May 3, 1949. H. D. BROTMAN 2,468,919

WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 1

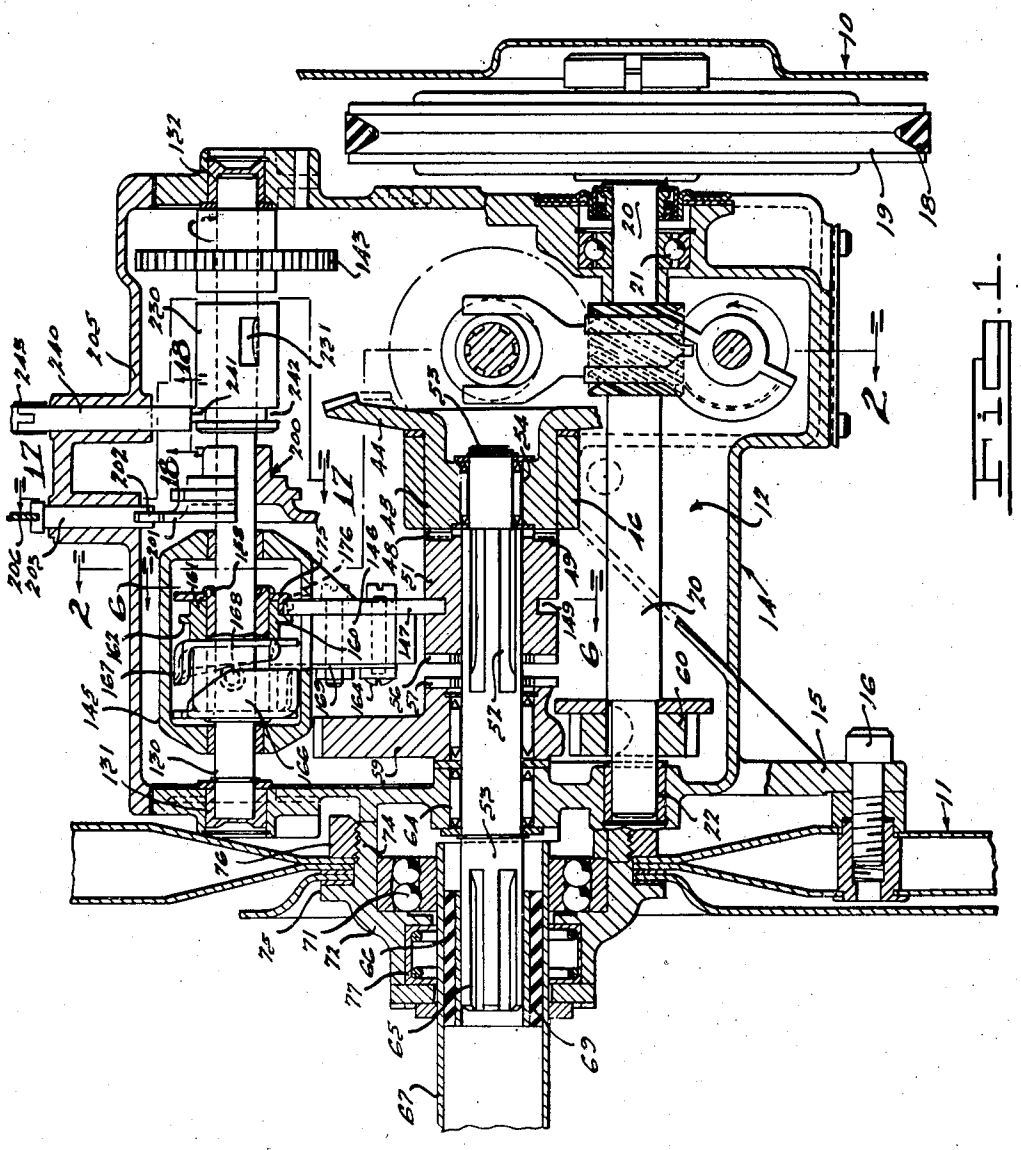


Fig. 1.

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WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 2

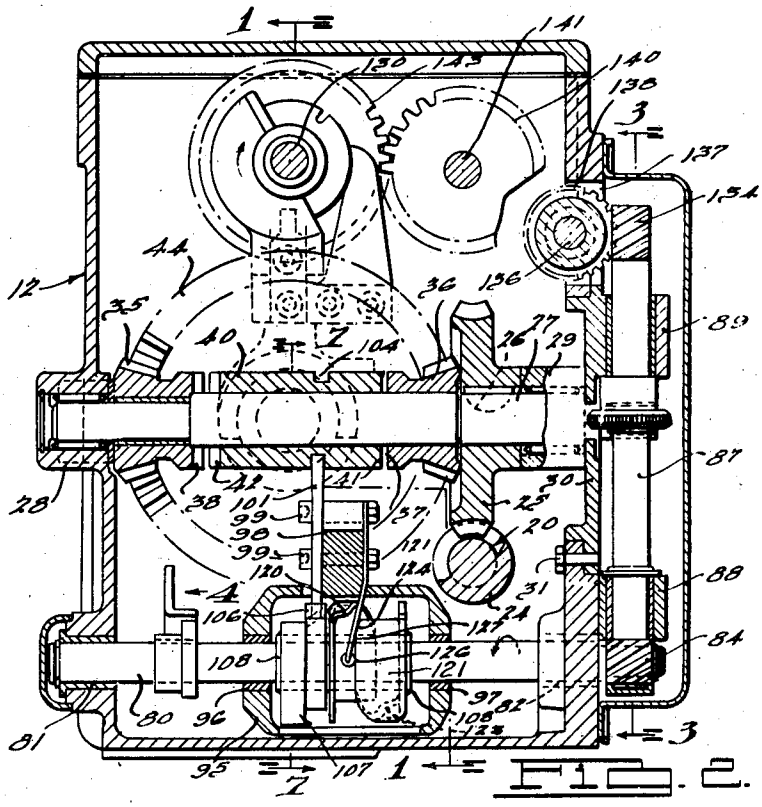


FIG. 2.

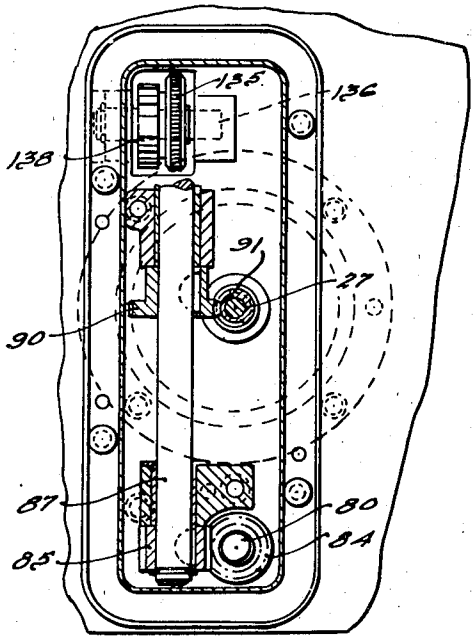


FIG. 3.

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WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 3

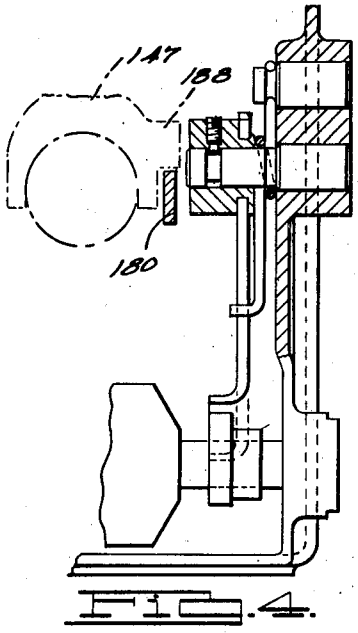


FIG. 4.

