Aug. 26, 1941. H. D. BROTMAN 2,253,842

LAUNDRY MACHINE

Filed March 6, 1939 5 Sheets-Sheet 1

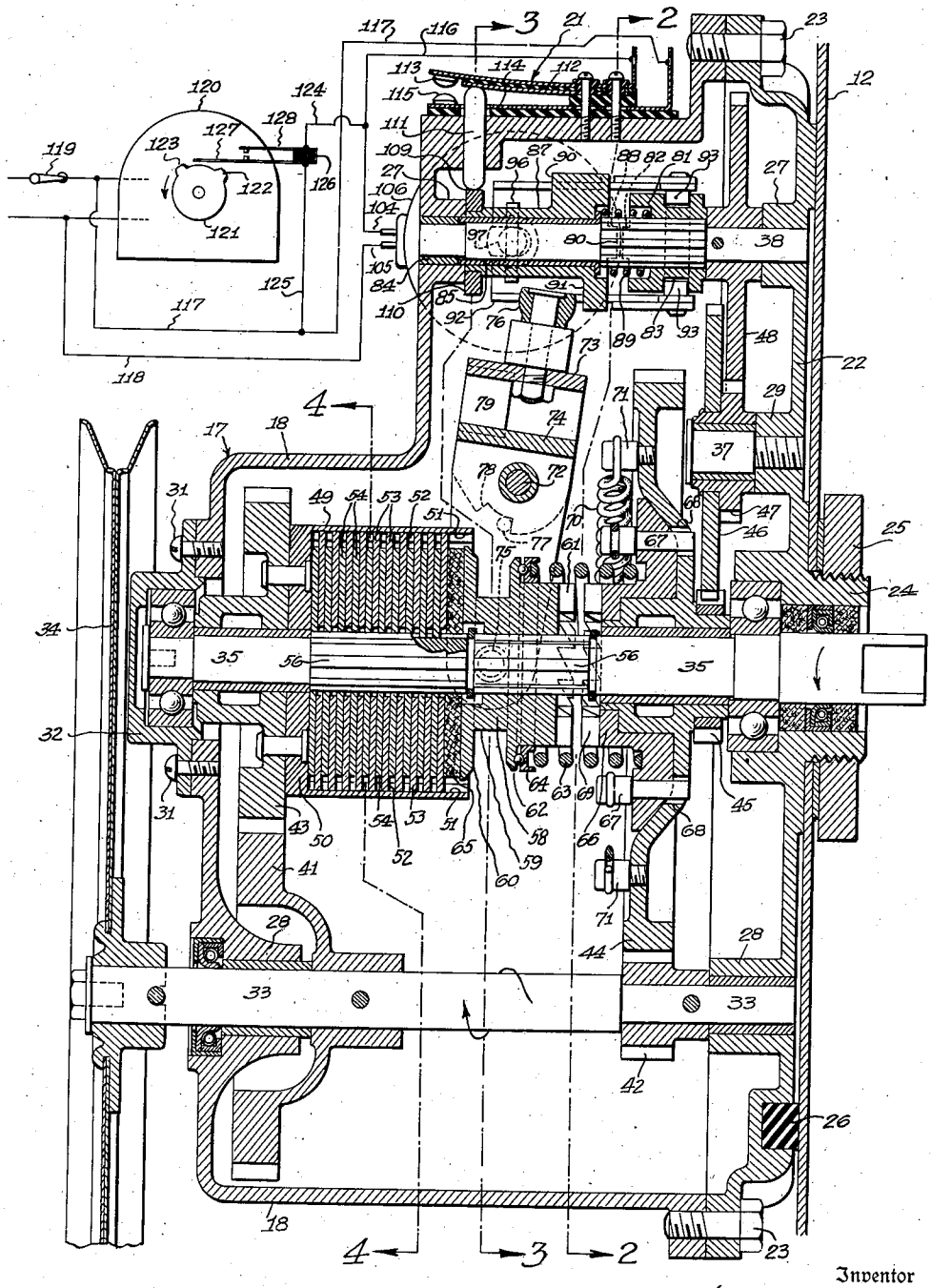


Fig. 1.

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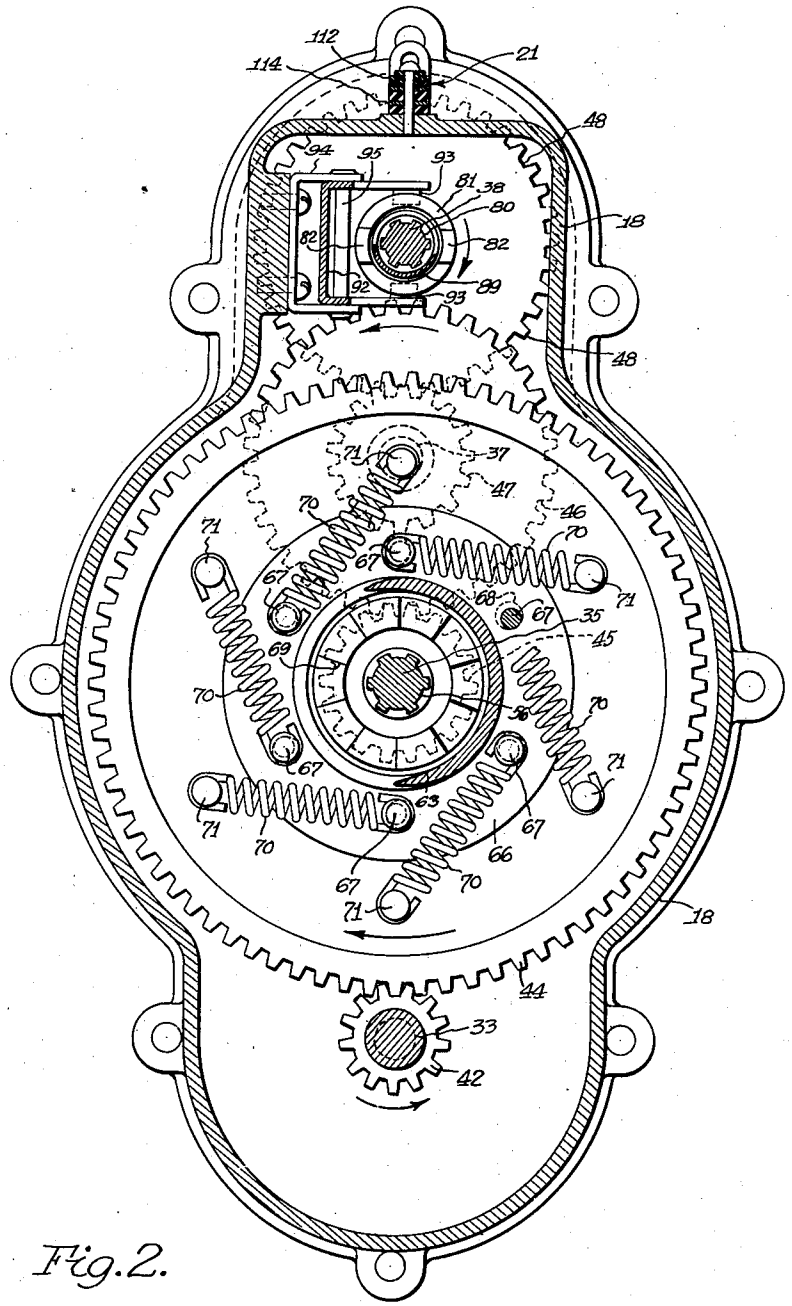


Fig. 2.

