

Nov. 16, 1948.

G. C. GRAHAM

2,453,707

AUTOMATIC WASHING MACHINE

Original Filed July 25, 1939

9 Sheets-Sheet 1

FIG. 1

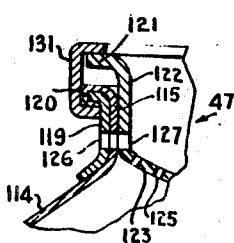
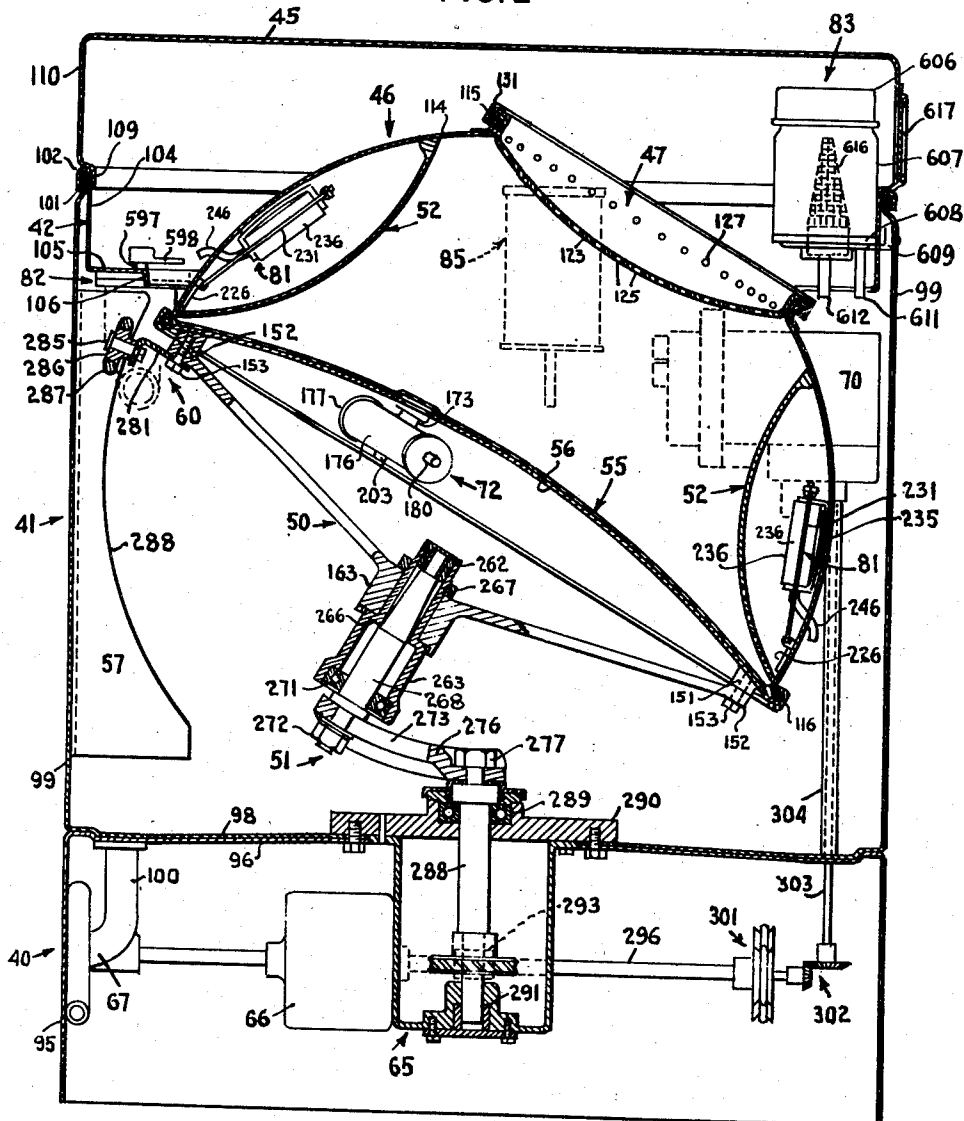


FIG. 3

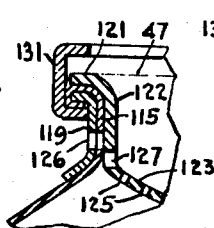
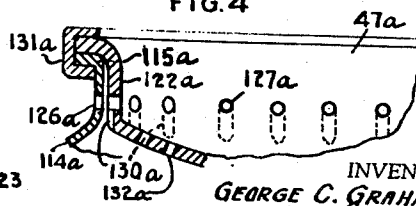