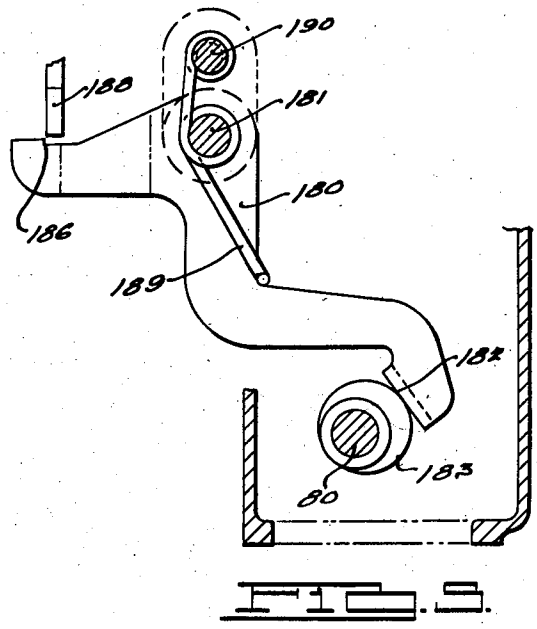


FIG. 5.

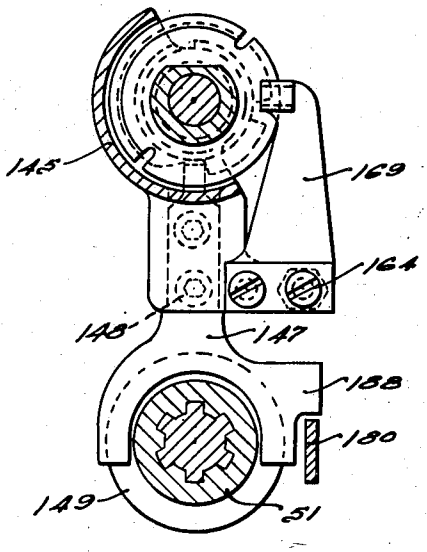


FIG. 6.

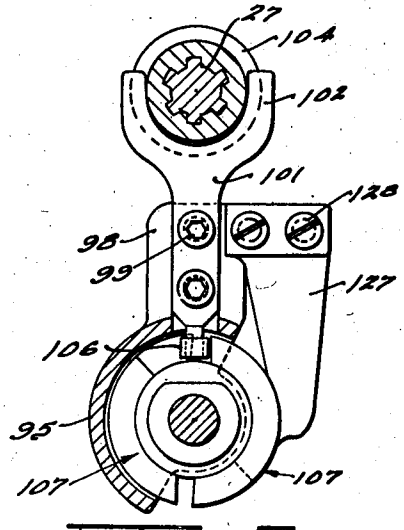


FIG. 7.

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May 3, 1949. H. D. BROTMAN 2,468,919

WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 4

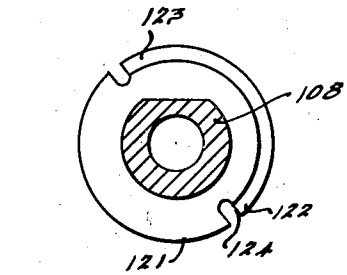


FIG. 8.

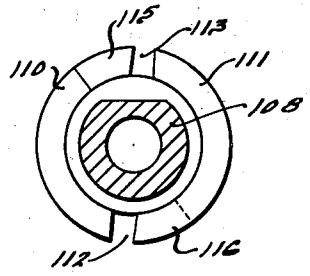


FIG. 9.

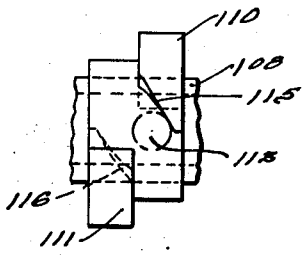


FIG. 10.

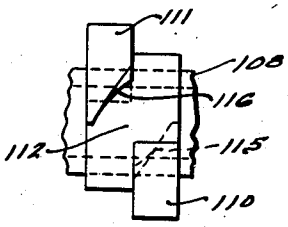


FIG. 11.

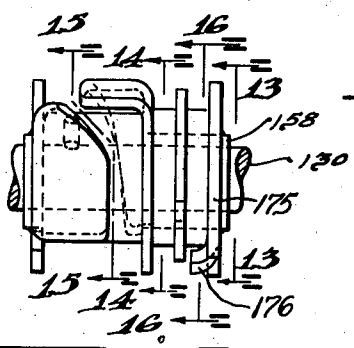


FIG. 12.

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WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 5

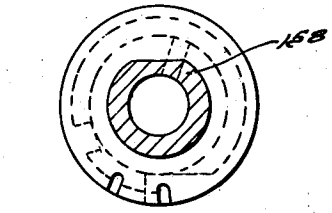


FIG. 13.

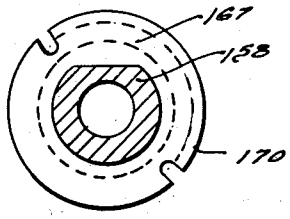


FIG. 14.

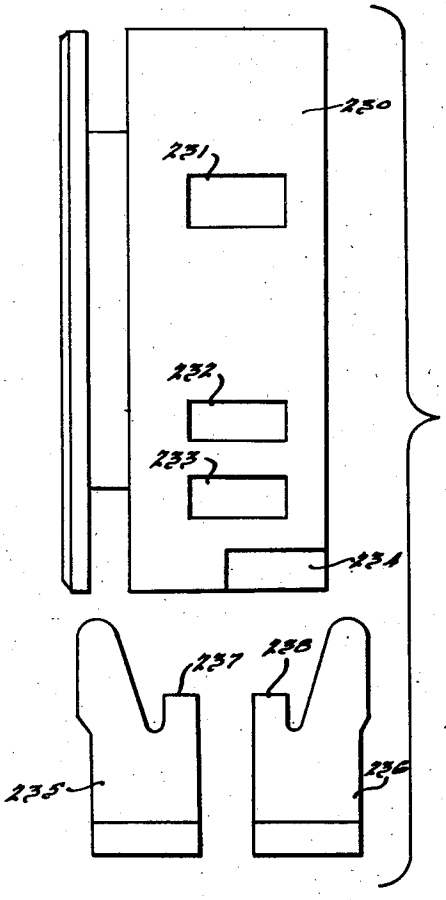


FIG. 21.

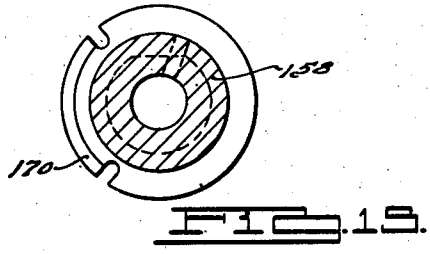


FIG. 19.

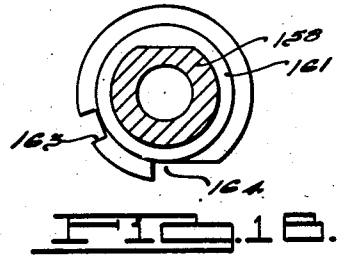


FIG. 18.

