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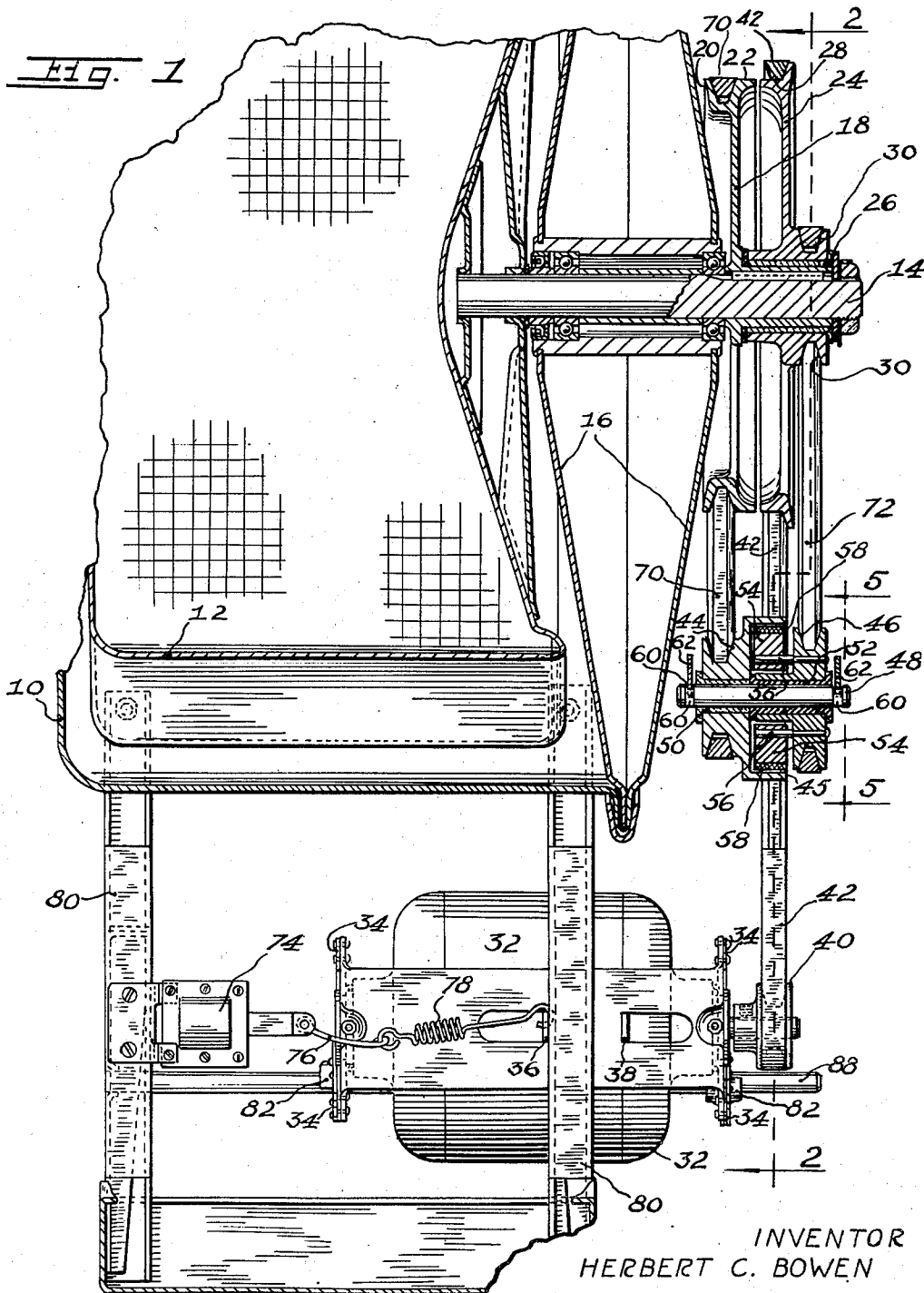
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BELT TRANSMISSION MECHANISM