FIG. 4



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FIG. 5

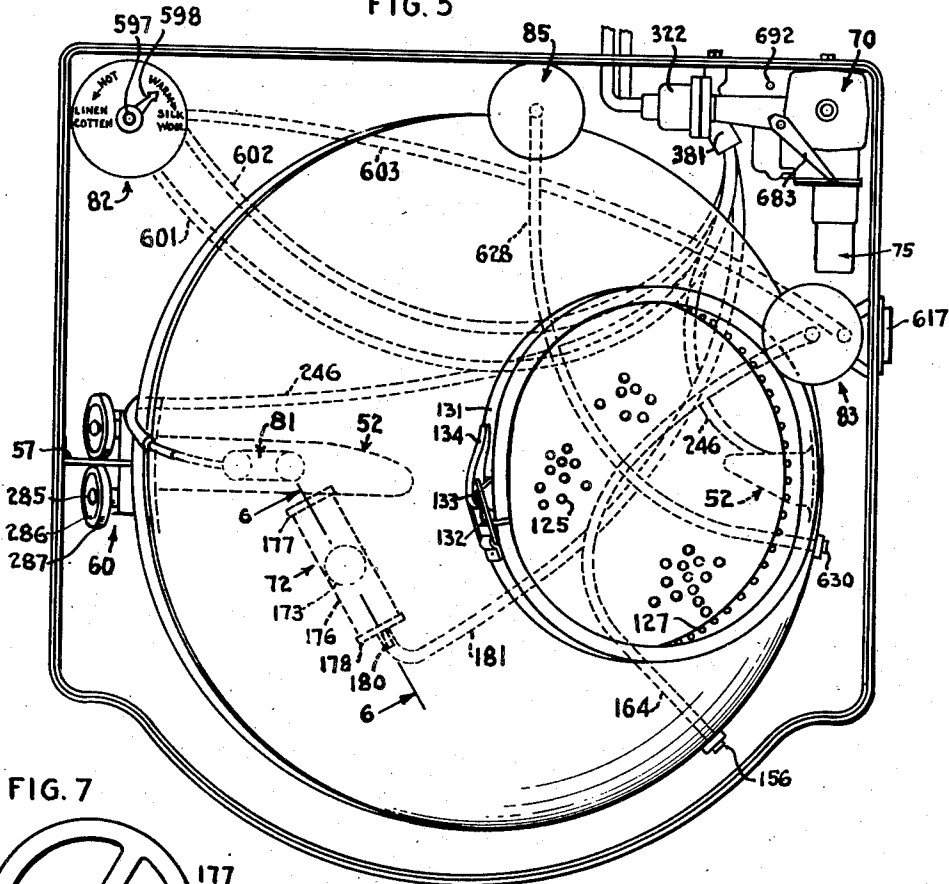


FIG. 7

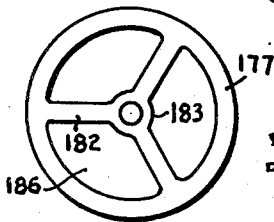
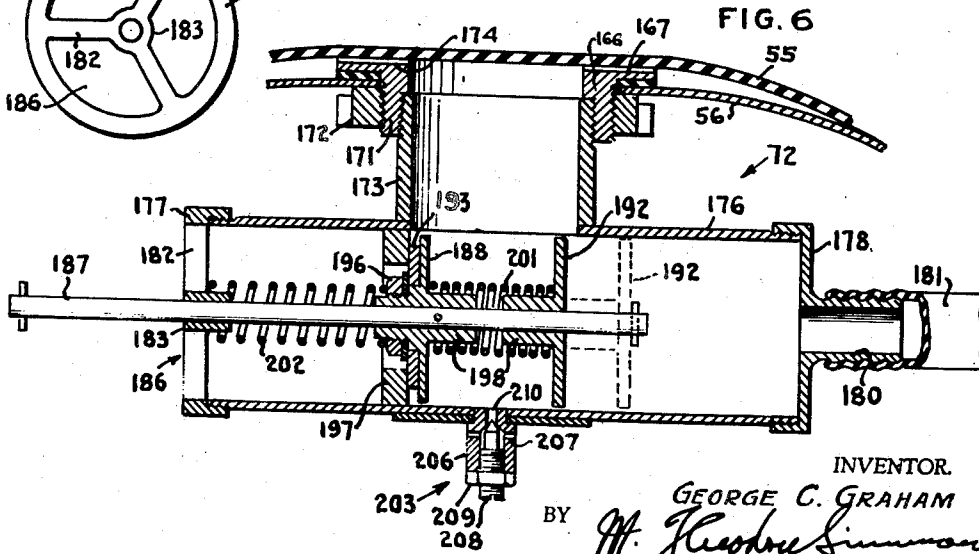


FIG. 6



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FIG. 8

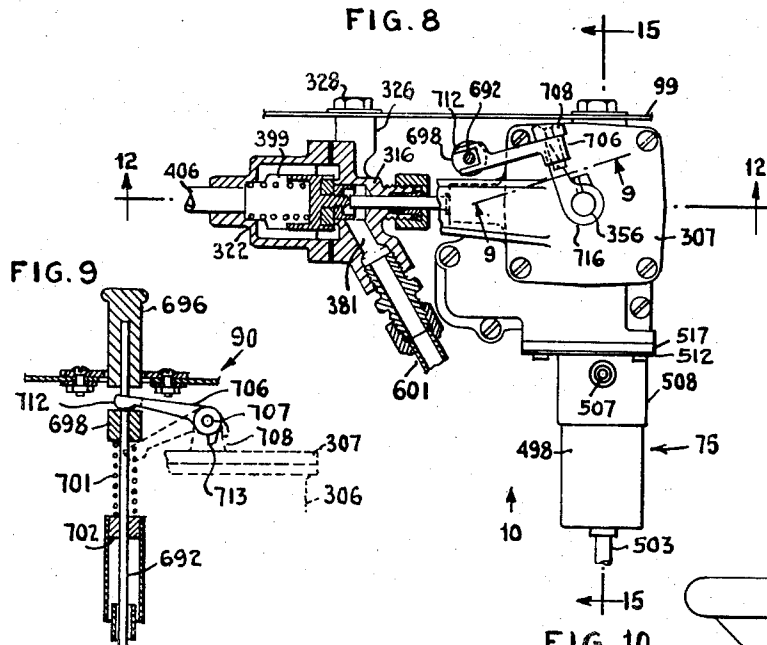


FIG. 10

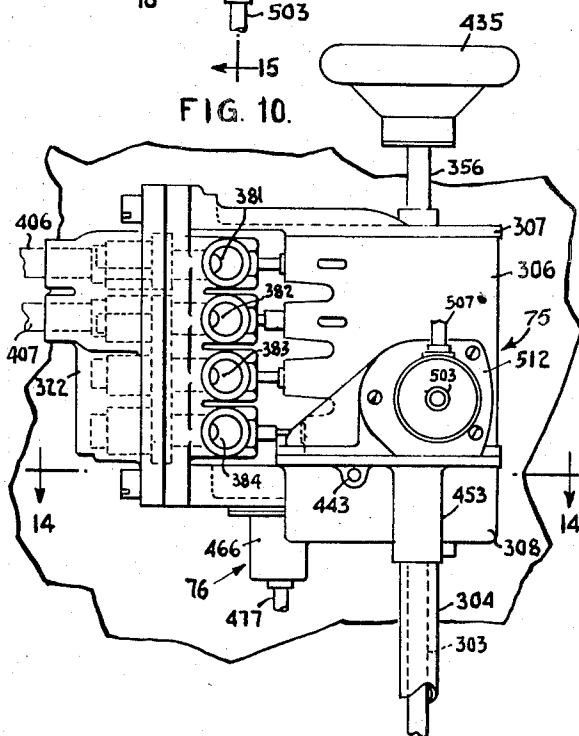
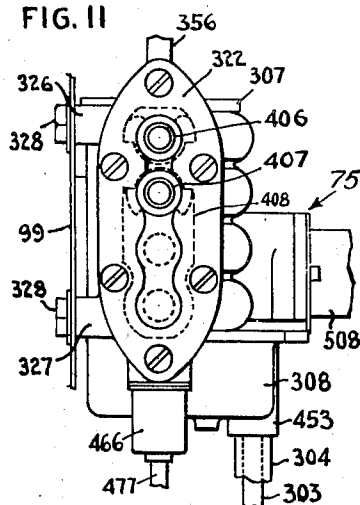