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May 3, 1949. H. D. BROTMAN 2,468,919

WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 6

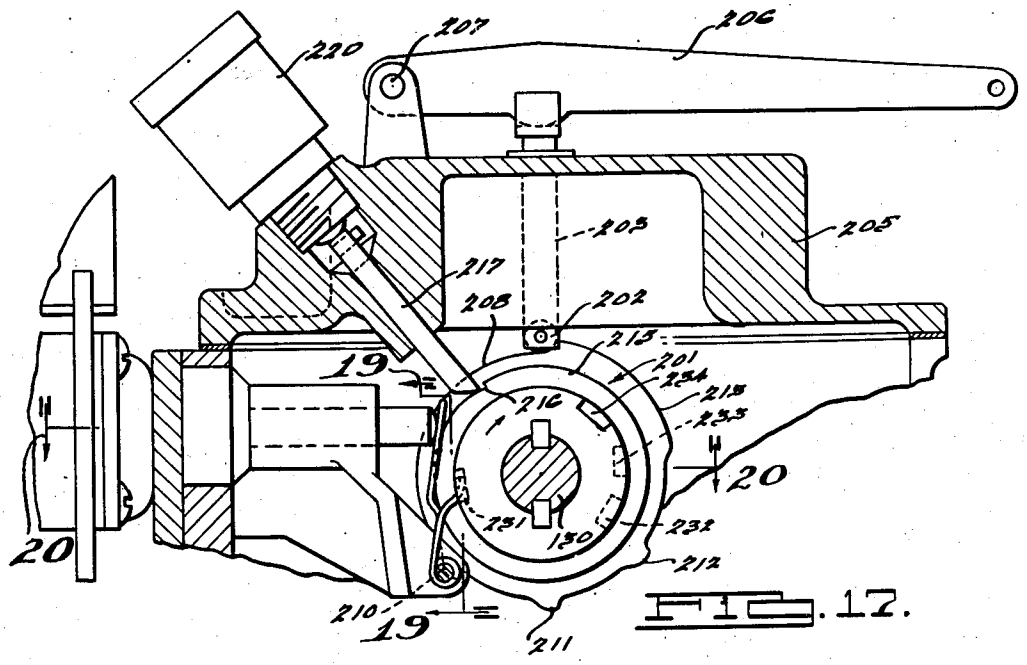


FIG. 17.

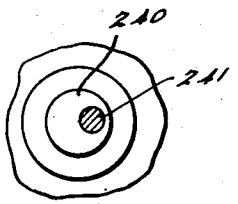


FIG. 18.

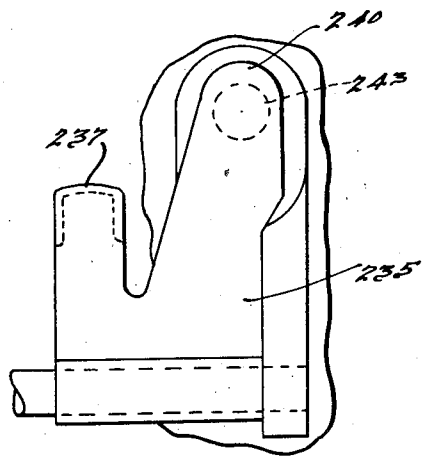


FIG. 19.

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WASHING MACHINE DRIVE

Filed Jan. 4, 1946 7 Sheets-Sheet 7

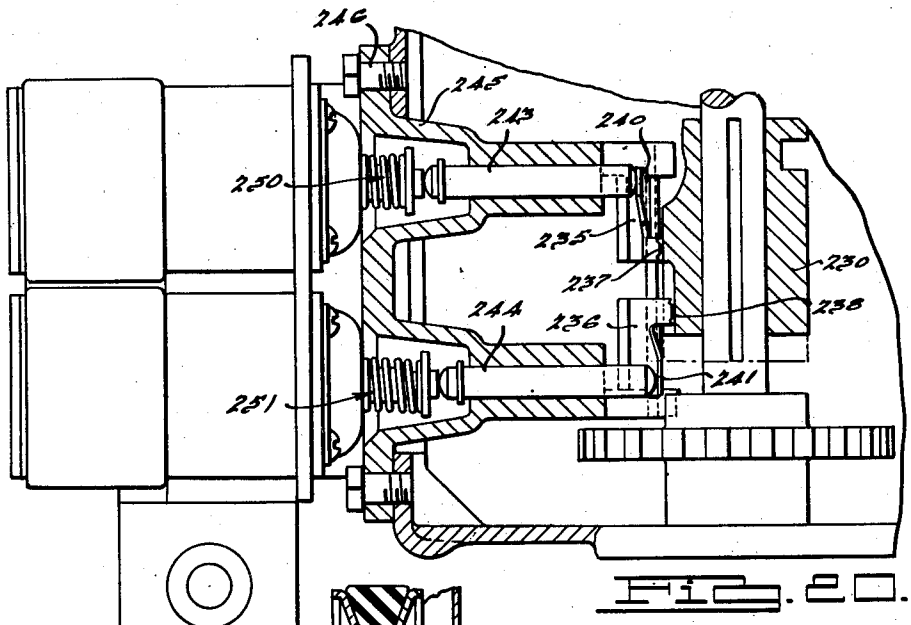


FIG. 20.

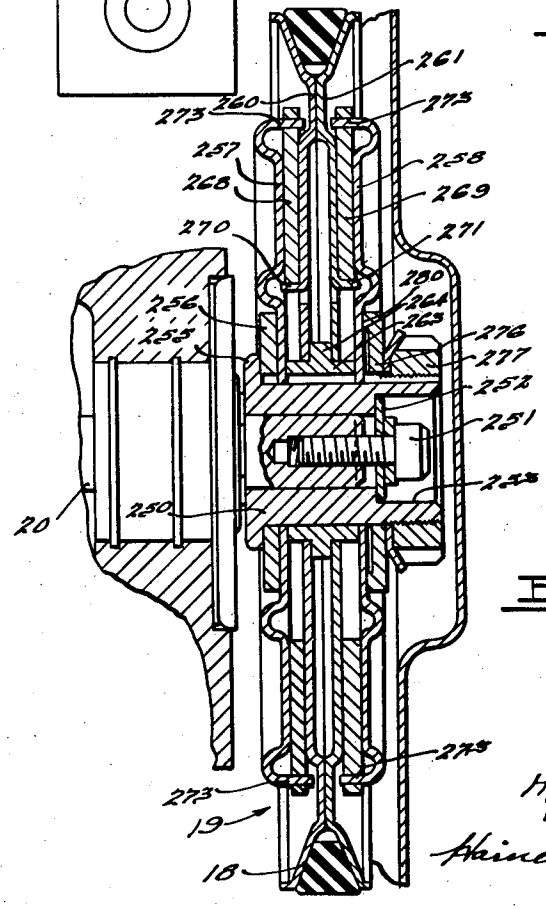


FIG. 22.

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Patented May 3, 1949

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UNITED STATES PATENT OFFICE

2,468,919

WASHING MACHINE DRIVE

Hyman D. Brotman, Detroit, Mich.

Application January 4, 1946, Serial No. 639,065

20 Claims. (Cl. 74—1)

1

The invention relates to clothes washing machines and it has particular relation to a machine of automatic character having a definite cycle of operation.

In certain respects the invention is related to and constitutes an improvement over that embodied in my copending application for patent, Serial No. 573,362, filed January 18, 1945. In the copending application for patent 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 continues 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 general 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.

An important object of the present invention is to provide an improved washing machine having power operated drive means for rotating the cylinder together with means for transmitting from the drive means to the clothes receiving cylinder rotational motion at slow speed repeatedly first in one direction and then in another direction through a predetermined slow speed stage, the machine also being provided with high speed means for transmitting from the drive means to the cylinder rotational motion at relatively high speed in a single direction, the construction and operation being such that the high speed means is not brought into operation until after the slow speed stage and at a time when the cylinder is rotating at slow speed in the same direction as it rotates at high speed. Preferably this controlled operation of the cylinder from the primary drive means, such as an electric motor, is accomplished by shifting the drive from a slow speed gear means to a high speed gear means in such manner and at such time that the shift will occur only after the slow speed stage when the slow speed gear means is rotating in the same direction as the high speed gear means.

A further object of the present invention is to

2

provide an improved washing machine of this type wherein a simpler and less expensive means is provided for effecting the periodic reversal of rotation of the cylinder.