Filed March 25, 1942

3 Sheets-Sheet 1



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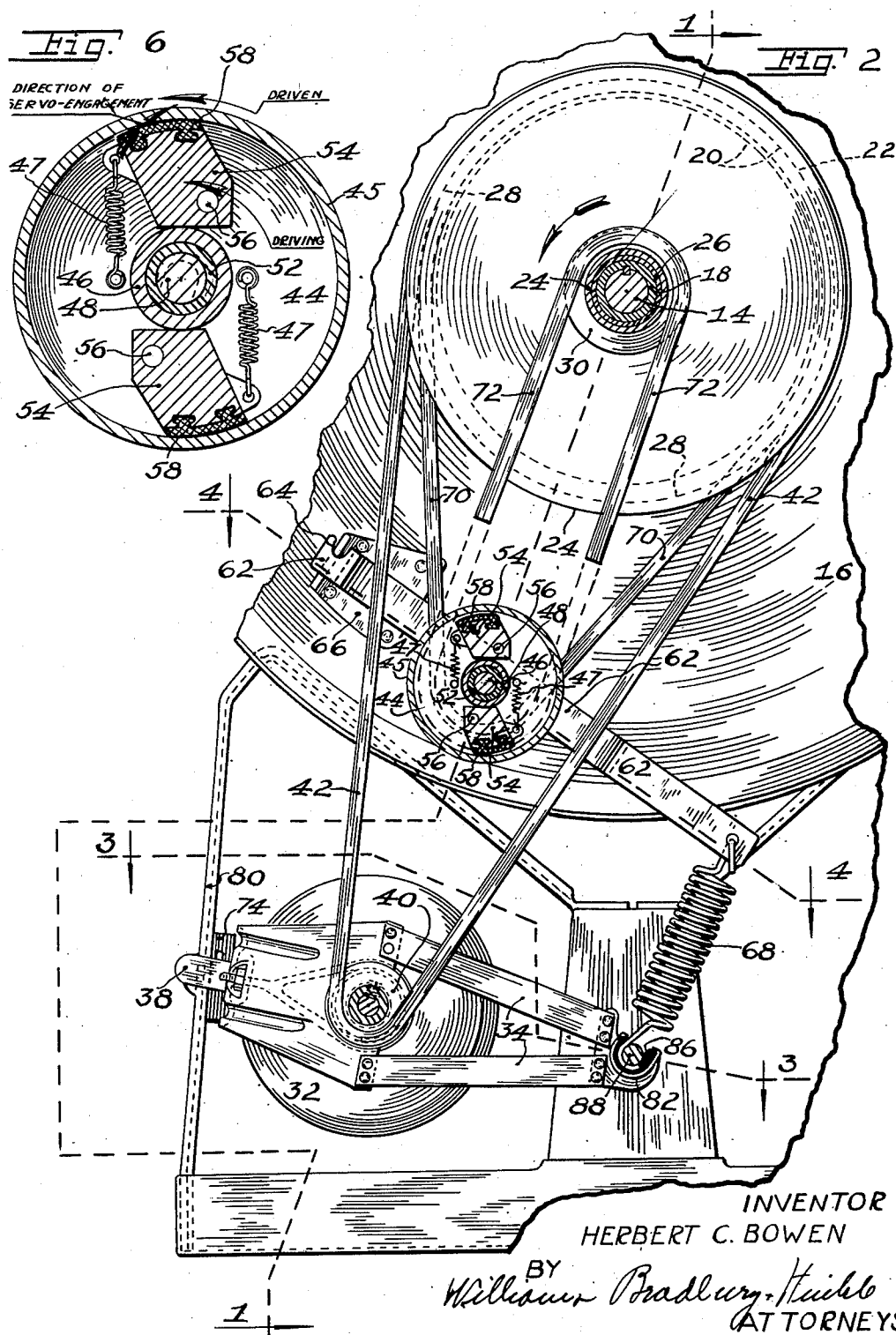
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3 Sheets-Sheet 2



Dec. 28, 1943.