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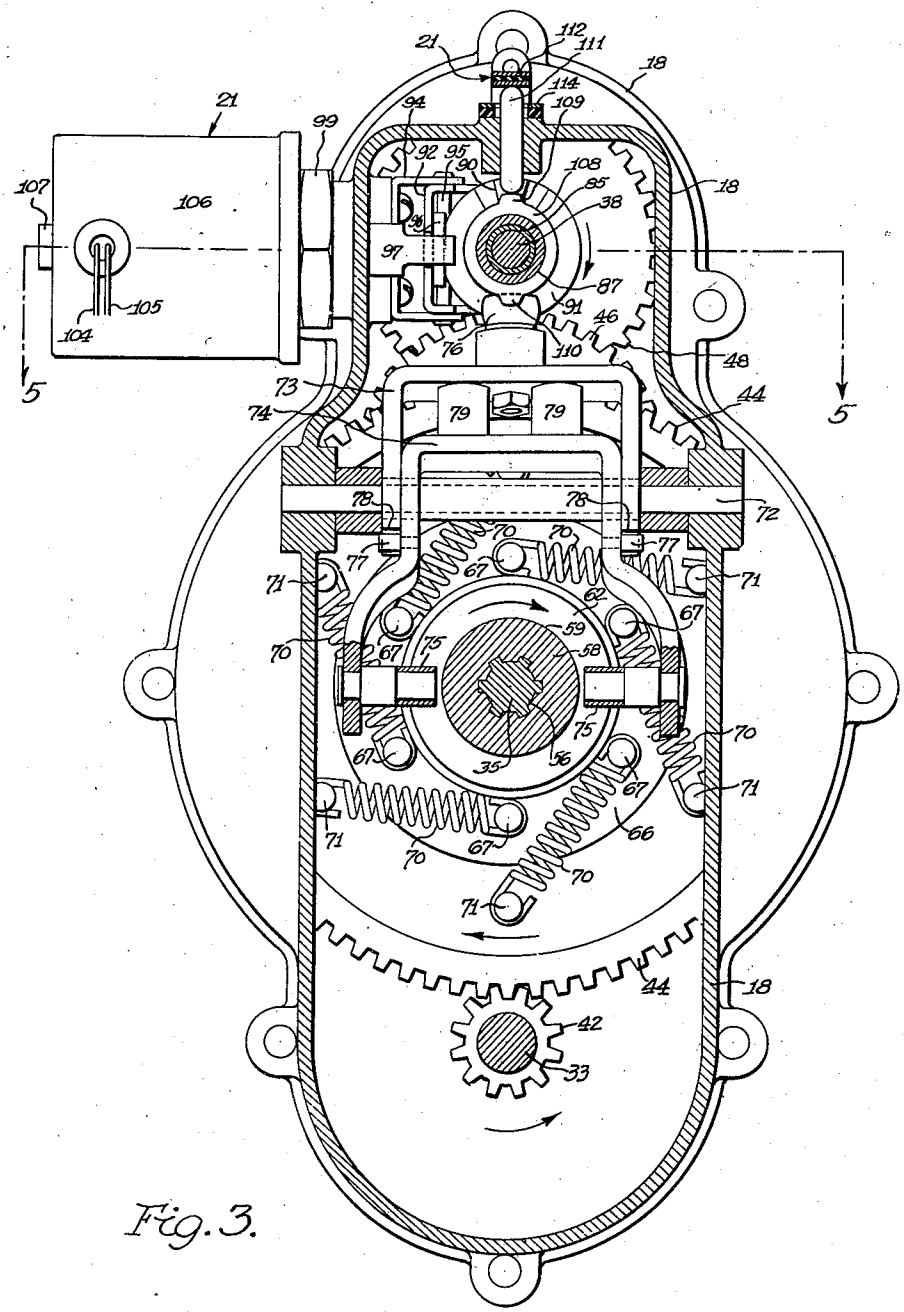


Fig. 3.

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Fig. 5.

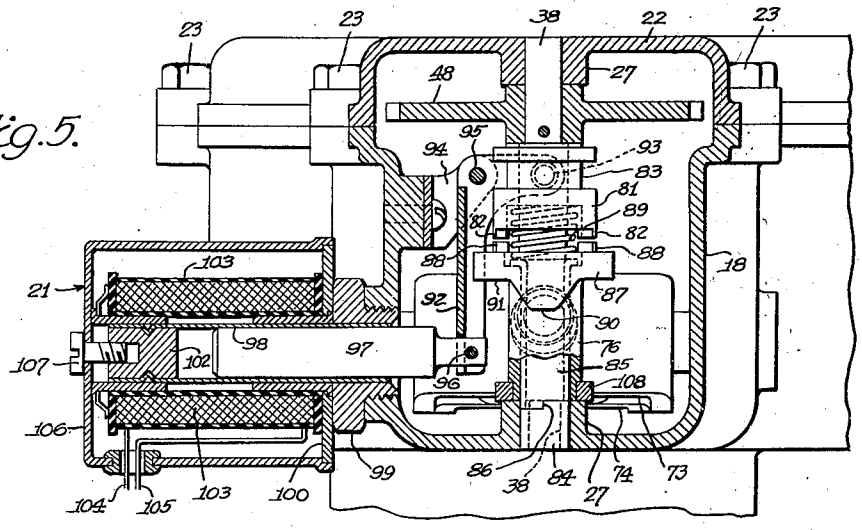
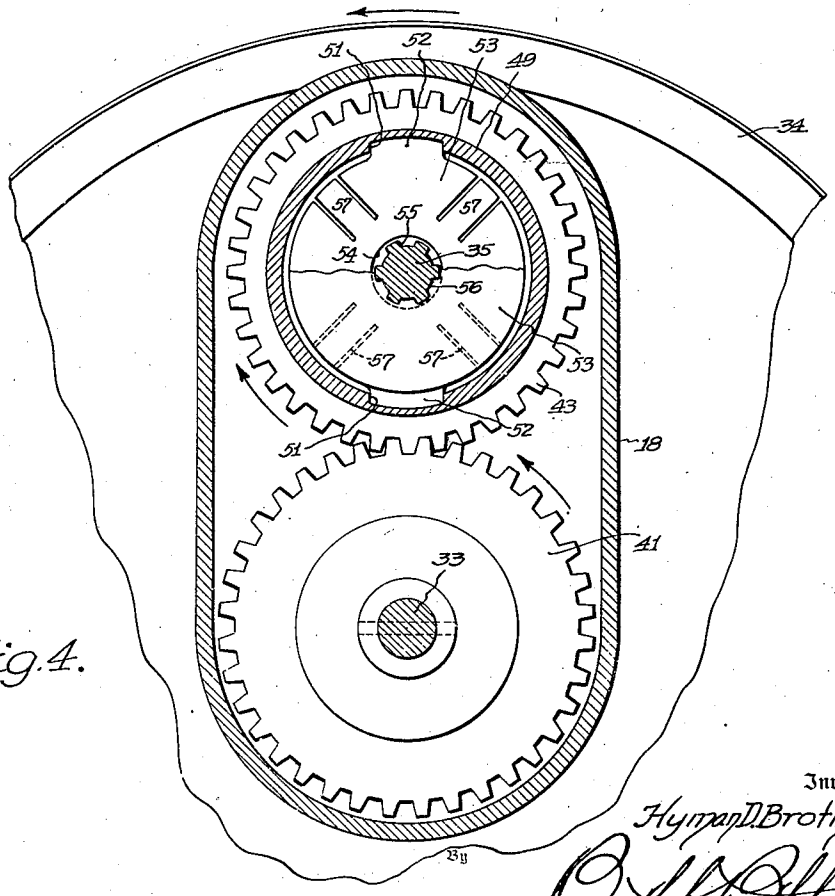


Fig. 4.