Another object of the invention is to provide an improved reversing mechanism having alternately engageable clutches wherein means are provided for positively initiating a releasing movement of each clutch at a predetermined time.

Another object of the invention is to provide an improved type of clutch arrangement wherein just preceding the time the clutch element is to be shifted, spring means for moving the clutch is energized so as to effect rapid movement of the clutch element.

Another object of the invention is to provide in a mechanism of the type designated a means operating automatically to prevent rotation of the cylinder at the high, drying speed excepting when the cylinder is turning in the same direction at the end of the last rinsing stage as the cylinder is to rotate in the drying stage.

Another object of the invention is to provide an improved, resilient connecting means between the driving unit and the clothes washing cylinder.

Another object of the invention is to provide an improved type of driving connection between the power means and the drive unit for the mechanism so as to permit slippage as may be required during operation of the washing machine.

Other objects of the invention will become apparent from the following specification, from the 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 vertical, cross-sectional view taken substantially along the line 1—1 of Fig. 2, of a driving unit for an automatic washing machine constructed according to 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 fragmentary cross-sectional view illustrating a clutch synchronizing lock as seen in the direction indicated by the arrow 4 in Fig. 2;

Fig. 5 is an end view partly in section as seen from the right side of Fig. 4;

Fig. 6 is a cross-sectional view taken substantially along the line 6—6 of Fig. 1;

Fig. 7 is a cross-sectional view taken substantially along the line 7—7 of Fig. 2;

Fig. 8 is an end view on a larger scale of one of the spring actuating cams for moving the reversing clutch shown on the lower cam shaft in Fig. 2;

Fig. 9 is an end view of the cam for positively initiating movement of the reversing clutch and which is also mounted on the lower cam shaft in Fig. 2 to the left of the spring actuating cams;

Fig. 10 is a view of the cam shown by Fig. 9 as seen along the line 10—10 of Fig. 9;

Fig. 11 is a view similar to Fig. 10 but showing the cam as seen when turned through 90°;

Fig. 12 is a side view of the cam arrangement for operating the high speed clutch;

Fig. 13 is an end view of the construction shown by Fig. 12 as seen along the line 13—13 of Fig. 12;

Fig. 14 is a view of one of the spring actuating cams as seen along the line 14—14 of Fig. 12;

Fig. 15 is an end view of the other spring actuating cam as seen along the line 15—15 of Fig. 12;

Fig. 16 is a view of one of the cam elements as seen along the line 16—16 of Fig. 12;

Fig. 17 is a cross-sectional view on a larger scale taken substantially along the line 17—17 of Fig. 1;

Fig. 18 is a cross-sectional view taken substantially along the line 18—18 of Fig. 1;

Fig. 19 is a cross-sectional view taken substantially along the line 19—19 of Fig. 17;

Fig. 20 is a cross-sectional view taken substantially along the line 20—20 of Fig. 17;

Fig. 21 illustrates a development of the water control cam and fingers adapted to co-operate therewith; and,

Fig. 22 illustrates a vertical section of the drive pulley for operating the driving unit.

Referring to Fig. 1, a part of the washing machine cabinet is indicated at 10 and such cabinet may include two compartments divided by partition means 11. That compartment to the left of the partition 11 contains a tub and a rotatable cylinder such, for instance, as embodied in my copending application for patent, while the compartment to the right of the partition provides a space for a drive unit indicated generally at 12. This drive unit generally comprises a casing 14 having a plurality of ears 15 secured by bolts 16 to the partition. Hence, the drive unit may be readily released from the partition merely by releasing the bolts.

For driving the unit, an electric motor is provided but not shown, and this motor drives a belt 18 trained about a relatively large pulley 19 which is secured to one end of a shaft 20 journalled in bearings 21 and 22 provided in opposed walls of the casing. Within the casing, as best shown by Fig. 2, the shaft 20 has a worm 24 meshing with a worm wheel 25 which is keyed as indicated at 26 to a shaft 27 disposed crosswise of the shaft 20 and above it. Such shaft 27 has one end journalled in a boss portion 28 forming a part of one of the walls of the casing while the other end of the shaft is journalled in a boss portion 29 integral with a pan or side cover element 30 secured to the casing by bolts 31.

The shaft 27 is provided with spaced bevel gears 35 and 36 which are loose on the shaft and such bevel gears respectively have clutch teeth 37 and 38 on their adjacent end faces. Each of these clutch type bevel gears is adapted to be engaged by a clutch sleeve 40 splined on the shaft 27 so that the sleeve may be axially moved on the shaft while being driven thereby and such sleeve has clutch teeth 41 and 42 on opposite ends for engaging the teeth 37 and 38. From this it follows that if the clutch sleeve is moved in one direction so as to engage the teeth 38 and 42, the gear 35 will be driven whereas if the sleeve is moved in the other direction, the teeth 37 and 41 will engage and the gear 36 will be driven. The gears 35 and 36 mesh with a ring type bevel gear 44 but the engagement is at diametrically opposite sides of the ring gear so that the ring gear will be driven in opposite directions depending upon which bevel gear is driven by shaft 27.

Now directing attention to Fig. 1 again, the ring gear 44 has a hub portion 45 journalled in a bearing 46 forming part of the casing 12 and such hub has clutch teeth 48 on its end opposite the gear. The teeth 48 are adapted to engage clutch teeth 49 on a second clutch sleeve 51 and this clutch sleeve has a spline engagement 52 with a shaft 53 having its inner end journalled in a bearing 54 within the gear hub 45. At its opposite end the sleeve 51 has clutch teeth 56 which are engageable with clutch teeth 57 on one end face of a relatively large gear 59 journalled on the shaft 53. Such gear 59 meshes with a smaller pinion 60 which is keyed to the shaft 20 and consequently the large gear 59 is constantly being rotated at a relatively higher speed in relation to worm reduction 24—25 at all times.

The shaft 53 extends through the casing wall next to the partition 11 and is journalled in a bearing 64 in such wall, and outwardly of the wall it has a splined engagement 65 with a sleeve 66. This sleeve fits within an outer sleeve 67 and between the sleeves a cylindrical layer of rubber 69 is provided which is bonded to both sleeves so that the driving connection between the shaft and outer sleeve 67 is of resilient character. The sleeve 67 is adapted by suitable means to be connected to the washing machine cylinder so that the cylinder will be turned by shaft 53 as the latter is driven.

At its inner end the sleeve 67 is journalled in a bearing 71 mounted in a hub 72 having a portion 74 extending through the partition 11. Such hub is rigidly connected to the partition by a flange 75 at that side of the partition where the clothes cylinder is located and by a nut 76 threaded on the opposite end of the portion 74 and which is located at the opposite side of the partition. While the hub 72 provides a bearing support for the sleeve shaft 67, it is to be noted that the bearing 71 is of such character that the sleeve may move so as to align itself with the axis of the clothes cylinder. A suitable sealing means 77 is provided in the hub 72 and next to the shaft 67 so as to prevent water from leaking along the shaft.

It may be noted in general now that if the clutch sleeve 40 is in one position so that the ring gear 44 is being driven in one direction, the washing machine cylinder will be rotated providing the clutch sleeve 51 is in engagement with the ring gear and the direction of rotation will depend upon whether or not the clutch sleeve 40 is in engagement with the teeth on the bevel gear 45 or in engagement with the teeth on the bevel gear 36. Reversing rotation of the ring gear will continue at all times but if the clutch sleeve 51 is shifted so as to engage the teeth 56

with the teeth 57 on the large pinion 59, the cylinder will then be rotated in one direction only and at relatively high speed. During the washing and rinsing stages of the machine operation, the cylinder will be rotated by the ring gear 44 and during the drying stage, the cylinder will be rotated by the large pinion 59 so that drying may be effected centrifugally.