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3 Sheets-Sheet 3

Fig. 3

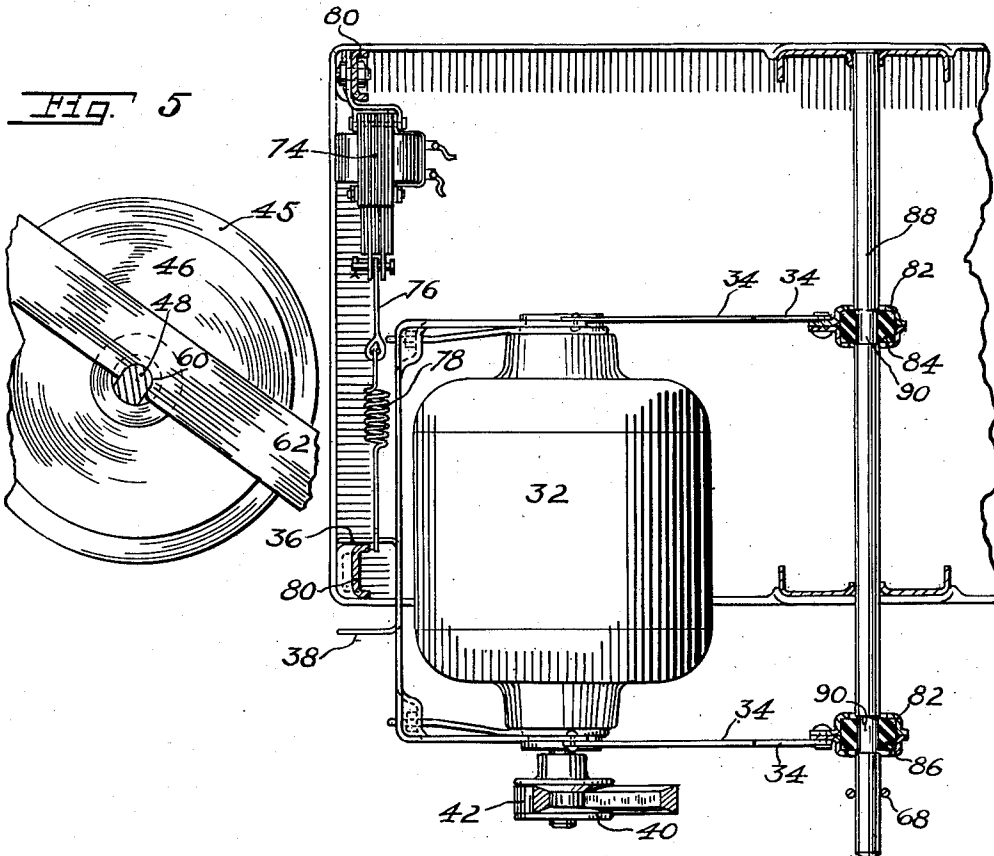
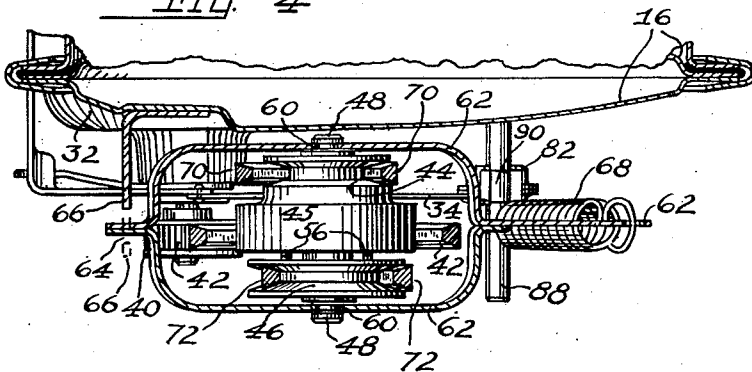


Fig. 4



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BELT TRANSMISSION MECHANISM

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8 Claims. (Cl. 74—217)

This invention relates to transmission mechanism.

