. However, if the operation continued, as it would when the machine again is operated, the roller 227 would continue to ride over the lower part of cam 152 while the roller 219 would ride over the high part 244 of cam 153. Then when the high part 241 of cam 152 reaches roller 227 it loads the plunger 229 but due to the fact that the finger 251 is still on the high part 255 of the escapement disk, the clutch element will not be shifted. Just before the finger 251 drops off of the high part 255 of the escapement disk, the roller 219 drops off of the high part 244 of cam 153 and then when the finger drops off of the high part of the escapement, the clutch element is rapidly shifted into its high speed position by the fully loaded plunger 229.

This much of the cam operation has been considered at this time so that it will be understood that the clutch element shifts slowly from high to low speed position, whereas it shifts rapidly from low to high speed position.

The flow of water into the tub is controlled by a thermostatic valve indicated generally at 260 in Fig. 2 and this valve may correspond substantially to the valve shown in my copending application, Serial No. 573,362, filed June 18, 1945. In such a valve a cold water line 261 is provided which may be connected to an ordinary water line in the home and hot water line 262 is pro-

vided which may be connected to a source of hot water under pressure. The valve includes two mixing chambers controlled thermostatically so that from these chambers respectively water may be drawn at approximately 100 degrees F. and 140 degrees F. Water flows from either chamber, as the case may be, to the tub through a conduit 263.

With particular reference to Fig. 17 in conjunction with Fig. 2, two valves 264 and 265 are provided for respectively opening the mixing chambers mentioned, to the pipe 263. Each of these valves includes a slidable stem 266 supported by a valve casing element 267 and a wall of the main casing and the stem is normally urged into valve closing position by a spring 268. The stem includes a conical end 270 adapted to open or close a valve opening 271 and when the stem is moved against the action of the spring, the opening 271 is uncovered so that water may flow to conduit 263. The principal difference between this type of valve and those shown in the other applications for patent is that the valve is urged to a closed position by a spring and this is desirable because the water supply is cut off from the tub most of the time and it is preferable to have the cam open the valve against the spring during the shorter periods as against holding the valve closed against the spring during the longer periods.

As shown by Figs. 2, 17 and 18, together, the valve stems are adapted respectively to be shifted to open positions by channel shaped arms 275 and 276 each of which straddles its valve stem and engages a recessed portion 277 thereof. Each arm is pivoted on the casing as indicated at 278 and the two arms terminate in fingers 279 and 280 disposed for engagement with the periphery of a cam sleeve 281, slidably keyed on the cam shaft 140 as indicated at 282.

The developed cam is shown in Figs. 18 and 19 so that the operation thereof will be better understood. This cam has a cylindrical or smooth surface except for projections 285, 286 and 287 adapted to engage the fingers on the arms. With the cam in the position as shown by Fig. 18, the finger 280 on the one arm will engage all three projections 285, 286 and 287 and each engagement will open the valve 264 and allow water at the 100 degree temperature to flow. If the cam is shifted to the right a short distance so as to cause the projection 285 just to clear the finger 280, it is evident that the latter finger will engage only the projections 286 and 287 while the finger 279 will engage the projection 285. Under these circumstances water at 140 degrees F. would flow into the tub when the finger 279 is engaged by the projection 285 but thereafter the water that will flow will be at the low temperature because the projections 286 and 287 would engage only the finger 280. It might be mentioned that water at one temperature or the other will be desired for the washing stage but in the two succeeding rinsing operations, water at the lower temperature ordinarily is desired.

The cam 281, as best shown by Fig. 9, has an annular groove 290 engaged by one end of an arm 291 projecting into the casing and pivoted thereon as indicated at 292. The outer end of the arm is engaged by a stiff wire 293 leading to an external point on the washing machine cabinet, and it follows that the cam may be shifted from one position to the other by pushing and pulling this wire.