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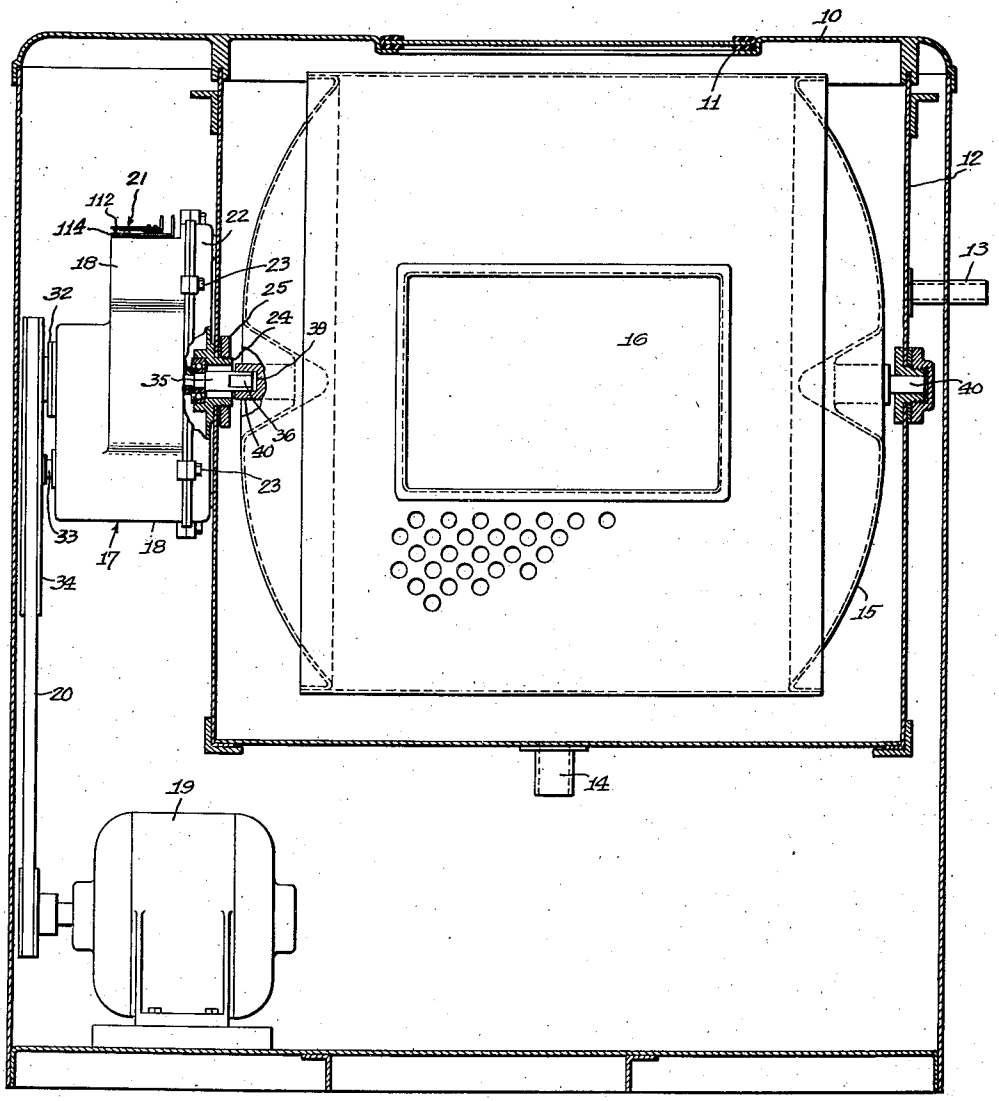


Fig. 6.

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UNITED STATES PATENT OFFICE

2,253,842

LAUNDRY MACHINE

Hyman D. Brotman, Detroit, Mich.

Application March 6, 1939, Serial No. 260,013

13 Claims. (Cl. 74—1)

This invention relates, in general, to laundry machines and, in particular, to improvements in those machines having variable speed transmissions.

One of the objects of this invention is to provide a new and improved variable speed transmission for a laundry machine which is automatically operable for varying the speed of said machine from one to another of its possible speeds and which is accurately timed and automatically controlled so that the speed changes occur at predetermined times wherefor each new speed condition prevails for a predetermined time interval.

Another object is to incorporate in a laundry machine employing a variable speed transmission a new and improved shifting mechanism which is automatically operated, controlled and timed so that said machine efficiently performs the plurality of duties expected thereof, such as, washing, rinsing and drying clothes without requiring the operator's attention, presence or manipulation.

Another object is to provide in conjunction with a variable speed transmission for a laundry machine a new and improved speed changing mechanism which is automatically and electrically operated at predetermined times to initiate speed changes in said transmission and which is automatically and mechanically operated for predetermined time intervals to consummate said speed changes.

Another object is to provide a new and improved multispeed laundry machine which is shifted from one speed to the other by the co-action of one set of means and which is controlled in the speed shifting by the co-action of another set of means, the co-action of said first set of means being initiated by the co-action of said second set of means and dependent upon the motivating power for said machine, but the co-action of said second set of means being dependent upon a motivating power which is independent of said other motivating power, whereby the phasing or synchronizing of said motivating powers is unnecessary for efficient operation of the machine in accordance with predetermined manners.

Another object is to improve a multi-speed laundry machine so that its multi-function performance is carried out and controlled entirely automatically and in strict and accurate accordance with the timing predetermined therefor, as well as to simplify its construction, to improve its compactness and to maximize its efficiencies.

Another object is to improve the shifting mechanism for the variable speed transmission employed in a laundry machine so that the relatively movable members of said mechanism are at all times more accurately related to each other for safer and more efficient operation than heretofore.

Another object is to improve the variable speed transmission for a laundry machine so as to minimize, without efficiency losses, shocks normally present upon and resulting from the shifting of said mechanism from one to the other of its speeds.

Other objects and advantages of the invention will become readily apparent from a reference to the following specification taken in conjunction with the accompanying drawings of which there are five (5) sheets and wherein:

Figure 1 is a longitudinal section taken through the laundry machine transmission and showing the shifting mechanism therefor, there also being shown, diagrammatically, the timing mechanism together with a wiring diagram for said two mechanisms;

Figs. 2, 3 and 4 are sections taken along the lines 2—2, 3—3 and 4—4, respectively, in Fig. 1, each of said sections being partly broken away to clarify the details of construction thereat;

Fig. 5 is a section taken along the lines 5—5 in Fig. 3; and

Fig. 6 is a view, partly in section and partly in elevation, of the assembled laundry machine.