The transmission mechanism of this invention is particularly adapted for use on substantially horizontal-shaft washing and extracting machines. In washing and extracting machines of the class to which this invention has been applied, it is important that the speed of rotation of the washing machine cylinder be maintained substantially constant for the washing and distributing operations and that the speed then be increased for extracting without any lowering of the speed below that at which distribution of the materials in the washing machine cylinder has taken place.

From the commercial standpoint, it is important that a small motor be used for driving the washing machine cylinder, both at washing and distributing speed and at extracting speed. During the washing operation, the wet contents of the cylinder are carried up from the bottom to a point near the top, from which they fall across the cylinder. There are occasions during the washing operation when all of the materials in the cylinder fall to the bottom and have to be carried to the top in about one-half revolution of the cylinder. In a household type washing machine designed to handle 9 pounds of dry materials in one charge, the cylinder has a diameter of 20 inches and rotates at about 60 R. P. M. for the washing operation. Nine pounds of dry materials weigh about 30 pounds when wet; therefore, the motor must be of such power as to lift 30 pounds of materials from the bottom of the cylinder to the top of the cylinder in substantially $\frac{1}{2}$ second. This load plus the friction of the bearings and speed-reduction mechanism and the resistance of the water in the tub in which the cylinder is being rotated imposes the maximum regular operating load upon the motor.

At the end of the washing and distributing operations, the cylinder of the washing machine with its load of substantially 30 pounds of wet materials must be brought from a speed of about 60 R. P. M. to some much higher extracting speed. Obviously, this increase in speed cannot be accomplished instantly, and in order that it may be accomplished by means of a motor whose power is limited by the requirements of the washing operation, a considerable time must elapse for the acceleration from washing to extracting speeds. If the time is too short, the speed of the motor will be slacked to such an extent that it will fall back upon its starting winding. This

is a condition which the Underwriters will not approve for household devices; that is, the Underwriters require that a machine be supplied with a motor of large enough power that it will not fall back upon its starting winding at any time during its regular operation.

In order to accomplish the acceleration of the cylinder from washing to extracting speeds without unduly loading the motor, a transmission must be provided which gradually shifts its ratio from low-speed operation to high-speed operation, or else one must be provided which allows a slip between moving parts during the acceleration period. The type of transmission which involves a gradual speed change without slip is expensive and somewhat complicated, and from those standpoints such a mechanism is impractical for household washing machines.

Experience has demonstrated that friction clutches are both expensive and unreliable. It is not difficult to construct a friction clutch which, at the time of construction, will slip for the necessary time for the acceleration of the cylinder from washing to extracting speeds; but either dry or lubricated multiple-disc clutches or cone clutches change their gripping characteristics with change of temperature and with wear, so that after considerable use either they may grip too rapidly and throw the motor onto its starting winding or else they may not grip at all and fail to bring the cylinder from its washing speed to its extracting speed. In accordance with the usual type of transmission mechanism which includes a friction clutch, there is a sudden shift from low-speed conditions to high-speed conditions with the clutch interposed to provide the accelerating period. If the clutch grips too rapidly, the speed of the motor is reduced and the materials which have been distributed fall to the bottom of the cylinder. If this happens, the motor will be thrown back on its starting winding and usually will not have enough torque, under the newly established speed ratio, to rotate the cylinder to lift the materials from the bottom to the top of the cylinder. Under these conditions, a fuse will be blown or some other objectionable disarrangement of the apparatus will occur.

When a belt is used for transmitting the power from a single pulley associated with the motor to a pulley associated with the washing machine cylinder, it is necessary that the belt be tight enough to prevent slippage of the belt on its pulleys at the time the cylinder is driven at low speed and the wet materials have to be raised

from the bottom to the top of the cylinder. Therefore, all slip must take place in some form of clutch rather than a slip of the belt on its pulleys.