FIG. 11



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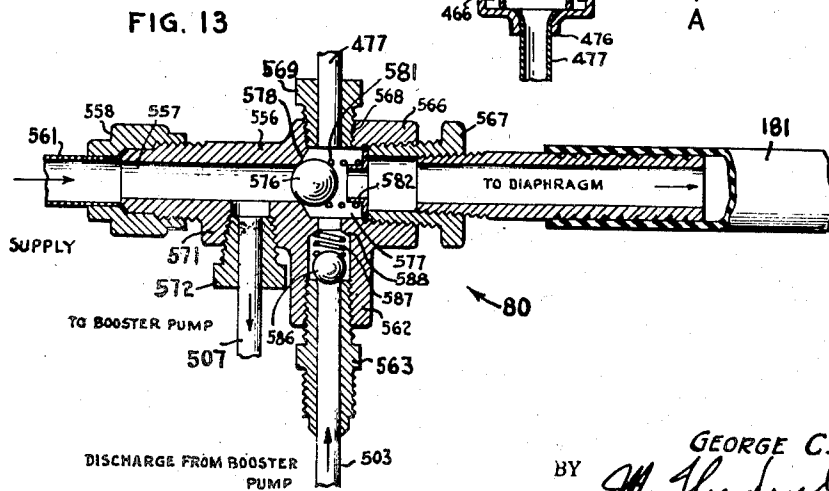
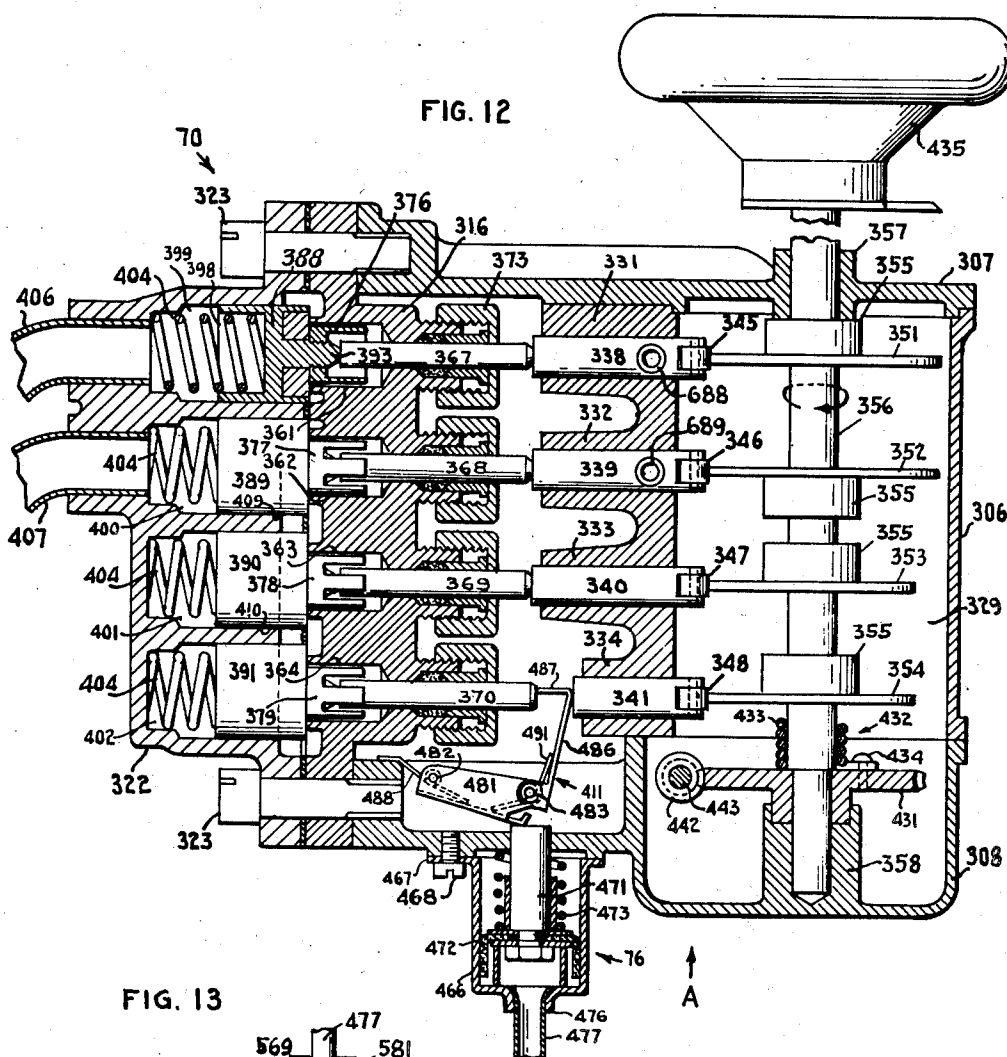
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FIG. 14

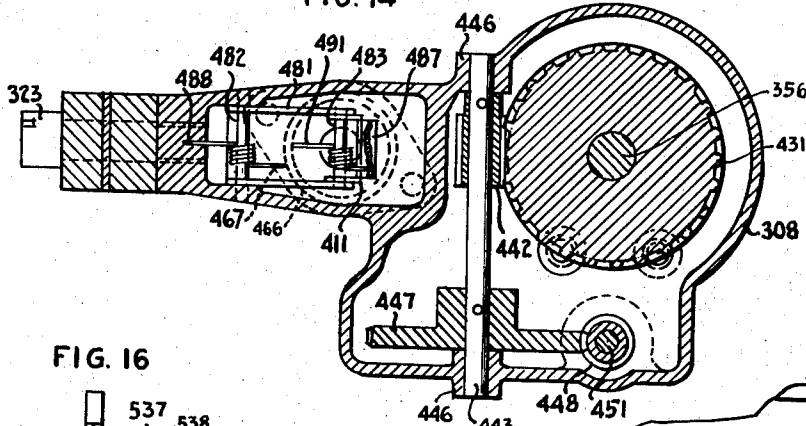


FIG. 16

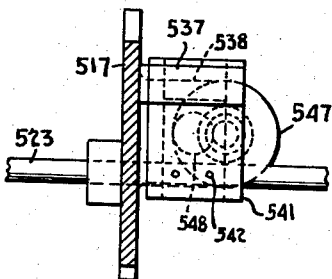


FIG. 15

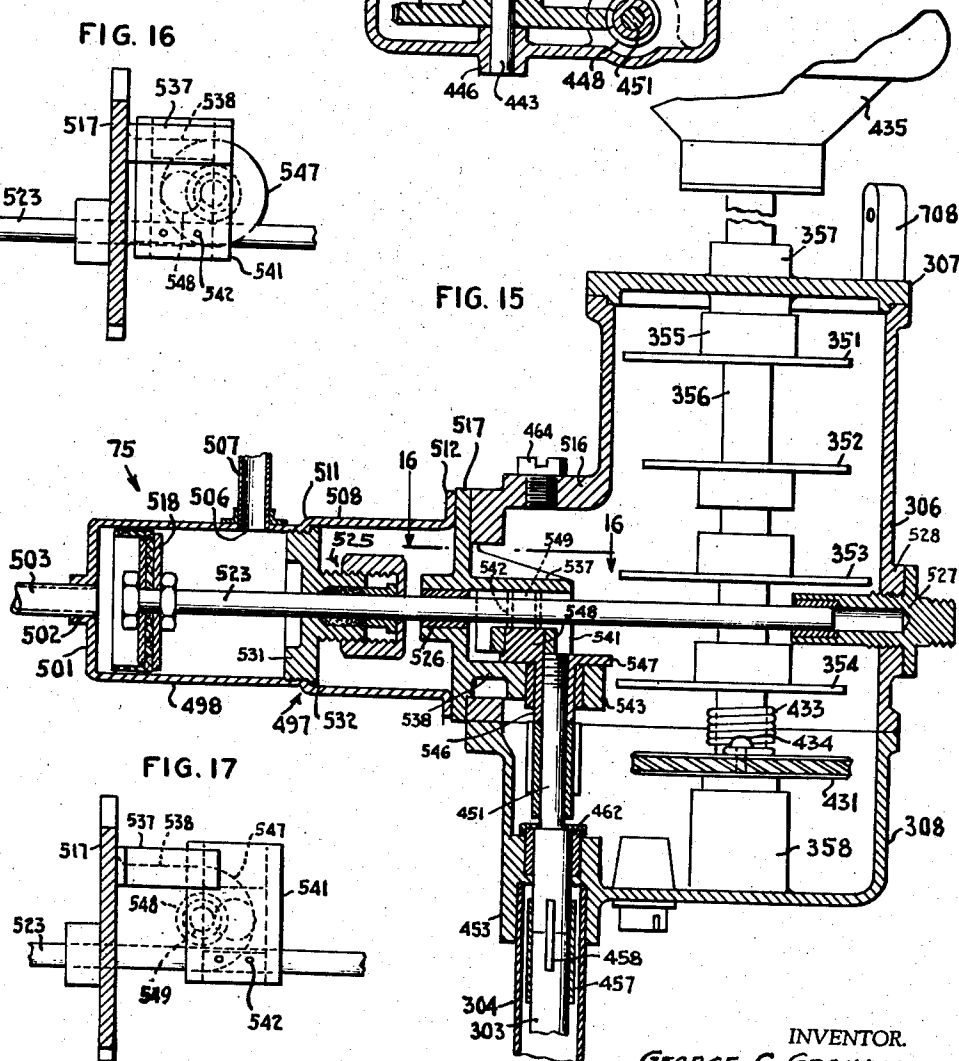
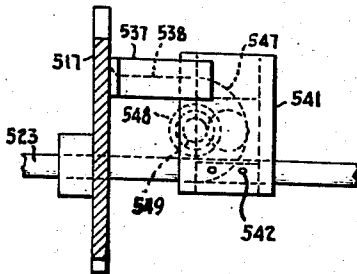