As seen in Fig. 9, stopping of the machine

through control of the motor may be effected by a projection or cam element 300 on the cam shaft 140 which is adapted to engage a plunger 301 slidably extending through the casing. The outer end of this plunger engages a contact element 302 forming a part of a micro-switch 303 which is mounted on a bracket 304 secured to the casing. Insulating parts will be used as required to avoid short circuiting. As indicated in the applications previously mentioned, the machine may be started by means of a relay circuit which is closed manually when it is desired to start the machine. This relay circuit is held closed until the cam element 300 passes the plunger 301 and then the micro-switch is closed and the relay cut out. When the cam element again reaches the element 301 the micro-switch is opened and the motor stops.

In order to prevent a continued flow of water into the tub in the event the motor should stop for any reason while water is flowing into the tube, a centrifugal control is provided in the water line as shown by Fig. 2. The water line 263 coming from the thermostatic valve previously described is connected to a valve casing 305 and within this casing a tube 306 is provided which in turn is connected to a rubber conduit 307 leading to the upper part of the tub. The end of the tube 306 is adapted to engage a rubber disk 308 extending across the casing 305 and this disk has a central opening 309 adapted to be closed by a conical end 310 on a valve stem 311. A spring 312 around the valve stem 311 urges it to closed position. The stem 311 projects through the casing wall and at its inner end has a recess 313 engaged by one end of a bellcrank 314. This bellcrank is pivoted intermediate its ends as indicated at 315 and its opposite end is bifurcated and engages a disk 315 rotating on the main drive shaft 22. The disk 316 houses and contains a series of balls 317 which in turn engage a disk 318 also on the shaft. Both disks are adapted to be moved along the shaft so as to move the bellcrank about its pivot and open the valve by a pair of opposed bellcranks 320 and 321 pivoted to the shaft by a pin 323 and having their inner ends abutting the disk 318. The other ends of the bellcranks have weights 325 and 326 and when the shaft 22 is rotating, these weights move outwardly and this in turn swings the bellcrank 314 and opens the valve. As soon as the shaft 22 stops rotating, the spring 312 will close the valve and cause the weights to move in against the shaft.

With respect to the general operation of the machine, it should be said initially that the various cams are shown in the positions which they occupy during the drying stage. For instance the drain cam as shown in Fig. 10, has its high part 191 holding the drain valve open and as seen in Figs. 11 and 13, the clutch element 39 is in its high speed position with the roller 219 on a low part of cam 153 and the roller 227 on the high part 240 of cam 152. The finger 251 on the escapement arm is on a low part of cam 252. Furthermore, as will be apparent in Fig. 12, the arm 197 is prevented from moving because of high part 194 on cam 151 and thus the clutch spring 65 is maintained in expanded condition.

Operation of the machine in this drying stage will continue until the roller 227 in Fig. 13 drops off of the high part 240 of cam 152 and the roller 219 rides up on the high part 244 of cam 153. This will cause the clutch element 39 to move to its low speed position, and shortly after this oc-

curs, the high part 255 of the escapement cam 252 moves under the finger 251 of the escapement arm 250. When the clutch element moves to its low speed position, the arm 197 (Fig. 12) on the reciprocatory member 100 is still locked out by the high part 194 of cam 151 and thus the washing machine cylinder will continue running in the same direction as it would in the drying stage, but, of course, it will have slowed down after the shift of the clutch element and will now be running at slow, washing speed. Approximately at this time, that is after the clutch element has shifted, the cam 300 on the cam shaft as seen in Fig. 9, will have opened the switch 303 and the motor will stop. The clothes may now be removed.