In order to shift the sleeve 40 periodically and preferably after the cylinder has rotated through, for example, seven to ten revolutions in one direction, cam means are provided for shifting the clutch sleeve 40 at predetermined intervals for obtaining this reversal of rotation. Referring again to Fig. 2 in particular, a cam shaft 80 is provided below the shaft 27 and this shaft is journalled in opposing side walls of the casing as indicated at 81 and 82. Outwardly of the casing at one side, the shaft 80 has a worm 84 as best shown by Fig. 3, and this worm meshes with a second worm 85 mounted on a vertically disposed shaft 87 located externally of the casing and journalled in bearing portions 88 and 89 secured respectively to the casing and cover 30. Such shaft 87 intermediate its upper and lower ends has a worm wheel 90 thereon which meshes with a worm 91 on an external end of shaft 27. From this it should follow that shaft 27 will drive shaft 87 and in turn shaft 87 will drive the cam shaft 80.

Within the casing the shaft 80 has a shell 95 provided with end portions 96 and 97 slidably journalled on the shaft and this shell has an extension 98 on its upper side. Such extension is rigidly secured as by screws 99 to a clutch shifting bar 101 having, as best shown by Fig. 7, a fork 102 straddling the sleeve 40 and disposed in an annular groove 104 in such sleeve. This relationship between the shell 95 on shaft 80 and the bar 101 engaging the sleeve 40, holds the shell 95 against turing on the shaft. The clutch sleeve shifting bar 101 extends downwardly within the shell 95 and at its lower end is provided with a roller 106 and this roller co-operates with a cam indicated generally at 107. This cam is provided for the purpose of positively initiating disengagement of the teeth 41 or teeth 42, as the case may be, from the teeth on the bevel gears 35 and 36, and this is desirable particularly in view of the fact that there is considerable frictional resistance to the disengagement of the teeth.

With reference now to Figs. 9, 10 and 11, the cam is drivingly secured and keyed to a sleeve 108 fastened to the shaft and such cam includes two somewhat less than semicircular rim portions 110 and 111 which are separated at their ends by gaps 112 and 113. Such semicircular rim portions are axially adjacent and not in the same radial plane, but the left side of the rim portion 110, as seen in Fig. 11, is approximately in the radial plane of the right side of rim portion 111. One end of the cam portion 110 has a bevel or taper 115 leading to the gap 113 while the other rim portion has a taper 116 leading to the gap 112. Assuming that the cam is turning around the axis of the shaft 80 and that the roller is in contact with the side of rim 110, such contact will continue until the gap 112 reaches the roller. As the gap passes the roller, the cam 116 engages the roller and shifts it axially until it is at the side of rim 111 and then it travels along the side of this rim until it reaches the gap 113. Then when the gap 113 passes the roller, the taper 115 shifts the roller until it is again in position to roll along the side of rim 110.

The two tapers 115 and 116 merely provide means for moving the roller at each half turn of the shaft 80 while the rims 110 and 111 provide means for positively holding the roller against a return axial movement until the roller is ready to engage the next taper. Thus while one rim is in contact with the roller, the clutch sleeve 40 is positively held in one engaged position and then as the roller contacts the next taper, movement of the clutch sleeve is positively initiated and after it is shifted to engagement with the other bevel gear, the roller maintains its axial position at the side of the other rim until it engages the next taper on the cam.

While the two tapers 115 and 116 thus provide a means for shifting the clutch sleeve 40, the movement is relatively slow and it is not desirable that the clutch teeth be completely moved out of engagement by the tapers for the reason that the load would be all on a small portion of the teeth just before complete disengagement occurs. It is desirable that the tapers on the cam merely initiate disengagement of the clutch teeth so as to overcome the considerable forces of friction between the teeth and then that the teeth be rapidly disengaged and the sleeve moved quickly from one position to the other. The means for effecting this rapid shifting of the clutch sleeve comprises a pair of cam elements 120 and 121 secured on the sleeve 108, and such cam elements are identical but displaced relatively 180°.

As best shown by Figs. 2 and 8, each cam element has an axially extending rim 122 extending substantially through 180° and this rim has a rising portion 123 at one end while its other end drops off sharply at the point indicated at 124. The cams are adapted to co-operate with a roller 126 on one end of a leaf spring 127 which is connected to the projection 98 by screws or bolts 128. The roller 126 and spring arm shown in broken lines in Fig. 2 are above the plane of the paper, and in the position shown, the roller is in contact with the cam 121. As thus arranged, the leaf spring is flexed substantially to the left so that it urges the clutch sleeve 40 to the left. However, the clutch sleeve 40 cannot move to the left until the roller 106 is at the end of cam rim 111 or in other words when the roller is at the gap 113 as seen in Fig. 10, and when it is at such gap, the taper 115 positively initiates movement of the clutch sleeve. As soon as movement is initiated, the built up spring force in leaf spring 127 acts quickly to throw the clutch sleeve to the left so as to cause the teeth 37 and 41 to disengage and the teeth 38 and 42 to engage. Following this movement the roller 106 is at the side of cam surface 110 which prevents return movement of the clutch sleeve. As the cams continue turning, the cam 121 leaves the roller and then the rise 123 on cam 120 engages the roller. This causes the spring to flex in the opposite direction and to build up a spring force tending to move the clutch sleeve to the right. Then when the roller 106 is at the gap 112 in the cam and engages the taper 116, positive movement of the clutch sleeve is initiated in the opposite direction and the built up spring action throws the clutch rapidly over into its other position. Cyclic movement of the clutch sleeve in this manner and hence, reversing rotation of the ring gear 44, thus are automatically accomplished.

Directing attention now to Fig. 1, a second cam shaft 130 is journalled at its ends in side walls

of the casing as indicated at 131 and 132, and this cam shaft is driven by a gear train shown by Figs 2 and 3. At its upper end the vertical shaft 87 has a worm 134 which meshes with a worm 135 on a short horizontal shaft 136 disposed in an opening 137 in the side wall of the casing. The shaft 136 also has a pinion 138 next to the worm wheel 135 as shown by Fig. 3, and the pinion meshes with a pinion 140 mounted on a shaft 141 in the casing, and in turn the pinion 140 meshes with a pinion 143 on the cam shaft 130. Thus the cam shaft 130 is driven by the shaft 87 and the arrangement of pinions is such that the cam shaft rotates very slowly, as for example, turning through one revolution in forty-five minutes.

The shaft 130 as shown by Fig. 1 has a shell 145 similar to the shell 95 and this shell is mounted on the cam shaft for axial movement thereon. In this case the shell has a projection 146 extending downwardly, and an arm 147 secured by screws 148 to the projection has a forked shaped lower end shown by Fig. 6 slidably fitting in a groove 149 in the clutch sleeve 51. Thus if the shell 145 shifts axially, the clutch sleeve 51 will shift likewise. The clutch sleeve shifting means generally is similar to the clutch shifting means on shaft 80 but differs in two particular respects in that shifting of the clutch sleeve 51 is not positively initiated although it could be if desired, and secondly, in that means are provided for bringing the clutch sleeve into neutral position at the end of the drying operation. The reason for not positively initiating movement of this clutch sleeve is that it does not seem to be necessary as the friction forces holding the clutch sleeve in engagement are less and more easily overcome by the spring action provided.

The bar 147 projects into the shell 145 and cooperates with a holding means generally indicated at 160, and this holding means includes a sleeve 158 fastened to the shaft 130 as by set screws and a bushing 161 keyed to the sleeve and having a rim 162 at its center. As best seen in Fig. 16, the rim 162 has a gap 163 at one point and a second gap 164 which is wider than gap 163 and has its bottom extending tagentially to the periphery of the rim. The two gaps provide spaces for the end of the bar 147 to shift axially from one side of the rim 162 to the other at predetermined times.