FIG. 17



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FIG. 18

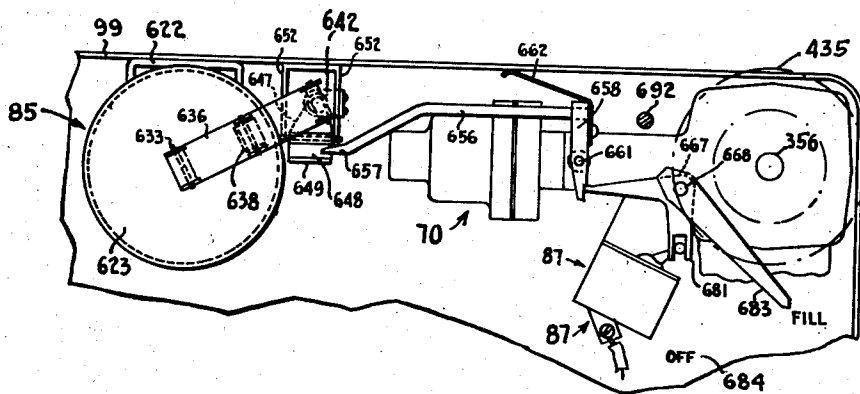


FIG. 19

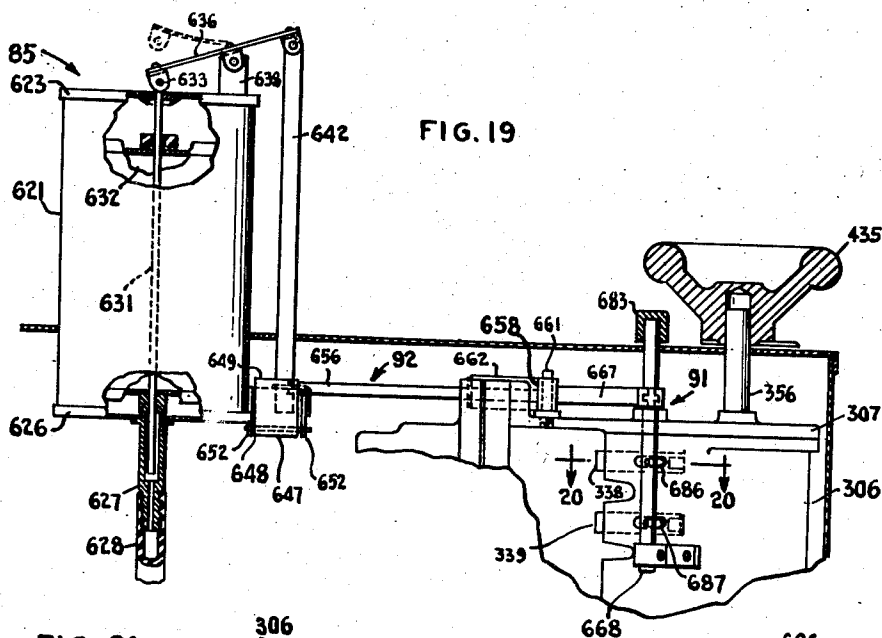


FIG. 20

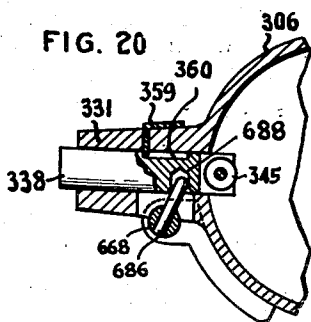
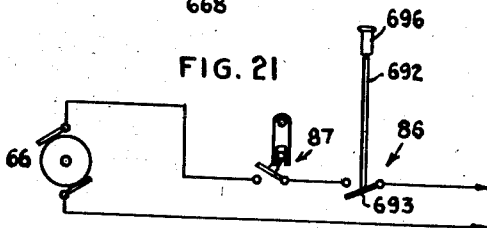


FIG. 21



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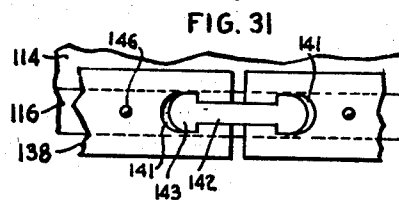
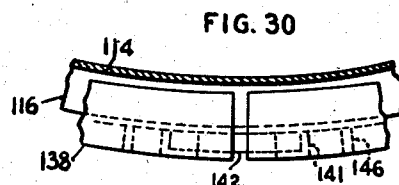
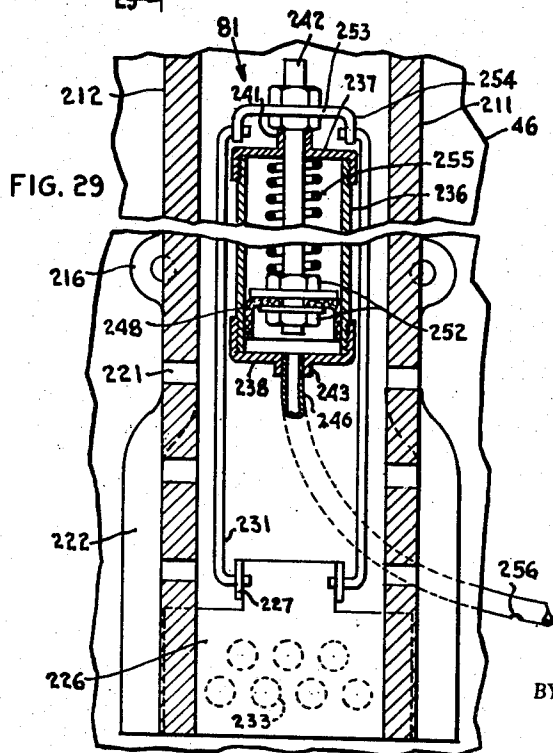
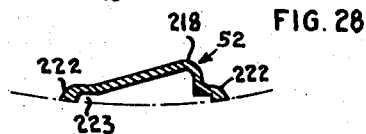
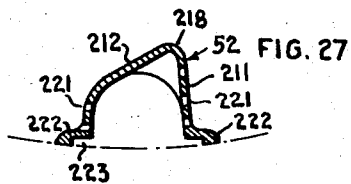
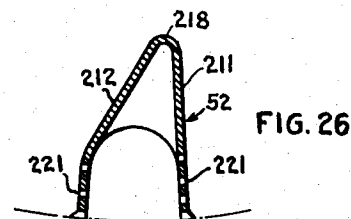
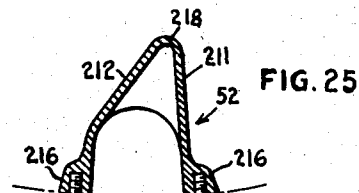
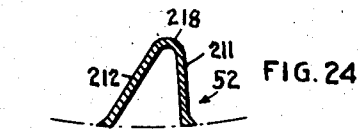
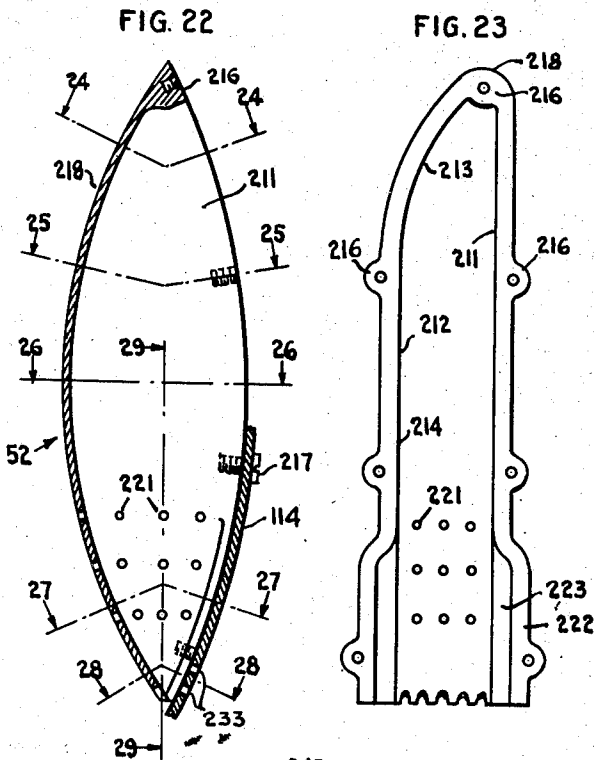
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AUTOMATIC WASHING MACHINE