According to the present invention, all of the slip which necessarily takes place while accelerating the cylinder from washing and distributing speed to extracting speed occurs between a belt and one of its pulleys, which belt is run at such high speed that it may be loose enough to slip while the cylinder is being accelerated from washing and distributing speed to extracting speed but at the same time will be tight enough not to slip while the cylinder is being operated either at final extracting speed or at washing speed.

This invention is illustrated in the accompanying drawings, in which:

Figure 1 is a view, partly in elevation and partly in section on the line 1—1 of Figure 2, of a washing machine to which this invention has been applied;

Figure 2 is an elevation, partly in section on the line 2—2 of Figure 1;

Figure 3 is a plan of the motor mounting, partly in section on the line 3—3 of Figure 2;

Figure 4 is a plan of the overrunning clutch mechanism, partly in section on the line 4—4 of Figure 2;

Figure 5 is an elevation of the overrunning clutch mechanism, partly in section on the line 5—5 of Figure 1; and

Figure 6 is a sectional elevation of a modification of the overrunning clutch mechanism.

In the illustrated embodiment of the invention, a tub 10 contains a cylinder 12 supported upon a substantially horizontal shaft 14 rotatably mounted in a rigid tub back 16. Fixedly secured to the protruding end of the main shaft 14 is a tight pulley 18 provided with a groove or face 20 and a substantially flat face 22. A loose pulley 24 is rotatably mounted on the hub of the pulley 18, there being an Oilite bushing 26 interposed between the hub of the pulley 24 and the hub of the pulley 18. The pulley 24 has a flat face 28 of the same diameter as the flat face 22 of the pulley 18. The hub of the pulley 24 is provided with a V-belt groove or face 30.

A motor 32, supported on leaf springs 34, Figure 3, and carrying stops 36 and 38 for limiting its axial movement, is provided with a grooved pulley or face 40 for driving a V-belt 42, which in the right-hand position of the motor 32 rides upon the outer flat face 28 of pulley 24 and in the left-hand position of the motor 32 rides upon the flat face 22 of pulley 18.

An overrunning clutch and jackshaft mechanism includes two V-pulleys or faces 44 and 46 journaled side by side upon a shaft 48 by means of Oilite bearing sleeves 50 and 52. The pulley 44 is provided with a drum 45 within which two clutch shoes 54 are mounted on pivot pins 56 supported on the pulley 46. The shoes 54 are provided with linings of brake material 58 and are so shaped that they grip the inner surface of the drum 45 when relative rotation of the pulleys 44 and 46 is attempted in one direction but permit free relative rotation of these pulleys in the opposite direction. Springs 47 are of such strength that they hold the shoes away from the drum when the pulley 46 is not rotating but are expanded, by centrifugal force, when the pulley 46 is rotated at its operating speed. The ends of the shaft 48 fit into notches 60 in the lower sides of opposite members of a

frame 62. The opposite members of this frame 62 are secured together on a plane extending substantially midway between the grooves of pulleys 44 and 46. The attached portions at one end of each of the frame members are notched on their upper edges at 64 to fit into a notch in the under side of a bracket 66 attached to the outer tub end 16. An extension from the other ends of the attached frame members 62 engages an anchored spring 68 for pulling downwardly upon the frame members 62.

A V-belt 70 embraces the groove 20 in pulley 18 and the V-groove in pulley 44, and a V-belt 72 embraces the V-groove 30 in pulley 24 and the V-groove in pulley 46. The downward pull of the spring 68 upon the frame 62 maintains substantially equal tension upon the V-belts 70 and 72, the frame 62 being permitted to rock on its support sufficiently to compensate for any slight change in length of the belts 70 and 72.