The means for shifting the shell 145 and bar 147 comprises a pair of cam elements 166 and 167 secured to the cam shaft 130 and which are adapted to co-operate with a roller 168 mounted on the end of a leaf spring 169 secured to the projection 146 by screw means 164. The two cams 167 and 168 are shown in Figs. 14 and 15 and such cams have rims 170 and 171, respectively. These rims are provided with rising surfaces at prearranged locations to cause the spring arm to flex in one direction or the other as the case may be. With the clutch 51 in its right hand position, the spring roller 168 in riding over the rising cam surface on cam 167 flexes the leaf spring to the left and then when the gap 163 in the rim 162 on element 161 reaches the arm 147, the end of the latter is rapidly moved through the gap in an axial direction due to the spring action so as to cause the teeth 56 and 57 to engage. Continued turning of the bushing 161 in the clockwise direction as seen in Fig. 16, causes the gap 164 to become aligned with the arm 147 and in the meantime the spring roller 168 has been flexed to the right by the cam 166. This causes the arm to now shift through the gap 164.

It might be mentioned at this time that the clutch sleeve 51 is shifted to the right from its high, drying speed position only at the end of the drying operation and at this particular time, it is desirable to have the clutch sleeve stop in a neutral position with all clutch teeth disengaged as this will permit turning of the washing cylinder freely so that the operator may manually move the cylinder to a position necessary to remove the clothes. Therefore, when the clutch sleeve 51 first moves to the right it must stop in a neutral position and in order to obtain this result, a disk element 175 is secured to the sleeve 158 as seen in Fig. 12 and this disk has a turned-in lip 176 in line with the left end of the gap 164 seen in Fig. 16. Hence, when the end of the bar 147 first moves through the gap, it engages the lip 176 and the clutch sleeve stops. This leaves the parts in neutral position and as will be seen presently, the motor is stopped at this particular time and the entire drive unit ceases to operate.

Subsequently upon starting the motor by an auxiliary starting circuit, the cam shaft will rotate sufficiently to move the lip 176 away from the arm 147 and then the arm will complete its movement through the gap 164 until it is at the right side of the rim 162 and this automatically throws the clutch teeth 48 and 49 into engagement. Operation of the machine with the teeth 48 and 49 engaged then continues until the gap 163 reaches the arm 147 and then the clutch sleeve is shifted to the left and the arm 147 moves along the left side of rim 162 until the gap 164 is again reached. It might be noted in connection with Fig. 16 that the clutch sleeve will be held at the right for a much longer period of time due to the major circumferential distance between the gaps 163 and 164 whereas the clutch will be held at its left hand position for drying the clothes for a relatively short period of time due to the short circumferential distance between the gaps.

In order to insure rotation of the washing machine cylinder in the same direction as it is to rotate during drying at the time shifting of the clutch sleeve is to occur, a synchronizing interlock is provided which is best shown by Figs. 4 and 5. This interlock comprises a bell crank 180 pivoted as indicated at 181 on a cross shaft 181 in the casing and which has a lower end 182 contacting a cam 183 on the lower cam shaft 80. The opposite end of the bell crank has a notched portion 186 which is adapted to engage a lip 188 on the clutch shifting arm 147. A spring 189 looped about the shaft 181 and engaging a fixed pin 190 at one end and a part of the bell crank at its other end, urges the crank into interlocking engagement with the lip 188 on the arm 147. The cam 183 is so related to the reversing cam means on the shaft 80 that the arm 147 is held in its right hand position as seen in Fig. 1 or in other words, in a position where the teeth 48 and 49 are engaged, until the ring gear 44 is turning in the same direction as the high speed driving pinion 59 is turning. Thus if the arm 147 reaches the gap 163 and is about to be shifted by the leaf spring 169 but the ring gear 44 is turning oppositely to the high speed gear 59, the notch 187 will be in engagement with the lip 188 on arm 147 and will prevent the shifting action. However, as soon as the lower cam shaft 80 has turned sufficiently to effect a reversal of rotation

of ring gear 44, the cam 183 will have shifted the bell crank so as to release the clutch arm 147. It might be mentioned at this time that the notch 163 will be sufficiently large to allow this interlock to occur if necessary while still providing enough of a gap for the arm 147 to be shifted when the interlock is released.

In order to control drainage of water from the tube and also to control operation of the electric motor, a cam 200 is provided on the upper cam shaft 130, and this cam has a cam surface 201 engageable with a cam roller 202 on a vertically movable pin 203 extending upwardly through a cover 205 on the casing. As best shown by Fig. 17, the vertically movable member 203 engages an arm 206 on top of the cover which is pivoted at 207 thereon, and this arm is provided for opening and closing a drain valve for the tub. The same drain valve means otherwise may be employed as is embodied in my copending application for patent identified, and generally it might be mentioned that when the member 203 is raised, the drain is open and when it is in its lower position, the drain is closed. It will be noted that the drain cam 201 has a long cam surface 208 permitting the drain valve to be closed for a long period and it is during this time that the clothes are washed. The drain cam also has four raised portions 210, 211, 212 and 213 which respectively open the drain valve at the end of the washing operation, then at the end of the first rinse, at the end of the second rinse, and then at the end of the third rinse. Between such operations the valve, of course, is closed. It should be observed that at the end of the third rinse the drain is opened for a substantial period by the rise 213 on the cam so that it will be open during the drying operation.

The cam 200 also includes a cam portion 215 which is provided with a single notch 216 for allowing a switch actuating element 217 to move inwardly into the notch. When this switch element 217 is moved outwardly, a switch indicated at 220 is closed and this closes the motor circuit. When the element 217 drops into the notch 216, however, the motor is stopped. As stated before, an auxiliary circuit is provided for starting the motor so as to cause the cam shaft 130 to turn sufficiently as to move the switch operating element 217 outwardly and thus close the primary motor circuit. From this it should be understood that the primary motor circuit is closed until the switch operating element 217 drops into the notch 216 and then in order to start the cam shaft turning again sufficiently to move the switch operating element out of the notch 216, the auxiliary motor circuit is closed and remains closed until the primary circuit is closed. It does not seem necessary to show such circuits as they will be readily understood by those skilled in the art.

For causing water to enter the cylinder, another cam 230 is provided on the cam shaft 130 and this cam, as best shown by Fig. 21 in developed form, has four recesses 231, 232, 233 and 234 which are adapted to co-operate with spring finger elements 235 and 236. These finger elements have lip portions 237 and 238 engageable with the cam and other lip portions 240 and 241 which contact plungers 243 and 244, respectively. Such plungers are slidably mounted in a closure or cap 245 held securely by bolts 246 to the casing wall and respectively operate water controlling valves 250 and 251. It seems unnecessary to discuss this valve in detail here except generally in as much as particular reference is directed to it in my copending application for patent. The valve 250 controls the inlet of water to the tub at a temperature of 140° while the valve 141 controls the inlet of water of water at 100°.

Referring to Fig. 21 and assuming that the cam 230 is moving downwardly with respect to the valve controlling elements 235 and 236, it is apparent that the finger 237 will not be engaged by any of the recesses and that the finger 238 will drop into all the recesses in circumferential order. This means that all the water supplied to the tub will have a temperature of 100°. However, if the cam 230 is shifted to the left a short distance, it will be seen that the finger 237 will be engaged by the recesses 233, 232, and 231 but not by the recess 234, and that the finger 238 will be engaged by the recess 234 and not by the others. This means then that water will flow into the tub at 140° temperature at three stages whereas at the other stage as noted by the recess 234, water will flow into the tub at 100°.