Referring first to Fig. 6, the assembled laundry machine shown therein comprises, in general, a main casing 10 having a selectively closed opening 11 for providing access therethrough, an inner casing 12 rigidly supported by said main casing and being provided with a fluid inlet 13 and a drain 14, a cylindrical tub 15 journaled at its axis of rotation in the opposite walls of said inner casing and having a selectively closed opening 16 for alignment with said other opening to enable loading and unloading of said tub, a transmission, generally indicated at 17, supported by said inner casing and in operative driving engagement with said tub, a housing 18 for said transmission, a motor 19 for driving said transmission through a belt 20, and a portion of a cluch shifting control mechanism, generally indicated at 21, for said transmission.

Transmission housing 18 cooperates with a backing member 22 to form therewithin a closed chamber in which is supported the entire transmission 17 and a substantial portion of the clutch shifting control mechanism 21, said housing and

said member being removably sealed together at their abutting peripheries by means of bolts 23 which pass through openings provided in one of said cooperants into threaded engagement with tapped openings in the other of said cooperants. On the side of backing member 22 opposite the housing 18 there is centrally formed a hollow boss 24 which is operable for insertion through an opening provided therefor in the adjacent wall of the inner casing 12 and which boss is externally threaded to receive a nut 25. Tightening of nut 25 on boss 24 against the inner wall of casing 12 draws member 22 and said casing together so as to lend rigid support to said member and the housing 18 secured thereto, the face of said member adjacent said casing being preferably provided with a series of annularly spaced cushioning members 26 which are compressed during the tightening of said nut and serve thereafter as resilient spacers between said member and said casing.

Transmission housing members 18 and 22, when assembled, serve as bearing supports for the various shafts employed in the transmission 17, and for this purpose each of said members is provided with an upper bearing-forming boss 27 and with a lower bearing-forming boss 28, the axes of bosses 27 being aligned, the axes of bosses 28 being aligned, and these two pairs of aligned axes being parallel with each other and with the axis of rotation of the tub 15. Member 22 is also formed with another boss 29, said boss being internally threaded and arranged on said member intermediate the other bosses 24 and 27 thereon in axial parallelism therewith. Member 18, on the other hand, is provided with an opening 30, said opening, in the assembly of the housing members 18 and 22, being in alignment with the axis of the boss 24 on member 22, and this axis being parallel with the axes of bosses 27, 28 and 29. To the member 18 over the opening 30 therein there is removably secured, such as by screws 31, a cupped cap member 32.

The shafts in the transmission 17 comprise, a drive shaft 33 supported for rotation in the bearings provided therefor by the bosses 28 on the housing members 18 and 22 and extending outwardly from said member 18 to receive thereon for rotation therewith a pulley 34, a driven shaft 35 supported for rotation in suitable bearings provided therefor in the cap member 32 on housing member 18 and in the hollow boss 24 on housing member 22 and extending outwardly from said member 22 through the opening provided therefor in the wall of the inner casing 12 and being flattened at its outer end to provide a male fitting 36 thereat for the tub 15, a stub shaft 37 fixedly secured against rotation by means of a threaded engagement with the internally threaded boss 29 on the housing member 22, and another driven shaft 38 supported for rotation in the bearings provided therefor by the bosses 27 on the housing members 18 and 22. The drive shaft 33, which shaft is mechanically associated with the stub shaft 37 and driven shafts 35 and 38 and which association will soon be explained, is driven by the motor 19 through the belt 20 and pulley 34. The driven shaft 35 is operable for driving the tub 15 through the metal-to-metal connection between the male fitting 36 on said shaft and a female fitting 39 formed in one of a pair of hubs 40 on said tub at the axis of rotation thereof, the other of said hubs being journaled in any suitable manner in the opposite wall of the inner casing 12.

The gearing in the transmission 17 comprises, a pair of axially spaced pinions 41 and 42 keyed to the drive shaft 33 for pure rotation therewith, said pinion 41 having a greater diameter than said pinion 42 so that the driven shaft 35 may be selectively driven at different rotative speeds, a pair of driven gears 43 and 44 freely mounted on said driven shaft 35 and operable at different times for selectively rotating said driven shaft at different speeds, said gears 43 and 44 being arranged on said driven shaft for constant meshing engagement with said pinions 41 and 42, respectively, a gear 45 press-fitted or otherwise secured to the hub of gear 44 so as to rotate in accordance therewith about the axis of shaft 35, a gear 46 arranged in constant mesh with gear 45 for rotation about the axis of the stub shaft 37, a gear 47 freely mounted on shaft 37 and being press-fitted or otherwise secured to the gear 46 for rotation in accordance therewith about the axis of said shaft 37, and a gear 48 keyed to the other driven shaft 38 for rotating same and being arranged thereon in constant mesh with said gear 47 to be rotated in accordance therewith about the axis of said shaft 38. In operation, the drive shaft 33 effectuates the simultaneous and continuous rotation of the two pinions 41 and 42 and of each and every one of the six gears 43, 44, 45, 46, 47 and 48, said pinions 41 and 42 being rotated by and about the axis of said shaft 33, said gears 43, 44 and 45 being rotated by said pinions 41 and 42 about the axis of the shaft 35, said gears 46 and 47 being rotated by said gear 45 about the axis of the stub shaft 37, and said gear 48 being rotated by said gear 47 about the axis of the shaft 38.

Now referring particularly to Figs. 1 and 4, it is to be seen therein that the driven shaft 35 and the gear 43 which is freely mounted thereon cooperate to support one portion of the clutching mechanism for changing the speed of said shaft. This portion of said clutching mechanism comprises, an annular spool 49 which is telescopically arranged centrally about the shaft 35 and closed at one end by a wall 50 integral therewith, said wall and spool and the gear 43 being secured against relative rotation therebetween by riveting said wall and gear together. The internal peripheral wall of spool 49 is axially grooved, as at 51, at a pair of diametrically opposite positions, and in these grooves are fitted diametrically arranged fingers 52 formed on the outer peripheries of a plurality of spaced annular plates 53, said plates being smooth at their inner peripheries and disposed freely about the shaft 35 and operable, as is seen, for relative rotative and axial movements with respect to said shaft on account of the free connection therebetween, for relative axial movement with respect to said gear and said spool because of the spacing between said plates, and for rotation with said spool and gear in accordance therewith on account of the metal-to-metal contacts 51—52. Alternately spaced between the plates 53, and also mounted about the shaft 35, is another plurality of annular plates 54, plates 54 being distinguishable from plates 53 in that the former plates 54 are smooth at their outer peripheries to rotate relatively with respect to the gear 43, spool 49 and plates 53 and are notched at their inner peripheries, as at 55, for driven engagement with a splined portion 56 on the shaft 35 so as to rotate with said shaft and in accordance therewith and to move rotatively and axially relatively with respect to said gear, said spool and said

plates 53. In order to minimize the friction between the plates 53 and 54 when same are supposed to be separated during inoperation of the clutch, and in order to insure such separation upon intention toward such inoperation, either one of the two sets of said plates, plates 53 being shown in Fig. 4 for illustration, is provided on each of its constituents with a plurality of annularly spaced milled fingers 57 each of which is bent in the direction of the axis of shaft 35 outwardly from the plane of the plate proper to serve as a resilient means for opposing the contact between said plate and the plates 54 on opposite sides thereof.