With the machine in a stopped condition, the drain valve is still open, the thermostatic valves opened by cam 281 are both closed and the centrifugally controlled valve 310, is closed. If it is now desired to use the machine, the clothes are placed in the cylinder and then the relay switch is closed to start the motor. The cylinder is initially driven in its washing stage since the long high part 244 of cam 153 will be in engagement with the roller 219 as viewed in Fig. 11, while the roller 227 will be in engagement with the long low part of cam 152 as viewed in Fig. 13. Soon after the motor starts running, the cam 150 closes the drain valve 171 and the cam 281 causes one or the other of fingers 279 and 280, as seen in Fig. 18, to move its arm about the pivot therefor and this causes the corresponding inlet valve to open and allows the water to flow into the tub. With the motor running, the centrifugally opened valve 310 will be opened and it might be mentioned here that even if the cam 281 caused one of the inlet valves to open before the motor got up to any substantial speed, the centrifugally controlled valve would still prevent water from entering the tub until the motor had reached a predetermined speed. After the motor is running, the cam 151 allows the lockout arm 197 to drop off of the high part 194 of the cam as viewed in Fig. 12, and then the lockout arm and the reciprocatory member 100, controlling the reversing rotation, are free to reciprocate in accordance with the operation of cam 115 as seen in Fig. 4.

Reversing rotation of the cylinder now occurs for a predetermined time considered necessary for washing the clothes as for example for a period of 15 minutes. The amount of water entering the tub is governed by the length of the projection 285 of the cam 281 as seen in Fig. 18 and the amount will be sufficient for proper washing action.

At the end of the washing stage, the high part 193 on the drain valve cam (Fig. 10) opens the drain valve and water drains from the tub and through the constantly driven drain water pump. Approximately when the water has drained from the tub the lockout arm 197 is locked out against return by the high part 195 of cam 151 and then shortly after this, the operation of cams 152, 153 and 252 causes the clutch element 39 to shift into its high speed position. A short period of high speed operation now occurs to throw off the wash water. After this short period of high speed operation the roller 219 rides up on the high part 246 of cam 153 and then as the roller 227 rides off of the high part 241 of cam 152, the clutch element shifts back to its low speed position. At this time the arm 197 is still locked out by the high part 195 of cam 151 and then

shortly after the shift of the clutch element, the arm 197 clears the high part 195 and allows the reciprocatory member 199 to move. At about this time also the drain valve has closed as the roller 165 drops between the two high parts 192 and 193 of cam 150 and furthermore, fresh water enters the tub as the projection 236 engages the finger 230 on the thermostatic valve control arm 276. Water now enters the tub for a short period of time and reversing rotation of the cylinder occurs for the purpose of rinsing the clothes. At the end of this rinsing period, the drain valve opens again and shortly afterward the clutch element 39 is shifted into its high speed position and a second short high speed spin occurs for throwing off the rinse water.

Following this second high speed spin of short duration, the drain valve again closes, the clutch element is shifted back to its low speed position, fresh water enters the tub as the projection 287 on cam 281 engages the finger 280 and then a second rinse occurs during which time the cylinder is reversely rotated. After this second rinse, the drain valve opens and remains open for the drying stage, and then after the water is substantially drained from the tub, the clutch element is shifted into its high speed position for the purpose of drying the clothes. This final high speed spin occurs for a substantial period of time and as mentioned previously, the various cams are shown in the positions they occupy during this drying stage.

Although only one form of the invention has been illustrated and described in detail, it will be apparent to those skilled in the art that various modifications may be made without departing from the scope of the claims.

What is claimed is:

1. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, and means for shifting the clutch member in opposite directions including a cam on the cam shaft for shifting the clutch member in one direction, and a second cam on the shaft for shifting the clutch member in the other direction.

2. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, cam means on the cam shaft, a swingable arm for shifting the clutch member, and resilient means engaged by the cam for swinging the arm depending upon loading of the resilient means.

3. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a swingable arm for shifting the clutch member, resilient means between the arm and each cam so that the arm is shifted through energizing of the resilient means,

4. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a swingable arm for shifting the clutch member, and a compression spring means between each cam and the arm, the cams being so related in contour that one compression spring means is loaded at a time when the other spring means is unloaded.

5. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a rocker shaft, a first arm on the rocker shaft for actuating the clutch member, a pair of secondary arms rockable relative to the first arm and engaging the cams respectively, and compression spring means between each secondary arm and the first arm, the cams being so related that one spring means is loaded when the other is unloaded.

6. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a rocker shaft, a first arm on the rocker shaft for actuating the clutch member, a pair of secondary arms rockable relative to the first arm and engaging the cams respectively, and resilient means between each secondary arm and the first arm.

7. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a rocker shaft, a first arm on the rocker shaft for actuating the clutch member, a pair of secondary arms rockable relative to the first arm and engaging the cams respectively, compression spring means between each secondary arm and the first arm for swinging the first arm in one direction or the other through loading of the spring means respectively, and escapement means actuated by the cam shaft for preventing a shift of the clutch member in one direction until the shifting spring is strongly loaded so as to insure rapid shifting of the clutch member.

8. A drive unit for a washing machine comprising a driven shaft, a pair of driving shafts for alternately driving the driven shaft, drive means for driving one driving shaft at a slow rate compared to the other, means for alternately connecting the two driving shafts to the driven shaft and including a shiftable clutch member, a driven cam shaft, a pair of cams on the cam shaft, a rocker shaft, a first arm on the rocker shaft for actuating the clutch member,

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a pair of secondary arms rockable relative to the first arm and engaging the cams respectively, compression spring means between each secondary arm and the first arm for swinging the first arm in one direction or the other through loading of the spring means respectively, an escapement means actuated by the cam shaft for preventing a shift of the clutch member in one direction until the shifting spring is strongly loaded so as to insure rapid shifting of the clutch member, the cams being so related that one spring is loaded at a time when the other is unloaded.

9. A drive unit for a washing machine comprising a casing, a driving shaft in the casing, a driven shaft in the casing, means including a shiftable clutch means between the two shafts for alternately driving the driven shaft in opposite directions depending upon shifting of the clutch means between two positions, a swingable arm for shifting the clutch means, a driven cam for governing swinging of the arm, a member shifted by the cam, and means including a spring for connecting the member to the arm for moving the latter in one direction through tensioning of the spring, and including a second spring for connecting the casing to the member for moving the latter in the other direction.

10. A drive unit for a washing machine comprising a casing, a driving shaft in the casing, a driven shaft in the casing, means including a shiftable clutch means between the two shafts for alternately driving the driven shaft in opposite directions depending upon shifting of the clutch means between two positions, a swingable arm for shifting the clutch means, a driven cam for governing swinging of the arm, means including a spring connecting the cam to the arm for shifting the clutch, and means including a second driven cam for holding the arm in one position for a predetermined time independently of the first cam.

11. A drive unit for a washing machine comprising a casing, a driving shaft having spaced gears thereon, a driven shaft, a ring gear on the driven shaft and meshing at diametrically opposite points with the first gears respectively, coil clutch springs on the driving shaft for clutching the gears thereon to the shaft depending upon unwinding and expansion of the spring, means shiftable between the two springs and including fingers adapted respectively to abut the adjacent end convolutions of the springs respectively and to engage the ends of the spring wire to cause unwinding of the springs depending upon which spring is engaged through shifting of said means, a driven cam, a reciprocatory member having a portion in contact with the cam, means including a spring for connecting the shifting means and said member, and including a second spring for connecting the member and casing, and lockout means for holding the shiftable means for a predetermined time in one position with one clutch spring unwound independently of the cam.

12. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, mechanism for alternately driving said second gear means first in one direction and then in the other direc-

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tion, and means for controlling said mechanism to cause the same to drive said second gear means in the same direction as the direction of rotation of said first gear means during operation of said clutch means.

13. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, means for driving said second gear means in the same direction as the direction of rotation of the first gear means, means for driving said second gear means in the opposite direction, and means for restraining operation of said last named driving means during operation of said clutch means.

14. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, means for driving said second gear means in the same direction as the direction of rotation of the first gear means, means for driving said second gear means in the opposite direction, and cam controlled means for rendering said last named driving means inoperative during operation of said clutch means.

15. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, mechanism for alternately driving said second gear means first in one direction and then in the other direction, and means for retarding the rate of movement of said clutch means in one direction.

16. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, mechanism for alternately driving said second gear means first in one direction and then in the other direction, and means for retarding the rate of movement of said clutch means in the direction in which it connects the second gear means to said shaft.

17. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving receptacle, mechanism for driving said shaft in one direction at a relatively high rate of speed, mechanism for driving said shaft alternately in opposite directions at a relatively low rate of speed, clutch means movable in opposite directions for alternately connecting said first and second mechanisms to the shaft, and means for controlling said second mechanism during movement of said clutch means to cause the second mechanism to drive said shaft in the same direction as the direction in which the first mechanism drives the shaft.

18. A drive unit for a washing machine, com-

prising a driven shaft for rotating a clothes receiving receptacle, mechanism for driving said shaft in one direction at a relatively high rate of speed, mechanism for driving said shaft alternately in opposite directions at a relatively low rate of speed, clutch means movable in opposite directions for alternately connecting said first and second mechanisms to the shaft, means for controlling said second mechanism during movement of said clutch means to cause the second mechanism to drive said shaft in the same direction as the direction in which the first mechanism drives the shaft, and means for retarding the rate of movement of said clutch means in the direction in which it connects the second mechanism to the shaft.

19. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, means for driving said second gear means in a direction opposite to the direction of rotation of the first gear means, means for driving said second gear means in the same direction as the direction of rotation of said first gear means, and means for maintaining said last named driving means in driving relation to said second gear means during operation of said clutch means.

20. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, mechanism for alternately driving said second gear means first in one direction and then in the other direction, means for controlling said mechanism to cause the same to drive said second gear means in the same direction as the direction of rotation of said first gear means during operation of said clutch means, and means for decelerating the rate of movement of said clutch means in one direction.

21. A drive unit for a washing machine, comprising a driven shaft for rotating a clothes receiving cylinder, gear means for driving said shaft at a relatively high rate of speed, gear means for driving said shaft at a relatively low rate of speed, clutch means shiftable in opposite directions for alternately connecting said first and second gear means to said shaft, means for driving said second gear means in the same direction as the direction of rotation of the first gear means, means for driving said second gear means in the opposite direction, means for restraining operation of said last named driving means during operation of said clutch means, and means for retarding the rate of movement of said clutch means in the direction in which it connects the second gear means to said shaft.

22. A drive unit for a washing machine having a rotatable clothes receiving receptacle, means for driving said receptacle in one direction at a relatively high rate of speed, means for driving said receptacle alternately in said one direction and in the opposite direction at a relatively low

rate of speed, control means movable in one direction into position to render said first driving means operative and movable in another direction into position to render said second driving means operative, and means for maintaining said second driving means in driving relation to the receptacle so as to drive the latter in said one direction during operation of said control means.

23. A drive unit for a washing machine having a rotatable clothes receiving receptacle, means for driving said receptacle in one direction at a relatively high rate of speed, means for driving said receptacle alternately in said one direction and in the opposite direction at a relatively low rate of speed, control means movable in one direction into position to render said first driving means operative and movable in another direction into position to render said second driving means operative, means for retarding the movement of said control means in said last named direction, and means for maintaining said second driving means in driving relation to the receptacle so as to drive the latter in said one direction during operation of said control means.

24. In a washing machine having a rotatable clothes receiving receptacle, drive means for rotating said receptacle in one direction at a relatively high rate of speed, mechanism including a pair of alternately operable drive means for rotating said receptacle in said one direction and in the opposite direction at a relatively slow rate of speed, actuating means shiftable in opposite directions for alternately rendering said pair of drive means operable, control means effective in one position for rendering said first named drive means operable and effective in another position for rendering said mechanism operable, and means for restraining said actuating means to cause one of said pair of drive means to continue to rotate the receptacle in said one direction during operation of said control means.

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