The motor 32 may be moved axially by means of a solenoid 74 connected to the stop 36 by means of a link 76 and a spring 78. The leaf springs 34 which support the motor 32 are provided with sufficient normal flexure to hold the motor in its right-hand position, so that stop 36 abuts the tub support 80. The leaf springs 34 preferably terminate in housings 82 enclosing C-shaped, open rubber bushings 84 and 86, the bushing 84 being turned with the open side of the C downwardly and the bushing 86 being turned with the open side of the C upwardly. The V-belt 42 is tensioned by the weight of the motor, which hangs upon the belt. Since the pulley 40 is located in a vertical plane outside of the vertical planes of the leaf springs 34, the rubber bushing 86 is forced upwardly against the supporting shaft 88, whereas the rubber bushing 84 is forced downwardly against the shaft 88. Thus the motor may be unhooked for removal by simply raising the motor enough to loosen the belt 42. Undercut portions 90 on the shaft 88 prevent the rubber bushings from movement along the supporting shaft 88.

The size ratios of the various belt surfaces are such that, when the motor pulley 40 rotates at a speed of 1750 R. P. M., the cylinder 12 is driven at substantially 60 R. P. M. when the motor and its belt 42 are in the right-hand position and at substantially 325 R. P. M. when the motor and its belt 42 are in the left-hand position.

In operation, materials and washing fluid are placed in the cylinder 12 and the motor 32 is operated in its right-hand position, shown in Figure 1. This causes the pulley 24 to rotate, in a counterclockwise direction, at about 325 R. P. M. The V-pulley groove 30, which is an integral part of the pulley 24, drives the V-pulley 46 through belt 72, at a speed of about 280 R. P. M. Since the direction of rotation of the pulley 46 is such as to cause the clutch shoes 54 to engage the drum 45 of pulley 44 in a nonslipping contact, the pulley 44 is now rotated in a counterclockwise direction, Figure 2, at a speed of substantially 280 R. P. M. The ratio of size of the pulley 44 and the V-groove 20 of pulley 18 being substantially 4.75 to 1, the cylinder 12 is now rotated at a speed of substantially 60 R. P. M. At this speed, with a 20 inch cylinder, materials in the cylinder will tumble for washing so long as there is water in the cylinder, but when the water has been withdrawn after the washing operation, the materials in the cylinder, outside of a critical cylinder a few inches inside of the periphery of the cylinder 12, will be held, by cen-

trifugal force, against the periphery of the cylinder. The materials inside the critical cylinder either will find an opening into which to deposit themselves at least partially outside the critical cylinder or else will remain within the critical cylinder even during extracting, and will thus contribute to a slight out-of-balance condition of the materials.

When it is desired that the speed of the cylinder be increased to a much higher speed for extracting the water from the wet materials in the cylinder, the solenoid 74 is energized, its armature pulled in and the motor shifted to the left until the abutment 38 engages the tub support 80. When the motor position is thus shifted, the belt 42 is caused to move to the left, on the flat face 28 of pulley 24, until the belt engages the right-hand edge, Figure 1, of the flat face 22 of pulley 18. The belt 42 is now traveling at a speed which tends to rotate the pulley 18 and the attached cylinder at about 325 R. P. M. But on account of the inertia of the cylinder 12 and the wet materials which it contains, the belt 42 does not immediately grip the face 22 of pulley 18 but, instead, continues to slip on the face 22 of pulley 18 until the speed of the pulley 18 has increased to 325 R. P. M.; whereupon the belt 42 continues to drive the pulley 18 so long as the feed of the belt to that pulley by the position of pulley 40 continues.

During the time that the belt 42 engages both the face 28 of pulley 24 and the face 22 of pulley 18 the pulley 24 continues to rotate at substantially 325 R. P. M. This is made possible by the overrunning clutch mechanism mounted on the jackshaft 48, which permits the pulley 44 to be driven at this time by the belt 70 at a speed much higher than that at which the pulley 46 is now being driven by belt 72.