Original Filed July 25, 1939

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Original Filed July 25, 1939

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FIG. 32

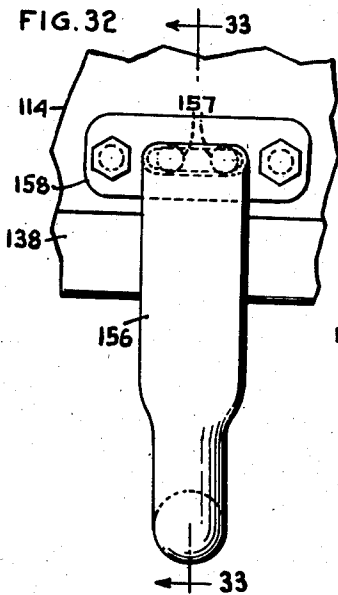


FIG. 33

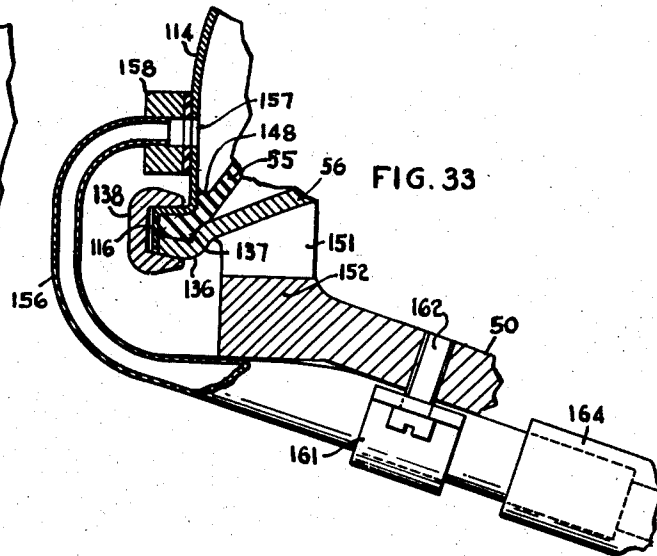


FIG. 34

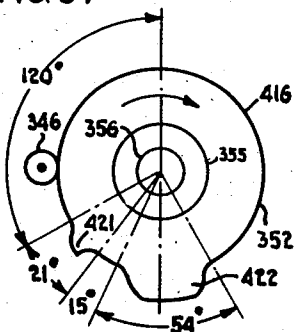


FIG. 35

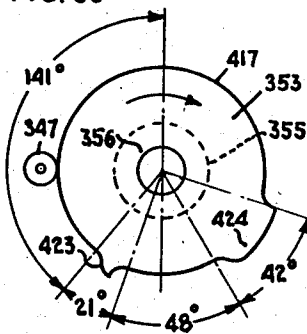


FIG. 36

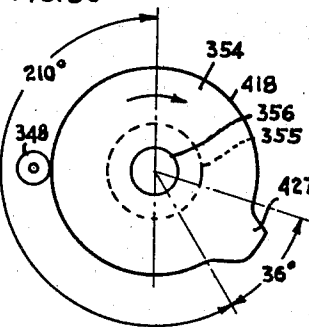


FIG. 37

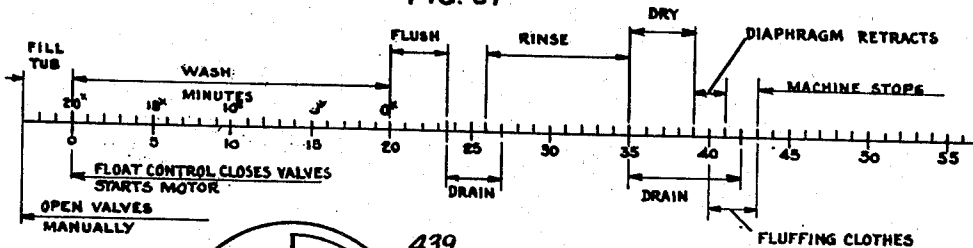
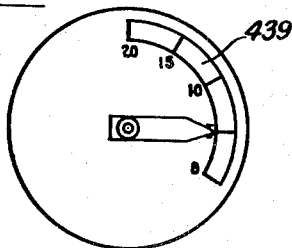