The portion of the clutching mechanism which is also carried on shaft 35 and which selectively effectuates or ineffectuates the operation of the plates 53 and 54 comprises, as is particularly shown in Figs. 1 and 3, an annular clutch member 58 which is arranged on and about said shaft in splined engagement with the splined portion 56 thereof for rotation with said shaft and relative axial movement therealong toward and away from the end plate of the multi-plate clutching device just described. At a substantially central portion of the member 58 there is formed a circumferential groove 59 through the agency of which said member is axially driven, and on the end of said member adjacent the multiplate device there is integrally formed an annular flange 60 which abuts the adjacent end plate 53 of said device to compress the plates 53 and 54 thereof during operation of the clutch and which is separated therefrom during inoperation of the clutch. The opposite end of member 58 is integrally formed with a plurality of annularly spaced, axially directed jaw-clutch elements 61, and integrally formed on the periphery of member 58, intermediate the groove 59 and elements 61 thereof, is an annular shoulder 62 which serves as a backing means for a spring 63 telescopically arranged about the member 58 against and ahead of the shoulder 62. In view of the fact that there is relative rotation between the members which abut the opposite ends of the spring 63, it is preferable to provide that end of said spring which otherwise rests in direct contact with and against the shoulder 62 with a bearing-equipped cage member 64. It is seen in Fig. 1 that the spring 63 constrains the member 58 toward the multi-plate device, which means that the jaw-clutch elements 61 are normally out of engagement with their presently to be described mating jaw clutch elements. Since the purpose of the clutch which comprises the multi-plate device and the member 58 is to drive each together when desired, and since the plate which is engaged by the member 58 is the end plate 53 which rotates normally with the gear 43 and spool 49 rather than with the shaft 35 (with which the member 58 constantly rotates), it is preferable to provide on the plate-engaging face of member 58 a disc 65 of high coefficient of friction. This provision, together with the already mentioned provisions, render the clutch 49—53—54—58 highly effective.

The portion of the jaw clutch which is carried on the shaft 35 and which is cooperable with the jaw-clutch elements 61 on clutch member 58 comprises, an annular clutch member 66 which is freely mounted on the hub of the gear 44 and secured to said gear radially outwardly of said hub on the side of said gear adjacent the member 58 for rotative movement with said gear. It will be noted that, whereas clutch member 58 is splined to the shaft 35 for rotation therewith, the clutch member 66 is carried exclusively by the gear 44, which is freely mounted on said shaft, and is rotated only when said gear is rotated. As is shown in Figs. 1, 2 and 3, the means for holding the clutch member 66 and the gear 44 together constitute a series of annularly spaced pins 67 which are tightly fixed in openings provided therefor in said member and which extend therefrom loosely through openings 68 provided therefor in said gear. It will be noted that the openings 68 in gear 44 are larger in diameter than the pins 67 received therein, such provision permitting a slight and limited relative rotation between said gear and the member 66 during the engagement between the clutch members 58 and 66. It will also be noted that the clutch member 66 is constantly constrained toward the gear 44 supporting it by the spring 63 which abuts it. The end of the clutch member 66 adjacent the jaw-clutch elements 61 on clutch member 58 is integrally formed with a plurality of annularly spaced, axially directed jaw clutch elements 69 which are operable for being drivingly engaged by said elements 61 when desired. For opposing the aforementioned relative rotation between the clutch member 66 and gear 44, each pin 67 which is carried in said member for drivingly connecting said member and said gear together has connected thereto one end of one of a series of springs 70, the other end of each of said springs being anchored to one of a series of annularly spaced pins 71 fixedly mounted in said gear. In view of the fact that the gear 44 is continuously driven by the pinion 42, the rotation of gear 44 being shown for illustrative purposes as rotating in a clockwise direction when viewed in Figs. 2 and 3 and when looking from left to right in Fig. 1, and in view of the fact that the clutch members 58 and 66 and shaft 35 also rotate in said clockwise direction when said members 58 and 66 are inter-engaged, tension is placed on the springs 70 while said members 58 and 66 are being engaged and said springs tend to absorb the shock of said engagement as well as permit slight rotary play between said members thereupon.

The transmission of the laundry machine is shown in Fig. 1 as being in position for driving the shaft 35 (and tub 15) at drying speed, that is, the faster of the two speeds capable of being employed by said machine, because of the engagement shown therein between the clutch member 58 and the multi-plate device 49—53—54 (to which the gear 43 is permanently attached). This faster speed is due, of course, to the favorable relation between the diameters of the pinion 41 and gear 43. While in this position and during the drying interval, the clutch members 58 and 66 are out of engagement, the clutch member 66 and gear 44 are rotating together idly about the axis of shaft 35 because of the continuous driving engagement between the pinion 42 and said gear 44, and the tub 15 and said shaft 35 are driven at substantially the same speed as that of the drive shaft 33 because of the positive engagement between the pinion 41 and the gear 43, the positive engagement between said gear 43 and the multi-plate device 49—53, the positive engagement between the plates 54 of the multiplate device and said shaft 35, and the compression of the plates 53 and 54 caused by said clutch member 58 which is splined to said shaft 35. The slower, or washing, speed of the transmission, on the other hand, is attained

when the multi-plate clutch device 49—53—54 and the clutch member 58 are out of engagement and the clutch members 58 and 66 in engagement through the agency of the jaw-clutch elements 61 and 69 thereof, the means for attaining such engagement being presently described and it being sufficient to say at present that such engagement is opposed by the spring 63 and the shock thereupon and otherwise possible damage to said elements being substantially absorbed and eliminated by the springs 70. This engagement between the clutch members 58 and 66 through their elements 61 and 69 drives the shaft 35 and tub 15 at a speed well below that of the speed of the shaft 33 because of the relationship between the diameters of the pinion 42 and the gear 44 and the constant driving engagement between said pinion and gear. While in this washing position, the gear 43 and multi-plate clutch device attached thereto are rotating idly about the axis of the shaft 35, said device and the clutch member 58 are out of engagement, said member 58 is in metal-to-metal contact with the clutch member 66, and said shaft 35 and the tub 15 are driven at this washing speed because of the constant engagement between the pinion 42 and the gear 44, the substantially rigid connection between said gear 44 and said clutch member 66, the metal-to-metal contact between said member 66 and said member 58, and the splined engagement between said member 58 and said shaft 35.