If the overrunning clutch mechanism were not present in the packshaft mechanism, the pulley 24 would be compelled, through the belts 70 and 72, continuously to rotate at a speed higher than that of the pulley 18. Since the power ratio between the pulley 24 and the main shaft 14 is about six times as great as the 1 to 1 ratio of the pulley 18 and the main shaft 14, the belt 42 would not slip on the face 28 of the pulley 24 during the transition of the belt from the face 28 of pulley 24 to the face 22 of pulley 18. Consequently, when the additional load was thrown onto the motor by the slipping of the belt on the face 22 of pulley 18 and the motor speed thus became momentarily slackened by the additional load, the cylinder speed likewise would be proportionately slackened, so long as any part of the belt 42 continued to engage any part of the face 28 of pulley 24. The slackening of the speed of the cylinder of a washing machine below the critical distribution speed is detrimental because it permits the materials which had been distributed at the 60 R. P. M. speed to fall away from the top of the cylinder and to become maldistributed before the speed of the cylinder again comes up to substantially 60 R. P. M. By reason of the presence of the overrunning clutch, however, the pulley 24 may continue to rotate at the slackened speed of belt 42 without imposing any brake upon the rotation of the cylinder. The speed of rotation of the cylinder, therefore, commences to accelerate as soon as the belt 42 starts to slide upon the face 22 of pulley 18, and this acceleration takes place notwithstanding a decrease in the speed of the motor due to the extra

load placed upon it through the sliding of the belt 42 on the face 22 of pulley 18.

After the belt 42 has moved entirely onto the face 22 of pulley 18, the pulley 24 may continue to rotate at the same speed as the pulley 18, or pulley 24 may come to a complete rest, or it may be driven at a very high speed, depending entirely upon the relative frictions of the several bearings. Ordinarily, the friction at the hub of pulley 24 will be great enough to cause that pulley to continue to rotate at substantially the same speed as that of the pulley 18 and the cylinder 12, after the pulley 18 has arrived at extracting speed.

An advantage of the construction just described is that the tension on the belt 42 may be very much less than the tension required of belts 70 and 72, which latter belts travel at very much slower speeds than belt 42. As pointed out earlier in this specification, the tension on belt 42 must be light enough so that as it shifts from the pulley 24 to the pulley 18 it will slip on the face 22 of pulley 18. This slipping must continue for 8 or 10 seconds, in order that the load thrown upon the motor in accelerating the cylinder 12 from 60 R. P. M. to extracting speed will not be sufficient to throw in the starting winding of the motor. However, if the belt 42 were relied upon to drive the pulley 18 at slow speed for washing, it would have to be so tight, in order to lift the mass of wet materials from the bottom of the cylinder to the top of the cylinder, that it would not slip on the face 22 of pulley 18 for acceleration of the cylinder.

At the end of the high-speed operation of the cylinder 12, the circuit of solenoid 74 is interrupted and the motor 32 again moves to its right-hand position. At the time that this happens, the belt 42 drives the pulley 24 at substantially 325 R. P. M., but at this time the overrunning clutch shoes 54 permit the jackshaft pulley 44 to be driven by the inertia of the cylinder at a speed much higher than that at which the jackshaft pulley 46 is then being rotated. This slippage of the clutch shoes 54 within the drum 45 permits the cylinder, with its materials, gradually to decelerate until the pulleys 44 and 46 are rotating at exactly the same speed, whereupon the clutch shoes 54 engage the drum 45 to continue the rotation of the cylinder at substantially 60 R. P. M. At the end of the last extracting operation, the circuit of the motor 32 is interrupted so that the motor, the pulley 24 and the V-pulley 46 all come to rest, while the cylinder 12 continues to rotate until friction of its bearings finally brings it to rest. The overrunning clutch makes it unnecessary for the belt 42 to move entirely off the pulley 24 so long as it moves far enough onto pulley 18 to drive that pulley at belt speed after the acceleration period.

In the operation of the clutch mechanism mounted on the jackshaft, there is no condition under which the shoes of the clutch suddenly take hold of the drum, thus eliminating any strain on the mechanism.

In this specification, the word "face" is used as applied to either V-pulleys or flat pulleys, because flat belts may be used in place of any of the V-belts illustrated and described.

Although this invention is peculiarly adapted for use on washing machines in which a substantially fixed speed must be maintained for washing and distributing and a much higher speed provided for extracting, it is to be understood that it is not limited to this application.