FIG. 38



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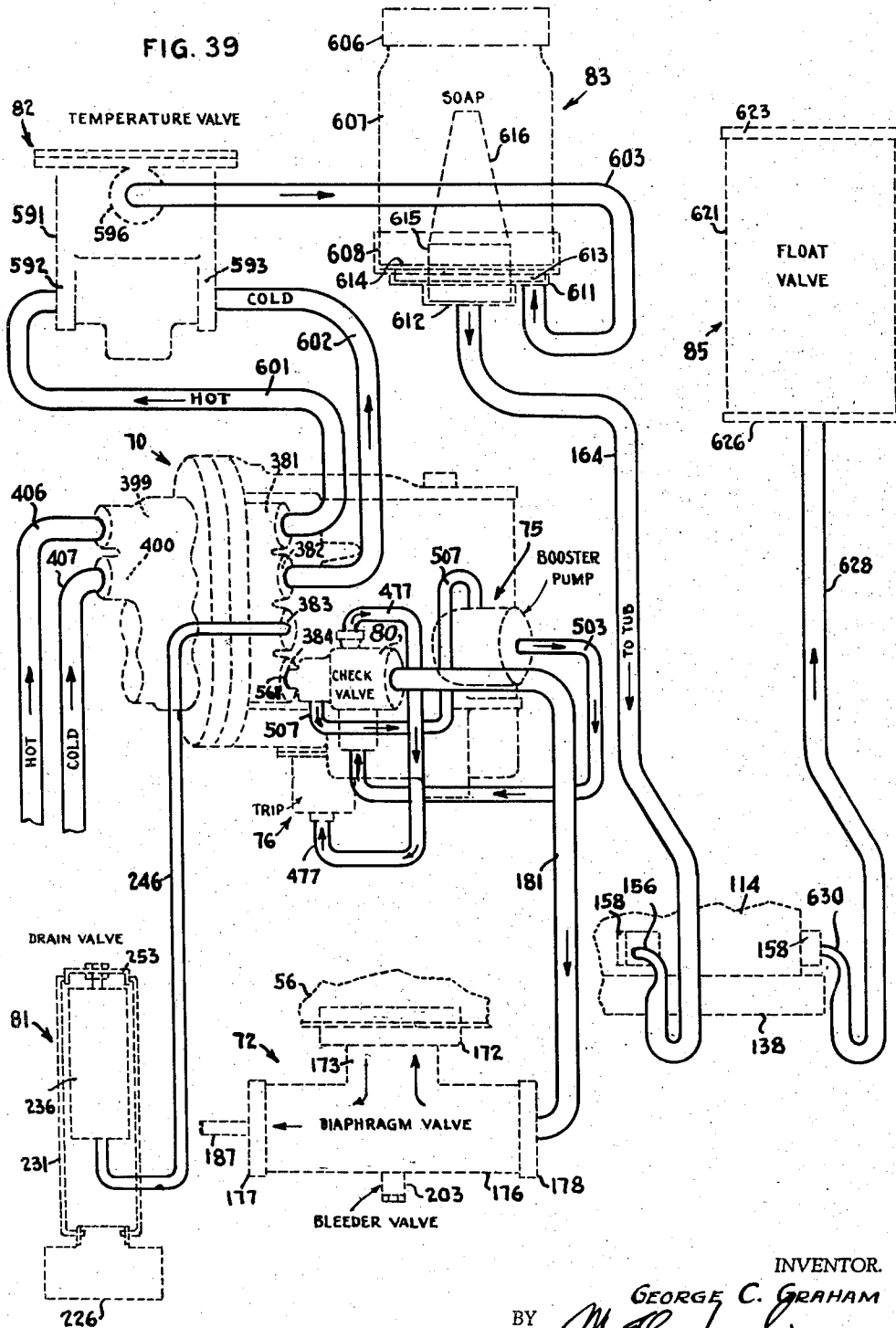
2,453,707

AUTOMATIC WASHING MACHINE

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FIG. 39



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## UNITED STATES PATENT OFFICE

2,453,707

## AUTOMATIC WASHING MACHINE

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by mesne assignments, to Graham & Barker,  
Ridgewood, N. J., a limited partnership

Continuation of application Serial No. 286,303,  
July 25, 1939. This application July 26, 1944,  
Serial No. 546,596

39 Claims. (Cl. 68—12)

1

My invention relates to washing machines, and the features thereof are illustrated, by way of example only, in connection with washing machines for use in household laundry applications. In the main, my present invention relates more specifically to the automatic and sequential control of the washing operations.

Clothes washing machines for household use have been of many types, including hand-operated rocker and other devices, power-driven structures utilizing the vacuum cup, oscillating agitator or tub, force nozzles, and other principles. However, the features of automatic control of the several steps of the complete "washing" operation are applicable to the various types of washing machines, as will be apparent to those skilled in the art. For the purposes of this patent a washing machine using the gyrating tub principle is used, and in addition to the automatic control certain improvements have been made in the washing machine per se.

It has heretofore been proposed to automatically control various of the steps in the washing operation and in some cases to secure sequential operation. In the latter endeavor, the entire operation starting with the dry clothes and finishing with clothes ready to be hung up to dry, or ready to be ironed, without the attention of the housewife or operator has not been obtained with satisfaction and recourse has been had to delicate control means, such as electromagnets, relays, switches and the like, and also to complex mechanical arrangements in connection with both of which trouble frequently occurs. Such difficulties, even though slight and within the ability of those skilled in repairing such defects, are a source of much delay, expense and other annoyance to the average user.

Various other difficulties enter into the construction and operation of an effective automatic machine, such as the control of fluid temperature and pressure, inability to flush residue from the top of the washing fluid thereby failing to clean the clothes properly, preventing excessive pressures, renewing parts, supplying proper quantities of soap, preventing the clothes from balling or forming into a dense mass, and the lack of safety appliances and facility of manipulation.

Among the objects of this invention are to void all the above mentioned difficulties, and to provide a machine that shall be self-sufficient in every feature, and well within the ability of a normal operator having no special knowledge of its structure or operation.

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Another object of the invention is to provide a washing machine that shall operate automatically through a complete cycle of several operations controlled entirely by rugged mechanical means in effecting such cycle, and free from the disadvantages of delicate electrical, and other, elements.

Other objects of the invention are to render the washing action more effective, as by providing for obtaining a more or less energetic washing action, for the flushing off of scum, etc., from the wash water prior to rinsing, and the provision of improved baffle means in the washing chamber or tub.

Another object of the invention is to improve the draining facilities of a washing chamber whereby to better clean the wash batch, and to reduce the operating period.

Another object of the invention is to provide an improved drying means of the contracting wash chamber, or flexible diaphragm, type.

Other objects of the invention are to control the operation of such drying means in accordance with the pressure developed therein, to prevent excessive fluid pressure in a drying means of the indicated type, and to provide for a period of sustained period of high pressure during the drying period.

Another object of the invention is to provide a compact, effective control unit for governing several operating mechanisms of a washing machine.

Another object of the invention is to provide means, responsive to the attainment of a proper quantity of washing fluid in the article receiving chamber structure or tub, for controlling the start of the above mentioned automatic cycle.

Another object of the invention is to provide a novel centralized manual control, adjusting, conditioning and index assembled for a washing machine.

Another object of the invention is to provide washing machine means of the above indicated character that shall be simple and durable in construction, economical to manufacture, and effective in operation.

With such objects in view, as well as other advantages which may be incident to a utilization of the improvements, the invention comprises the elements, steps and combinations thereof herein set forth and claimed, with the understanding that the several necessary elements may be varied in proportion, arrangement and texture, without departing from the spirit and scope of the invention as intended,

and as set forth in the drawings, specification and claims. However, there is set forth in the specification and drawings the best mode of applying the several features of my invention as now contemplated by me.

In practicing the invention, in one form considered as an assembly in a broad sense believed to be new, and not including all novel features which may be added, or employed individually, or in other combinations, as may also the elements of the broad assembly, the machine is provided with means for effecting in a complete automatic cycle, relative to the clothes or other articles to be washed, the steps in the order named, of washing, flushing, draining after washing, rinsing, draining after rinsing, and substantially drying the articles. All these actions occur without removing the clothes or other articles from the tub and without interrupting the driving connection from the motor to the tub.

The assembly also contemplates the addition of temperature control means, means for conditioning the machine for starting, such as means responsive to the reception in the washing chamber or tub of the proper quantity of washing liquid for effecting the actual starting, a soap container through which the liquid passes on its way to the tub, the step of flushing the top wash water and accumulated scum from the top of the tub prior to draining preparatory to the introduction of rinse water, means, such as a booster pump, for augmenting the pressure of an available water supply, where necessary, means, such as an automatic trip mechanism, for preventing excessive fluid pressure on the drying means, means such as a fluid actuated diaphragm, means for automatically stopping the machine, and other features.