The shifting mechanism for the clutch member 58 comprises, in part, and as shown in Figs. 1 and 3, a transverse shaft 72 which is arranged between the shafts 35 and 38 and journaled or otherwise supported at its ends in the front and rear walls of the housing member 18. Shaft 72 pivotally carries a pair of yokes 73 and 74, the upper yoke 73 being so carried by said shaft near the lower ends of its bifurcations and the lower yoke 74 being so carried by said shaft near the upper ends of its bifurcations. The lower ends of the bifurcations of yoke 74 are provided with pins or rollers 75 which fit into the circumferential groove 59 on the clutch member 58 for axially driving the latter toward and away from the adjacent clutch members on the shaft 35, and the upper end of the yoke 73 is provided with a cam follower 76 through which, as will soon be described, the two yokes 73 and 74 are oscillatably driven about the axis of the transverse shaft 72. Yoke 74 is also provided, above the pins or rollers 75, with pins 77 which are arranged adjacent the lower ends of the bifurcations of yoke 73 and operable for reception in arcuate recesses 78 formed therein. In other words, though the yokes 73 and 74 are operable for the most part for oscillatory movement together about the axis of shaft 72, the provision of the play connection between said yokes by means of the pins 77 on one and the slots 78 on the other permits a slight relativity in movement therebetween. This relativity in movement between the yokes 73 and 74 is provided because of the fact that there is no play between the yoke 73 and the means which drives it and because of the necessity in many instances for a slight relative rotation between the jaw-clutch elements 61 and 69 before same become positively engaged, it being remembered that the yoke 74 is the shifting agency for the clutch member 58 carrying the elements 61. A pair of relatively hard rubber cushions 79 is secured to and provided between the upper ends of the yokes 73 and 74 to oppose the relative motion therebetween and cause said yokes to move together and still to permit said relative motion when necessary.

It will be noted in Fig. 1 that the shaft 38 is rotated continuously by and simultaneously with the shaft 33 but at a much lower speed because of the small diameter of each of the driving gears 42, 45 and 47 as compared with the large diameter of each of the respective driven gears 44, 46 and 48. A portion of this shaft 38 is axially splined at its periphery, as at 80, and drivingly carries thereon an internally splined annular jaw clutch member 81. Member 81 is provided at its single working face with axially directed jaw-clutch elements 82 and intermediate its ends with a circumferential groove 83, said member being rotatable with the shaft 38 and axially slidable along the splined portion 80 thereon, said member being limited in said axial movement in one of its two directions by the hub of gear 48. Whereas the end of shaft 38 which carries the gear 48 is journaled in the bearing 27 provided therefor in the housing member 22, the opposite end of said shaft, though carried in the bearing 27 provided therefor in the housing member 18, is directly supported within a bushing 84 which is press fitted into said latter bearing or otherwise non-rotatively held. Between the inner end of the bushing 84 and the spline 80 on shaft 38 there is carried on said shaft a sleeve 85, said sleeve being held against axial movement along said shaft by means of said bushing and the annular shoulder formed by said spline, and said sleeve being held against rotation with said shaft by means of a positive male and female connection 86 (see Fig. 5 particularly) formed at the co-engaging ends of said bushing and said sleeve. Freely mounted about the sleeve 85 is an annular jaw clutch member 87 which is formed with axially directed jaw-clutch elements 88 engageable under certain conditions with the elements 82 on member 81 to be driven thereby. Between the clutch members 81 and 87 there is provided a spring 89 which is telescopically arranged about the shaft 38 and opposes the engagement between the clutch elements 82 and 88.

The purpose of providing the sleeve 85 and insuring its non-rotation by means of the locking connection 86 between said sleeve and the bushing 84 is so that the clutch member 87, which is freely mounted on said sleeve, will remain substantially idle and be non-rotative during inoperation of the clutch 81—87. This caution is taken in view of the constant rotation of the shaft 38, and more favorable control of the transmission 17 is obtained by the mounting of the clutch member 87 on the stationary sleeve 85 rather than by the free mounting of the member 87 directly on the shaft 38.

It will be noted in Figs. 1 and 5 that the face of clutch member 87 opposite the face thereof carrying the elements 88 is provided with an annular cam formation the high portion of which being shown at 90 and the low portion of which being shown at 91 and the camming action of which portions being in the direction of the axis of shaft 38. Cam portions 90 and 91 gradually merge with each other to form a continuous, annular camming surface the high portion 90 of which is cooperable with the cam follower 76 on the yoke 73, as viewed in Fig. 1, to move said yoke counter-clockwise about the axis of the

transverse shaft 72, the yoke 74 being substantially simultaneously moved counter-clockwise about said axis to throw the clutch member 58 on the shaft 35 out of the position at present shown in Fig. 1 into clutching engagement with the clutch member 66. During the adjacency of the cam follower 76 and the low portion 91 of the camming surface on member 87 the clutch member 58 is maintained in or returned to the position thereof shown in Fig. 1 through the spring pressure thereupon of spring 63.

Axial movement of the clutch member 81 toward and away from the clutch member 87 along the splined portion 80 of shaft 38 is effectuated through the agency of an L-shaped forked member 92 which is provided at its forked end with a pair of opposed pins 93 in driving engagement with the groove 83 on said member 81 and which is arranged with the other end extending substantially parallel with the axis of said shaft 38, said member 92 being pivoted intermediate its ends to a bracket 94 for movement about the vertical axis of a pivot pin 95, said bracket 94 being rigidly anchored to the inner wall of the housing member 18, as shown in Fig. 5. It will be seen, when viewed in Fig. 5, that clockwise movement of the member 92 about the vertical axis of pin 95 causes the clutch member 81 to move along the spline 80 on shaft 38 into driving engagement with the clutch member 87, said clockwise movement being opposed by the spring 89 which is arranged between said clutch members 81 and 87. It will likewise be seen that the member 92 is normally held in the position shown in Fig. 5 by the spring 89, or that said member is returned to such position automatically by said spring after the above-mentioned counter-clockwise movement of said member.

The free end of the pivoted clutch shifter 92 is pivotally connected, by means of a pivot pin 96, to the outer end of a plunger 97, said plunger being one of the elements embodied in the control mechanism 21. Plunger 97 is reciprocably mounted in a cylindrical, non-magnetic sleeve 98, said sleeve passing outwardly through and being rigidly supported by a hollow nut 99 which is threadedly secured in a threaded opening provided therefor in the wall of housing member 18 adjacent the pivoted connection between said plunger and the shifter 92, as shown in Fig. 5. Freely mounted about the sleeve 98 adjacent the forward face of the nut 99 is an annular plate 100, and fixedly mounted on the inner peripheral wall of said sleeve at the other end thereof is held a stationary magnetic core 102 in magnetizing relationship with the free end of the plunger 97. Properly arranged with respect to the core 102 is a magnetizing coil 103 having lead wires 104 and 105 which pass through an opening provided therefor in a solenoid casing 106, said casing being operable for housing the solenoid 97—102—103, and having a fitting engagement with the plate 100, a screw 107 being employed for stationarily holding said casing into threaded engagement with said core 102 which is stationarily held in place by said sleeve 98. Though the energization of the solenoid is to be explained in detail, it is readily seen that the magnetization of the core 102 causes the plunger 97 to be drawn inwardly along the sleeve 98 into the solenoid toward said core, this inward movement of said plunger causing the L-shaped clutch shifter 92 to move clockwise about its pivot 95 against the pressure of spring 89 and force the rotating clutch member 81 into clutching engagement with the idle clutch member 87. Of course, this effectuation of clutching between members 81 and 87 is simultaneous with the disengagement of the multi-plate clutch member 49—53—54 and clutch member 58 and the engagement between the clutch members 58 and 66 to change the rotative speed of the tub-carrying shaft 35 from drying, or its faster, speed to washing and/or rinsing, or its slower, speed, through the inter-engagement of the follower 76 and high cam surface 90.