I claim:

1. Change-speed drive mechanism for a main shaft comprising tight and loose pulleys on the shaft, speed-reducing means between the loose pulley and the shaft including a one-way drive connection permitting the shaft to rotate ahead of the drive connection, a driving belt adapted to be shifted from one to the other of said pulleys, and means to shift the belt from either pulley to both pulleys and then to the other pulley.

2. Change-speed drive mechanism for a main shaft comprising a tight pulley on said shaft, an associated loose pulley, speed-reducing drive means between the loose pulley and the shaft, a one-way drive connection in said speed-reducing drive means whereby the shaft may rotate ahead of the drive connection, a driving belt adapted to be shifted from one to the other of said pulleys, and means to shift said belt either wholly onto said loose pulley or partly on the loose pulley and partly on the tight pulley.

3. In a speed-reduction mechanism, a jackshaft, a pair of belt pulleys spaced from one another along the axis of the jackshaft, a pair of belts, one for each of said pulleys, a frame member engaging the jackshaft, means engaging said frame in a plane between the belt faces of said pulleys and applying a force to the frame opposite to the direction of the pull of the belts, the frame, jackshaft and pulleys being adapted to rock on said means, whereby both of said belts may be kept tight even though one may stretch more than the other.

4. In a speed-reduction mechanism, two associated V-belt pulleys spaced from one another along their common axis, two belts, one on each of said pulleys, applying their pull in substantially the same direction, and means rockingly engaging said pulleys in a plane between the V-grooves and applying a force on both pulleys in the opposite direction to that of the said belts.

5. In a power transmission mechanism, a pair of pulleys spaced apart along their common axis, two belts, one for each pulley, applying force to said pulleys in the same general direction, means applying force to and between said pulleys in the opposite direction to the force of said belts, said means permitting differential movement of said pulleys, whereby both belts will be maintained tight even though one or the other of said belts may stretch or shrink.

6. A change-speed drive mechanism of the type wherein a driving belt is shifted from one circumferential belt-contacting surface for a low

speed to an adjacent concentric circumferential belt-contacting surface of equal diameter for a higher speed, thereby to effect an increase in the rotative speed of a driven member, characterized by a speed-reducing drive connection between said low-speed circumferential belt-contacting surface and said driven member having a one-way clutch unit in said speed-reducing drive connection capable of transmitting torque from said low-speed contacting surface to said driven member but allowing free rotation of said driven member ahead of that imparted through said drive connection.

7. A change-speed drive mechanism comprising a driven member, a shiftable driving belt, a pulley adapted to be driven by said belt and secured to rotate with said driven member, a second pulley of equal diameter and free to rotate relative to said first-mentioned pulley and mounted in adjacent concentric belt-shifting position relative thereto, means to shift said belt from one to the other of said pulleys, a speed-reducing drive connection between said second pulley and said driven member, a one-way clutch connection in said speed-reducing drive connection capable of transmitting torque from said second pulley through said drive connection but allowing free rotation of said driven member ahead of that imparted through said drive connection.

8. A change-speed drive mechanism comprising a driven member, a shiftable driving belt, a pulley adapted to be driven by said belt and secured to rotate with said driven member, a second pulley of equal diameter and free to rotate relative to said first-mentioned pulley and mounted in adjacent concentric belt-shifting position relative thereto, means to shift said belt from one to the other of said pulleys, a speed-reducing drive connection between said second pulley and said driven member comprising a jackshaft, a pair of jackshaft pulleys mounted for rotation on said jackshaft, a belt on each of said jackshaft pulleys, one of said belts mounted to drive said driven member from one of the jackshaft pulleys and the other of said belts mounted to drive the other jackshaft pulley from said second pulley, a one-way clutch connection connecting said pair of pulleys on said jackshaft and capable of transmitting torque from said second pulley to said driven member but allowing a free rotation of said driven member ahead of that imparted from said second pulley through said drive connection.

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