Now relating the foregoing to Fig. 17, the recess 231 is so positioned that initially when the motor is turned on to start the washing machine operation, one of the fingers will drop into the recess and water will flow into the tub at either a temperature of 100° or a temperature of 140° depending upon which finger is in control. After drainage of the wash water and closing of the drain valve, water at the same selected temperature will again enter the tub when recess 232 reaches the valve controlling finger, and this water will be used in the first rinse. After the first rinse occurs and the rinse water is drained, the next recess 233 will reach the finger and the second rinse water at the same selected temperature will flow into the tub. When the third rinse is to occur, however, the recess 234 will engage only the finger 238 and hence the third rinse water will always be at the lower temperature of 100°. For normal washing operations, the finger 237 will control all washing operations excepting the last rinse. However, for washing woolens, the finger 238 will control all washing operations so as to deliver water at a lower temperature.

The cam 230 is shiftable from one position to the other, as best shown by Fig. 1, by means of a turnable pin 240 projecting downwardly through the casing cover 35, and this pin has at its lower end an eccentric pin projection 241 arranged in an annular groove 242 in the cam. By turning the pin 240, the cam 230 thus can be shifted axially from one position to the other. The pin 240 is suitably connected to an operating element 243 which may extend to an external point on the washing machine cabinet.

Now referring to Fig. 22, the pulley 19 about which the belt 18 is trained comprises a hub 250 keyed to the external end of shaft 20 and secured thereon by a bolt 251 extending through a washer 252 in an enlarged portion 253 of the opening in the hub. The inner end of the hub 250 has an outwardly directed radical flange 255 and next to this flange a ring 256 is disposed on the hub. The pulley includes two positively driven disk elements 257 and 258 having a keyed engagement with the hub 250 and the disk 257 is disposed next to the ring 256. Between two disks 257 and 258, two other disks 260 and 261 are provided and these at their outer edges form an annular groove for the belt 18. At their inner edges, the disks are disposed on a short sleeve 263 slidably fitting the hub between the disks 257

and 258 and such sleeve has a central, annular rib 264 for holding the inner portions of the disks 260 and 261 apart. Friction plates 268 and 269 are disposed between the disks 257 and 260 and between the disks 258 and 261, respectively, and the disks 260 and 261 have struck out tongues 270 and 271 for holding the friction plates concentric to the hub. Outer portions of the disks 257 and 258 have circumferentially spaced fingers 273 projecting into the openings in the friction plates so as to drivingly lock them together.

All of the disks are held on the hub by a washer 276 engaging the outer side of the disk 258 and by a nut 277 threaded on the outer end of the hub. Only the outer margin of the washer 276 engages the disk as indicated at 280, and from this it follows that tightening of the nut 277 places a resilient pressure against the disk so as to in turn place a resilient pressure on the friction plates and the disks on opposite sides thereof. In this way the friction between the plates and disks may be adjusted.

It is evident when the disks 260 and 261 are rotated by the belt, that the disks 257 and 258 normally will rotate therewith and hence, the shaft 20 will rotate. It will be recalled that the shaft 53 is connected to the clothes cylinder driving shaft 67 by a rubber sleeve so that any shocks such as occur when the shaft 53 is reversed in direction will be cushioned. At the same time, however, the pulley 19 provides a slippage connection which allows the shaft 53 to slow up or change its speed temporarily relative to the driving motor. By means of such connections, moving parts of the mechanism are not subjected to the shock that might otherwise occur when the cylinder is reversed in direction. It is apparent too, that the resilient connection tends to minimize any noise during the reversing stages or during any period of the washing machine operation.

The present machine, illustrating by way of example one embodiment of the invention, operates generally in accordance with the machine disclosed in my copending application for patent in that the cylinder is first turned in one direction and then in the other during the washing and rinsing stages, and then is turned at high speed during the drying stage. Water is introduced into the cylinder at the beginning of the washing operation and at this time the drain is closed and then at the end of the washing operation the drain valve opens and remains open to allow the water to drain from the tub. Following this action the drain valve closes and fresh water enters the tub for a period of time so as to effect a first rinsing of the clothes. After a short rinsing period, the rinse water is drained and then the rinsing operation is repeated a second and third time, and after the third rinse, the drain valve remains open and the cylinder is rotated at high speed in a single direction. This high speed rotation always is initiated when the cylinder is turning in its slow speed stage in the same direction as it turns or rotates at high speed, and in the present embodiment after the final rinsing stage. Consequently the high speed dry picks up the cylinder when it is already rotating in the direction it will rotate for drying. At the end of the drying operation, the high speed clutch moves to a neutral position and is held in that position until the motor circuit is broken and the parts come to rest. Then the cylinder may be freely turned manually until in a proper position to remove the clothes. Starting of the washing operation is effected by an auxiliary motor circuit which may be of conventional character and then after a short period of time, the switch operating cam in the mechanism closes the motor switch 220 and thereafter the switch maintains control of the motor until it is again stopped at the end of the 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. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed mechanism for transmitting from the drive means to the cylinder rotational motion at slow speed repeatedly first in one direction and then in another direction through a predetermined slow speed stage, high speed mechanism for transmitting from the drive means to the cylinder rotational motion at a relatively high speed in one direction only after the slow speed stage, and means timed to maintain said high speed mechanism out of operation until after the slow speed stage and at a time when the cylinder is rotating at slow speed in the same direction as it rotates at high speed.

2. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for rotating the cylinder, slow speed means for transmitting from the drive means to the cylinder rotational motion at slow speed repeatedly first in one direction and then in another direction through a predetermined slow speed stage, high speed means for transmitting from the drive means to the cylinder rotational motion at a relatively high speed in one direction, and control means timed to bring said high speed means into operation only after the slow speed stage and at a time when the cylinder is rotating at slow speed in the same direction as it rotates at high speed.

3. In a clothes washing machine having a rotary clothes receiving cylinder, power operated drive means for turning the cylinder including slow speed gear means and high speed gear means, said high speed gear means being operative to rotate the cylinder at relatively high speed, control means for reversing the direction of rotation of said slow speed gear means to cause the cylinder repeatedly to turn slowly first in one direction and then in the other through one stage, means for shifting the drive from said slow speed gear means to said high speed gear means, and means for correlating the action of said control means and shifting means so that said shift will occur only after the slow speed stage at a time when the slow speed gear means is rotating in the same direction as the high speed gear means.

4. In a clothes washing machine having a rotary clothes receiving cylinder, power operated drive means for turning the cylinder including slow speed gear means and high speed gear means, said high speed gear means being operative to rotate the cylinder at relatively high speed, control means for reversing the direction of rotation of said slow speed gear means to cause the cylinder repeatedly to turn slowly first in one direction and then in the other through one stage, means for shifting the drive from said slow speed gear means to said high speed gear

means, and means operable in timed relation to said control means for causing said shift to occur only after the slow speed stage and at a time when the slow speed gear means is rotating in the same direction as the high speed gear means.

5. In a clothes washing machine having a rotary clothes receiving cylinder, power operated drive means for turning the cylinder including slow speed gear means for rotating the cylinder relatively slowly and high speed gear means for rotating the cylinder at relatively high speed in one direction, control means for reversing the direction of rotation of said slow speed gear means at timed intervals to cause the cylinder repeatedly to turn first in one direction and then in the other through a predetermined slow speed stage, and control means operative to cause the drive to be transmitted by said drive means through said high speed gear means and operable in timed relation to said first named control means so as to cause said cylinder to commence rotation at relatively high speed in one direction only after said slow speed stage and when the high speed gear means is rotating in the same direction as the slow speed gear means.

6. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed mechanism for transmitting from the drive means to the cylinder rotational motion at a relatively slow speed, control means for causing the drive means through said mechanism to turn the cylinder repeatedly first in one direction and then in the other direction through a predetermined slow speed stage, high speed mechanism for transmitting from the drive means to the cylinder rotational motion at a relatively high speed in one direction, and means for correlating the action of said control means and high speed mechanism so as to bring the latter into operation only when the cylinder is rotating after its slow speed stage in the same direction as it rotates at said high speed.

7. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed mechanism for transmitting from the drive means to the cylinder rotational motion at a relatively slow speed, control means for causing the drive means through said mechanism to turn the cylinder repeatedly first in one direction and then in the other direction through a predetermined slow speed stage, high speed mechanism for transmitting from the drive means to the cylinder rotational motion at a relatively high speed in one direction, means for shifting the drive from said slow speed mechanism to said high speed mechanism, and cam means for restraining operation of said shifting means to effect such shift until completion of said slow speed stage and only at a time when the cylinder is rotating in its slow speed stage in the same direction as it rotates at said high speed.

8. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed control means co-operating with the drive means for causing the cylinder repeatedly to turn first in one direction and then in the other through one stage, high speed control means co-operating with the drive means for causing the cylinder to rotate at a relatively high speed in one direction only after the slow speed stage, and means for preventing the operation of the high speed control means, except at a time when the cylinder in its slow speed stage is turning in the same direction as it turns in the high speed stage.

9. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed control means co-operating with the drive means for causing the cylinder repeatedly to turn first in one direction and then in the other through one stage, high speed control means co-operating with the drive means for causing the cylinder to rotate at a relatively high speed in one direction only after the slow speed stage, and means for modifying the operation of the high speed control means so as to delay the high speed operation until the cylinder is in a predetermined phase of its slow speed stage.

10. In a clothes washing machine having a rotary clothes receiving cylinder, a power operated drive means for turning the cylinder, slow speed control means co-operating with the drive means for causing the cylinder repeatedly to turn first in one direction and then in the other, high speed control means co-operating with the drive means for causing the cylinder to rotate at a relatively high speed in one direction only after the slow speed stage, and means for preventing the operation of the high speed control means when the receptacle in its slow speed stage is turning in a direction opposite that in which it will turn in its high speed operation.

11. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means for controlling the rotation of the cylinder so that during one stage of operations the cylinder will rotate slowly first in one direction and then in the other in a repeating manner, clutch means for controlling the rotation of the cylinder during another stage of operations so that the cylinder will rotate at a relatively high speed in one direction only, and means for moving the clutch means to shift from the slow speed stage to the high speed stage of operations only when the cylinder is turning in the same direction it will turn during the high speed stage.

12. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means for controlling the rotation of the cylinder so that during one stage of operations the cylinder will rotate slowly first in one direction and then in the other in a repeating manner, clutch means for controlling the rotation of the cylinder during another stage of operations so that the cylinder will rotate at a relatively high speed in one direction only, means for moving the clutch means so as to change from the slow speed stage to the high speed stage of operations, and cam means for preventing the change to high speed operation when the cylinder is turning in a direction opposite that in which it is to turn in the high speed stage.

13. In a clothes washing machine having a rotary clothes receiving cylinder, a drive unit for rotating the cylinder, means including a double acting clutch in the unit and movable back and forth between two positions for modifying rotary movement of the cylinder, means positively preventing movement of the clutch from either position to the other except at predetermined times and then acting to release the clutch for movement, cam means for positively initiating movement of the clutch at said predetermined times, and spring means independent of the movement

preventing means for moving the clutch after the initial movement occurs.

14. In a clothes washing machine having a rotary clothes receiving cylinder, a drive unit for rotating the cylinder, means including a clutch in the drive unit movable between two positions for modifying rotary movement of the cylinder, means for positively holding the clutch in a clutch engaged position during a predetermined time and then operating to place the clutch in a fully releasable condition, cam means acting to gradually disengage the clutch immediately prior to the clutch being placed in a fully releasable condition, and spring means independent of the movement preventing means for continuing the disengagement of the clutch after operation of the cam means.

15. In a clothes washing machine having a rotary clothes receiving cylinder, a drive unit for rotating the cylinder, a double clutch in the drive unit and including a clutch member movable between two engaged positions where with the member in one position the cylinder moves slowly and where in the other position the cylinder rotates rapidly, means positively preventing disengagement of the member from either engagement except at a predetermined time and then acting to permit movement of the clutch member to its other position, spring means acting to move the clutch member from one position to the other when such movement is permitted, and means associated with and adapted to engage and temporarily hold the clutch member in an intermediate, neutral position when it is moved from the position where rapid rotation of the cylinder has occurred.

16. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means in said drive means and movable between two positions for effecting reversing rotation of the cylinder in a repeating manner, a second clutch means in said drive means and movable between two positions wherein in one position the cylinder is driven in the mentioned reversing manner and in the other position it is driven at a relatively high speed in one direction only, cam means for effecting periodic reversing of the first clutch means, cam means for controlling movement of the second clutch means so that the cylinder can be driven first in a reversing manner and then in the one direction at higher speed, cam means for correlating the action of the two clutch means so that the second clutch means is shifted into its high speed position only when the first clutch means is in a position where the cylinder is turning in the same direction as it is to turn in the high speed stage, and means for driving all cam means in properly timed relation.

17. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means in said drive means and movable between two positions for effecting reversing rotation of the cylinder in a repeating manner, a second clutch means in said drive means and movable between two positions wherein in one position the cylinder is driven in the mentioned reversing manner and in the other position it is driven at a relatively high speed in one direction only, cam means for effecting periodic reversing of the first clutch means, cam means for controlling movement of the second clutch means so that the cylinder can be driven first in a reversing manner and then in the one direction at higher speed, cam means for modifying the action of one of the first two cam means so that the second clutch means is shifted into its high speed position only when the first clutch means is in a position where the cylinder is turning in the same direction as it is to turn in the high speed stage, and means for driving all cam means in properly timed relation.

18. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means in said drive means and movable between two positions for effecting reversing rotation of the cylinder in a repeating manner, a second clutch means in said drive means and movable between two positions wherein in one position the cylinder is driven in the mentioned reversing manner and in the other position it is driven at a relatively high speed in one direction only, driven control means for effecting periodic reversing of the first clutch means, control means for governing movement of the second clutch means so that the cylinder can be driven first in a reversing manner and then in the one direction at higher speed, driven control means for correlating the action of the two clutch means so that the second clutch is shifted into its high speed position only when the first clutch means is in a position where the cylinder is turning in the same direction as it is to turn in the high speed stage, and means for driving all control means in properly timed relation.

19. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means for controlling the rotation of the cylinder so that during one stage of operations the cylinder will rotate reversely first in one direction, and then the other in a repeating mannner, means including a clutch movable between two positions for controlling the rotation of the cylinder so that with the clutch in one position the cylinder is driven in the reversing manner and when in the other position it is driven at a relatively high speed in one direction, a control element for shifting the second mentioned clutch means from one position to the other, control means for shifting the element automatically between said two positions during operation of the machine, and means for preventing movement of the element when the second mentioned clutch is to be shifted to its relatively high speed position until the cylinder is turning in the same direction in its reversing stage as it is to turn in its high speed stage.

20. In a clothes washing machine having a rotary clothes receiving cylinder, motor operated drive means for turning the cylinder, clutch means for controlling the rotation of the cylinder so that during one stage of operations the cylinder will rotate reversely first in one direction and then the other in a repeating manner, means including a clutch movable between two positions for controlling the rotation of the cylinder so that with the clutch in one position the cylinder is driven in the reversing manner and when in the other position it is driven at a relatively high speed in one direction, a control element for shifting the second mentioned clutch means from one position to the other, control means for shifting the element automatically between said two positions during operation of the machine, means including a driven cam adapted to prevent movement of the element when the second mentioned

clutch is to be shifted to its relatively high speed position until the cylinder is turning in the same direction in its reversing stage as it is to turn in its high speed stage.

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