Returning to the normally idle clutch member 87 on the shaft 38, as shown in Figs. 1 and 3, said member has fixed thereon for rotation therewith an annular cam 108 having formed on its periphery a plurality of circumferentially spaced high points 109 and 110, preferably the number of said high points shown being two and the spacing therebetween being 180°. In cooperative engagement with the cam 108 for being reciprocably driven thereby along a vertical axis is a cam follower 111, said follower being freely received within a vertical opening provided therefor in the upper wall of the housing member 18, the lower end of said follower being in driven engagement with said cam, and the upper end of said follower being in driving engagement with an insulated portion of the under surface of a resilient conductor 112. Conductor 112 is anchored at one of its ends to and insulated from the upper wall of the housing member 18 in spaced relation to the driving end of the cam follower 111 and is provided at its free end with a contact point 113. Anchored also to and insulated from the upper wall of housing member 18 in proximity to and insulated from the conductor 112 is another conductor 114, said conductor 114 being provided at the end thereof adjacent the free end of conductor 112 with another contact point 115. The resiliency of conductor 112 normally constrains said conductor toward the other conductor 114 so as to inter-engage the contact points 113 and 115 thereon, and this inter-engagement occurs and exists when the cam follower 111 is in its lower position, that is, when the circumferential portions of the cam 108 between the high points 109 and 110 thereon are riding on the lower end of said follower. Upon the engagement of either of the high points 109 and 110 on cam 108 with the lower end of follower 111, on the other hand, said follower is raised against the resilient force of the conductor 112 and the contact points 113 and 115 are, as a result, separated.

As will be seen in the wiring diagram shown in conjunction with Fig. 1, the spring conductor 112 is electrically connected directly to the lead wire 104 of the solenoid coil 103 by a wire 116, that the other conductor 114 is electrically connected directly to one side of the power source for the energization of the solenoid 97—102—103 by a wire 117, and that the other side of said power source is electrically connected directly to the other lead wire 105 of said solenoid coil by a wire 118. The resulting circuit, therefore, is 118—105—103—104—116—112—114—117, and this circuit is either made or broken at the contact points 113 and 115 on conductors 112 and 114, or by a master switch 119. As shown in Fig. 1, this circuit is open, the clutch members 81 and 87 on shaft 38 are out of engagement, the friction clutch members 49—53—54 and 58 on shaft 35 are in engagement and the shaft 35

is being rotated at its faster speed, the drying speed.

To continue with the description of the above mentioned wiring diagram, there is shown a driving motor 120 connected across the power source for the solenoid 97—102—103, said motor being driven independently of the opening or closing of the switch 112, 113, 114, 115 but preferably dependently upon the switch 119. Motor 120 is operable for driving in accordance therewith any one of the numerous types of well known timing devices 121, said device being shown, preferably for the purpose of illustration, with two circumferentially spaced high points 122 and 123, the spacing between points 122 and 123 in a counterclockwise direction representing the time required by or alloted to the drying phase of the transmission 17, that is, the phase or phases during which the transmission drives the shaft 35 at the faster of its two speeds, and the spacing between points 123 and 122 in a counter-clockwise direction representing the time required by or alloted to the washing phase of the transmission 17, that is, the phase or phases during which the transmission drives the shaft 35 at the slower of its two speeds, such as during washing, rinsing, water changes, etc.

Connected across the wires 116 and 117, by wires 124 and 125, respectively, is a switch 126 having the usual contact arms 127 and 128, said arms being normally separated to provide an open circuit through said switch, said arm 127 being cooperable at different times with the high points 122 and 123 on the timer 121 to close the circuit through said switch, and the closing of said switch on either occasion being only momentarily.

It has been said that the circuit 118—105—103—104—116—112—114—117 is open in the showing in Fig. 1 and that the shaft 35 is rotating at the faster of its two speeds. At this same time, the clutch member 81 is rotating with the shaft 38, the clutch member 87 is non-rotatively stationary on said shaft 38, cam follower 111 is in the higher of its two positions because of its contact with the high point 109 on cam 108, cam follower 76 and the low portion 91 of the cam surface on clutch member 87 are adjacent each other, and, though the switch 126 is open, the timing device 121 is being slowly, though continuously, rotated in a counterclockwise direction by the motor 120 with its high point 122 gradually approaching the position whereat the contact arm 127 of said switch will be impressed upwardly into contact with the arm 128 to close said switch. The solenoid 97—102—103, as shown in Fig. 1, is not being energized because neither the switch 126 nor the herein referred to circuit is closed.

When the motor 120 has driven the timer 121 counterclockwise to such an extent that the high point 122 on the latter engages and raises the arm 127 of the switch 126, said switch is thereby closed and energizing current is caused to flow through the solenoid coil 103 to magnetize the solenoid core 102 and retract the plunger 97 (see Fig. 5), whereupon the rotating clutch member 81 on shaft 38 engages and drives the clutch member 87. As will be explained, this rotation of member 87 is for only one-half revolution, but during such partial movement, the cam follower 111 lowers to its lower position and causes the engagement between the contact points 113 and 115 on conductors 112 and 114, and the high portion 90 of the cam surface on clutch member 87 engages the cam follower 76 and drives the yokes 73 and 74 counter-clockwise about the pivot 72 to disengage the clutch members 49—53—54 and 58 on shaft 35 and to engage the clutch members 58 and 66, thereby causing the shaft 35 to be driven at the slower of its two speeds. The circuit for initiating the energization of the solenoid 97—102—103, and which is closed by the closing of the switch 126, is 118—105—103—104—116—124—128—127—125—117, and this circuit is closed for a shorter length of time than that which is required for one-half revolution of the clutch member 87.

Though the opening of the energy initiating circuit 118—105—103—104—116—124—128—127—125—117 for the solenoid 97—102—103 occurs, by the movement of the high point 122 on timer 121 past the contact arm 127 of switch 126, much earlier than the arrival of the high point 110 on cam 108 at the follower 111, the energization of said solenoid continues until said high point 110 reaches said follower because of the energy continuing circuit 118—105—103—104—116—112—114—117 for said solenoid having been closed by the engagement of the contact points 113 and 115 on conductors 112 and 114. This means that the clutch member 81 is positively kept in clutching engagement with the clutch member 87 by the cooperation between the solenoid plunger 97 and the shifter 92. When the half-revolution of clutch member 87 is completed, that is, when the high point 110 reaches the follower 111, the above mentioned energy continuing circuit for the solenoid will be broken at 113, 115 and the solenoid plunger will be protracted by the action of the spring 89, thereby disengaging the clutch members 81 and 87. However, by this time, the high portion 90 of the cam surface on member 87 will be adjacent the cam follower 76 and will positively hold the clutch members 58 and 66 in engagement with each other until the high point 123 on timer 121 reaches the position for engagement with the arm 127 of switch 126.

The closing of the switch 126 by the high point 123 on timer 121 re-closes the energy initiating circuit for the solenoid, and the clutch members 81 and 87 are thereby re-engaged, the beginning of the resulting half-revolution of rotation of the member 87 not only re-closing the energy continuing circuit for the solenoid but dis-engaging the clutch members 58 and 66 and permitting the re-engagement between the clutch members 58 and 49—53—54 through the action of the spring 63, so that the shaft 35 is thereupon driven at the faster of its two speeds. The high point 123 on timer 121 passes beyond the switch arm 127, thereby re-opening the energy initiating circuit for the solenoid, before the high point 109 on cam 108 reaches the follower 111 to re-open the energy continuing circuit for the solenoid. Upon the arrival of the high point 109 on cam 108 at follower 111, the clutch member 81 is thrown out of engagement with the clutch member 87 by the de-energization of the solenoid and the action of the spring 89, but the clutch members 49—53—54 and 58 remain in engagement with each other, notwithstanding the then adjacency of the cam follower 76 to the low portion 91 of the cam surface on member 87, by means of the spring 63. The shaft 35 continues to rotate at the faster of its two speeds until the high point 122 on the timer 121 reaches the switch arm 127, after which the shaft alternately rotates at its slower and faster speeds in the above and clearly described manners.