The invention will be better understood from the following description, and from the accompanying drawings in which:

Figure 1 is a substantially central section in vertical plane of a machine constructed in accordance with one example of the invention, drawn to a considerably reduced scale, and certain parts being omitted for clarity of illustration;

Fig. 2 is an enlarged detail view of the relationship of the cover and the washing machine tub;

Fig. 3 is a view similar to Fig. 2, with the parts thereof in different position;

Fig. 4 is a view, similar to Fig. 2, showing further details of an alternate structure thereof;

Fig. 5 is a top plan view, with the top lid removed, and other parts omitted, of the structure of Fig. 1;

Fig. 6 is an enlarged detail view, taken substantially along the line 6—6 of Fig. 5, of the diaphragm control valve;

Fig. 7 is an end view of a portion of the structure of Fig. 6, as seen from the left;

Fig. 8 is an enlarged view, partially in elevation and partially in section, of a portion of the control device, as viewed at the upper right hand corner of Fig. 5;

Fig. 9 is a view taken substantially along the line 9—9 of Fig. 8;

Fig. 10 is a view of the device of Fig. 8, as seen in the direction of an arrow 10 of that figure;

Fig. 11 is a view taken at right angles to Fig. 10;

Fig. 12 is an enlarged view, taken substantially along the line 12—12 of Fig. 8;

Fig. 13 is a view, in cross section, of a valve device which communicates at its top with a bot-

tom part of the structure of Fig. 12, and other elements, as will further appear;

Fig. 14 is a view, taken substantially along the line 14—14 of Fig. 10;

Fig. 15 is a view on an enlarged scale, taken substantially along the line 15—15 of Fig. 8;

Fig. 16 is a detail view, taken substantially along the line 16—16 of Fig. 15;

Fig. 17 is a view of the structure of Fig. 16, with the parts in different positions;

Fig. 18 is a plan view, on an enlarged scale, of structure as seen at the upper right hand corner of Fig. 5, showing parts omitted in that figure;

Fig. 19 is a view, partially in side elevation and partially in section, of the structure shown in Fig. 18;

Fig. 20 is a view on an enlarged scale, taken substantially along the line 20—20 of Fig. 19;

Fig. 21 is a diagram of an electrical circuit embodied in the structure;

Fig. 22 is an enlarged view, in vertical substantially central plan section, of one of two baffle elements shown at the upper left and lower right hand portions, respectively, of the tub of Fig. 1;

Fig. 23 is a view, of the element of Fig. 22, taken at right angles thereto;

Fig. 24, Fig. 25, Fig. 26, Fig. 27, and Fig. 28 are detail views in section, taken along the lines 24—24, 25—25, 26—26, 27—27 and 28—28, respectively of Fig. 22;

Fig. 29 is a sectional view, taken substantially along the line 29—29 of Fig. 22, showing, in addition thereto, an enlarged detail, partially in elevation and partially in section, of a valve indicated near the lower right hand portion of the tub shown in Fig. 1, the latter figure also showing a similar valve at its upper left hand side;

Fig. 30 is an enlarged detail plan view of a fragment of the tub of Fig. 1, showing portions of the top periphery of the tub, and a bail or cover clamping ring therefor;

Fig. 31 is a detail view of a removable clamp for holding the flexible diaphragm and tub sides and bottom together;

Fig. 32 is an enlarged detail view, in elevation, of an inlet conduit structure for the tub;

Fig. 33 is a view, taken substantially along the line 33—33 of Fig. 32, and showing also the clamp of Fig. 31;

Fig. 34, Fig. 35 and Fig. 36 are views, in elevation, of certain cam disks included in the device; there being a duplicate of the cam of Fig. 34 not here shown;

Fig. 37 is a chart indicating a sequence of operation of the machine;

Fig. 38 is a detail plan view of a control dial of the mechanism; and

Fig. 39 is a schematic diagram of the fluid circuit elements of the device.

#### General structure

Referring particularly to Figs. 1 and 5, and first giving a generalized indication of the several parts and their locations, the example of the invention illustrated comprises, in general, a lower housing member 40, an outer container 41, an internal peripheral or shelf member 42 supported at the top of container 41, an upper lid 45, an inner tub 46, a cover 47 therefor, baffles 52 in the tub, a flexible diaphragm 55 disposed over a bottom wall 56 of the tub 46 and used for the drying operation, a spider 50 for supporting the tub 46 on a mechanism 51 forming a portion of means for imparting a gyratory or "wobble" action to the tub, a stationary guide plate 57 se-

cured to the upright side wall of the outer container 41 for cooperation with guiding means 60 carried by the spider 50, a reduction gear housing 65 disposed between the mechanism 51 and a drive means or electric motor 66, a centrifugal pump 67 driven by the motor 66 for draining the outer container 41, a mechanical automatic control valve structure 70, also actuated by the motor 66, a valve 72 mounted beneath the inner tub 46 and connected to the automatic control 70 for controlling the action of the diaphragm 55 in drying the clothes in the tub 46, a booster pump 75 for augmenting, when necessary, the fluid pressure to the valve 72 and the diaphragm 55, a trip mechanism 76 (bottom of Fig. 12) operating as a release of the pressure on the diaphragm 55 under certain conditions, a check valve structure 80 (Fig. 13) between the valve 72 on the one side and the control unit 70 and trip mechanism 76 on the other side, valves 81 in the baffles 52 for controlling the draining of the tub 46 from the bottom, a temperature control valve 82 for determining the temperature of the washing fluid in the tub 46, a soap container 83 connected in the fluid circuit between the valve 82 on the inner tub 46, a float valve 85, a main electric switch 86 connected between the motor 66 and a source of electromotive force, an auxiliary electric switch 87 connected between the motor and the main switch and controlled by the float valve 85, an automatic switch trip device 90 (Fig. 9) for actuating the main switch 86 when all the washing operations are completed, manual means 91 (Fig. 19) for conditioning the valves and auxiliary switch to start operation of the machine, and linkage mechanism 92 connected between the float valve 85 and the conditioning means 91 for starting action of the tub when the latter is filled to the proper level. It will be noted that all of the control mechanism is compactly housed in the outer container.

#### Outer container structure

The base 40, in the example given herein, is constructed of non-corrosive sheet metal having upright side walls 95 and a top horizontal wall 96, on which is fixed a bottom wall 98 of the outer container 41, also, in this instance, constructed of sheet metal and having upright side walls 99, the outer surfaces of which are flush with the outer surfaces of the walls 95. The container 41 may be of any desired shape, here illustrated as substantially square so as to house the controls as well as provide room for the movements of the inner tub 46. Since the water from the inner tub drains into the outer container 41, it must be water-tight, and it is connected to the centrifugal pump 67 by the pipe 100 for emptying the container 41.

The top peripheral edges of the walls 99 lie inwardly of the remainder of the walls, so as to receive the rubber strips 101, of inverted channel section, and the top edge 102, also of inverted channel section, of the shelf 42, and the outer surfaces of the sections 102 will be flush with the outer surfaces of the walls 99. The shelf 42, also of sheet metal, has upright side walls 104 depending from the channel sections 102 and a horizontal portion 105 having a relatively large central opening surrounded by a further depending flange 106. The shelf 42 overlies the space between the inner tub 46 and the outer container 41, and serves to catch any articles that might otherwise fall therebetween.

The upper lid 45, also of sheet metal in the

example given, has a lower flange 109 closely fitting the inner surface of the channel section 102, with upright side walls 110 in longitudinal alignment with the walls 99.