Although the invention has been described with some detail it is not intended that such description is to be definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will come within the purview of the attached claims.

What I claim is:

1. In a laundry machine having clutch means and shifting means therefor, a rotatable actuator for intermittently shifting the shifting means, means for rotating said actuator, electrically operated means for actuating said last-mentioned means, switch means for intermittently energizing said electrically operated means, and switch control means fixed to said actuator for movement therewith and operatively connected to said switch means.

2. In a laundry machine having clutch means and shifting means therefor, a rotatable actuator for intermittently shifting the shifting means, means for rotating said actuator, electrically operated means for actuating said last mentioned means, switch means for intermittently energizing said electrically operated means, switch control means fixed to said actuator for movement therewith and operatively connected to said switch means, and time control means for controlling said electrically operated means.

3. In a laundry machine having clutch means and shifting means therefor, a rotatable member having a camming surface cooperable with the shifting means for intermittently shifting the latter, means for rotating said member, electrically operated means for actuating said last mentioned means, switch means for intermittently energizing said electrically operated means, and a second member integral with said first member for movement therewith and having a camming surface operatively connected to said switch means.

4. In a laundry machine having clutch means and shifting means therefor, a rotatable member having a camming surface cooperable with the shifting means for intermittently shifting the latter, means for rotating said member, electrically operated means for actuating said last mentioned means, switch means for intermittently energizing said electrically operated means, a second member integral with said first member for movement therewith and having a camming surface operatively connected to said switch means, and time control means for controlling said electrically operated means.

5. In a laundry machine having clutch means and shifting means therefor, a rotatable actuator having a camming surface cooperable with the shifting means for intermittently shifting the latter, means for rotating said actuator, electrically operated means for actuating said last mentioned means, a time control in circuit with said electrically operated means and operable at predetermined periods for energizing said electrically operated means, a cam rotatable with said actuator, and a second control operatively connected to said cam for controlling said circuit to control said rotation of said actuator.

6. In a laundry machine having clutch means and shifting means therefor, a driven shaft, a rotatable actuator carried on said shaft and having a camming surface cooperable with the shifting means for intermittently shifting the latter, means for unitarily rotating said shaft and said actuator, electrically operated means for actuating said last mentioned means, switch means for intermittently energizing said electrically operated means, means between said shaft and said actuator for limiting the rotation of the latter to the intermittent periods of said energization, and means operatively connecting said actuator and said switch means.

7. In a laundry machine having clutch means biased in one direction and shifting means therefor, a mechanism for actuating the shifting means and comprising, a pair of normally disengaged clutch members operable when engaged for being rotated one by the other, a cam rotatable dependently upon the rotation of said driven clutch member and operable for actuating the shifting means to move the clutch means in a direction opposite the direction toward which same is biased, means operable for interengaging said clutch members, and a second cam rotatable dependently upon the rotation of said first cam for effectuating intermittent operation of said last mentioned means.

8. In a laundry machine having clutch means biased in one direction and shifting means therefor, a mechanism for actuating the shifting means and comprising, a pair of normally disengaged clutch members operable when engaged for being rotated one by the other, a cam rotatable dependently upon the rotation of said driven clutch member and operable for actuating the shifting means to move the clutch means in a direction opposite the direction toward which same is biased, means operable for interengaging said clutch members, a control for said last mentioned means, and a second cam rotatable dependently upon the rotation of said first cam for controlling said control to effectuate intermittent operation of said last mentioned means.

9. In a laundry machine having a rotatable tub-carrying shaft with a clutch mechanism associated therewith and operable for controlling the rotative speed thereof, shifting means cooperable with the clutch mechanism and movable between a pair of predetermined limit positions for controlling the operation thereof, a pair of inter-engageable though normally separated clutch members the first of which being continuously rotatable and the second of which being rotatable dependent upon its engagement with said first clutch member, a pair of cam means rotatable unitarily but dependent upon the rotation of said second clutch member, one of said cam means being cooperable with said shifting means during its rotation for effectuating the movement thereof from one of said limit positions to the other, actuating means for interengaging said clutch members, and means operable in accordance with the rotation of said other cam means for controlling said actuating means.

10. In a laundry machine having clutch means and shifting means therefor, an actuator having an axis of rotation and being integrally formed with a pair of camming surfaces each of which has a high portion and a low portion, one of said camming surfaces being cooperable with the shifting means and effective by means of its high and low portions for instituting clutch engagement and dis-engagement, electrically operated means for moving said actuator about said axis, switch means in circuit with said electrically operated means for controlling energization and de-energization of the latter, and a follower operatively inter-engaging said switch means and the other of said camming surfaces and effective

by means of the high and low portions of the latter for opening and closing said switch means.

11. In a laundry machine having clutch means and shifting means therefor, an actuator having an axis of rotation and being integrally formed with a pair of camming surfaces each of which has a high portion and a low portion, one of said camming surfaces being cooperable with the shifting means and effective by means of its high and low portions for instituting clutch engagement and dis-engagement, electrically operated means for moving said actuator about said axis, switch means in circuit with said electrically operated means for controlling energization and de-energization of the latter, and a follower operatively inter-engaging said switch means and the other of said camming surfaces and effective by means of the high and low portions of the latter for opening and closing said switch means, the high portion of one of said surfaces being so arranged with respect to the low portion of the other of said surfaces as to be effective simultaneously therewith.

12. In a laundry machine having clutch means and shifting means therefor, an actuator having an axis of rotation and being integrally formed with a pair of camming surfaces one of which has a high portion and a low portion and the other of which has a pair of high portions and a pair of low portions, one of said camming surfaces being cooperable with the shifting means and effective by means of its high and low portions for instituting clutch engagement and dis-engagement, electrically operated means for moving said actuator about said axis, switch means in circuit with said electrically operated means for controlling energization and de-energization of the latter, and a follower operatively inter-engaging said switch means and the other of said camming surfaces and effective by means of the high and low portions of the latter for opening and closing said switch means.

13. In a laundry machine having clutch means and shifting means therefor, an actuator having an axis of rotation and being integrally formed with a pair of camming surfaces one of which has a high portion and a low portion and the other of which has a pair of high portions and a pair of low portions, one of said camming surfaces being cooperable with the shifting means and effective by means of its high and low portions for instituting clutch engagement and dis-engagement, electrically operated means for moving said actuator about said axis, switch means in circuit with said electrically operated means for controlling energization and de-energization of the latter, and a follower operatively inter-engaging said switch means and the other of said camming surfaces and effective by means of the high and low portions of the latter for opening and closing said switch means, said pair of high portions being so arranged with respect to the first mentioned high and low portions as to be individually effective simultaneously therewith.

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