#### The washing tub

The tub 46 includes a non-corrosive sheet metal side wall 114 of substantially semi-spheroidal shape having parallel plane top and bottom perimeters 115 and 116 of substantially channel section and Z-section, respectively (seen better in Figs. 2 and 33).

The top perimeter 115 partially embraces a reinforcing neck ring 119 (Fig. 2) which has a lip 120. The cover 47 is floatingly received in the perimeter 115 and is of dish shape with a radially extending top flange 121 that overlies the perimeter 115 of the tub, an upright side wall 122, and a concave bottom wall 123 having perforations 125 therein.

The neck 119 and the corresponding portion of the tub side wall 114 have permanently registering apertures 126, and the lower portion of the side wall 122 of the cover 47 has apertures 127 for cooperation with the apertures 126, as will appear later.

The cover 47 is held upon the tub by means of a clamp ring 131 which is a channel section and engages beneath the lip 120 of the reinforcing ring. The ring 131 is split, as indicated in Fig. 5, the ring carrying at one side of the split a bail 132 which has pivotally mounted thereon one portion of a toggle link 133 and a handle 134. When the link is open, the ring 131 expands so that the cover may be removed from the tub, and when the clamp is in the other position, the ring 131 is clamped tightly against the neck 119. The ring 131 has a sufficiently deep channel section to permit the raising of the cover 47 so as to bring the holes 127 thereof in register with the holes 126 as shown in Fig. 2. When the cover is in its lower position, shown in Fig. 3, the holes 127 of the cover are below the perimeter 115 so as to communicate with the interior of the tub 46. In this position, the side wall 122 of the cover closes the apertures 126. During certain operations as will be hereinafter described, the cover is in the upper position shown in Fig. 2 so that water in the tub drains through the holes 125 of the cover and the registering holes 127 and 126, and at other times the water which enters through the holes 125 drains back into the tub while the cover is in its lower position shown in Fig. 3.

An alternate construction for accomplishing the same result is illustrated in Fig. 4. In this case, the cover 47a does not rise when water is to be drained from the tub through the top. The construction of the tub wall 114a around the opening is the same as described in connection with Fig. 2, and is also provided with outlet apertures 126a. The clamping ring 131a is of less height than in Figs. 2 and 3, but engages the cover and tub in the same fashion to hold the cover in place. The cover 47a has apertures 132a in the lower part thereof and other apertures 127a in the upstanding side 122a thereof in position to register with the apertures 126a. The sides of the cover is also slotted upwardly from its lower edge in line with the apertures 127a, as indicated at 130a so that any small amounts of water that may enter the cover during the washing operation drains back into the tub through the slots 130a. When drying, the clothes or other articles under pressure in the chamber more or less seal

the slots 130a so that water goes out the apertures 126a. During the flushing and rinsing operations, it is not necessary for the cover to rise to drain water from the tub through the top, the water being free to get out of the tub through the slots 130 and the apertures 126a in the tub, while the cover is in its lower position.

Referring to Figs. 1, 6, 30, 31 and 33, the bottom wall 56, of the tub 46, is arched upwardly toward the center of the tub from a peripheral shoulder 136. The bottom of the tub may be flat or concave, as well as the convex shape shown. The diaphragm extends over the bottom and has a bead-like peripheral margin 137 which is received by the shoulder 136 (Fig. 33). The bead and shoulder fit beneath the offset perimeter 116 of the tub side wall 114, and all are clamped within a ring 138 of channel section. The latter, as better seen in Figs. 30 and 31, is a split ring having adjacent ends provided with registering slots 141, in which is disposed a link 142, the heads 143 of which engage in the enlarged ends of slots 141. When it is desired to remove or renew the diaphragm 55, for example, the link 142 is severed, as by sawing, between the ring ends, which allows the ring to be expanded and removed. When it is desired to replace the ring, new links 142 are employed, and the ring ends are drawn toward each other by a suitable tool having portions for insertion into holes 146 in the segments.

As better seen in Fig. 33, the arrangement of the offset portion of the tub bottom perimeter 116, the shoulder 136 of the tub bottom wall 56 and the bead 137 of the diaphragm 55, is such that the shoulder 136 cannot pull out of position, when clamped between the offset 116 and the shoulder 136 when the diaphragm is expanded upwardly in the drying operation, as will hereinafter appear. Furthermore, this is at all times a water tight joint. The diaphragm 55 also has an annular upstanding ridge 148 which, when the diaphragm is expanded, is tightly pressed against the inside of the tub side wall 114 to act as an additional seal, this being the position shown in Fig. 33. This ridge also serves to relieve some of the strain on the diaphragm where it passes through the juncture of the bottom and side walls of the tub.

As seen in Figs. 1 and 33, bosses 151, on the underside of the tub bottom wall 56, register with bosses 152, on the spider 50, for the reception of screws 153, whereby the tub is held in position supported on the spider.

As better seen in Figs. 32 and 33, the tub 46 has a water inlet tube 156 which communicates with a pair of ports 157 in the tub side wall 114. The tube 156 is secured in place by a coupling 158, and extends downwardly and inwardly along the underside of the spider 50, to which it is attached by a clip 161 and a screw or screws 162. A flexible hose 164 connects to the end of tube 156 within the clip 161 and at its other end to the bottom of soap container 83. The spider 50 has a bottom central bearing portion 163 (Fig. 1) connected to the mechanism 51, as will hereinafter appear.

#### Diaphragm valve

Referring to Figs. 1, 5, and particularly Figs. 6 and 7, the fluid valve 72, which governs the action of the diaphragm in response to the automatic control as later described, is mounted on the tub bottom wall 56 by means of a nipple 166 having a laterally extending top flange 167, and a depending tubular portion 171 that is interiorly and exteriorly screw threaded. The tube 173 of

the diaphragm valve screws into the nipple and a nut 172 screws upon the outside of the nipple to secure the same in place. The flange 167 holds the diaphragm slightly off the tub bottom 56, to facilitate the ingress of water between the diaphragm and the tub bottom wall, and the flange is provided with a plurality of transverse slots 174 to permit water to escape during the emptying of water from behind the diaphragm notwithstanding that the diaphragm may have become seated across the opening through the flange, which would normally seal the opening.

The tube 173 communicates with a cylinder 176 which has end members 177 and 178. The member 178 is in the form of a closure cap and has a nipple 180 from which a hose 181 extends to the mechanical automatic control valve 70. The member 177 is in the form of a spider having legs 182 supporting a central journal bearing 183 and defining apertures 186 constituting discharge ports.

A piston rod 187 carries a head 188 fixed there-to, and also a head 192 that is slidably mounted thereon. Under certain conditions, a yieldable washer 193, secured against one face of the head 188 by a nut and washer indicated at 196, bears against a ring seat 197 fixed to the cylinder 176. Each head 188 and 192 has a cylindrical hub portion 198 projecting toward the other and surrounded by a helical spring 201 tending to push the heads away from each other. Another spring 202 extends between the spider arms 182 and the piston head 188, tending to push the latter away from the stationary seat 197.

The bleeder valve 203 comprises a tubular body 206 secured to the cylinder 176 and in communication with the interior thereof between the heads 188 and 192. The body 206 has side ports 207. A needle valve screw 208, locked in adjusted position in the body 206 by a nut 209, partially closes the opening 210 into the bleeder valve to determine the amount of bleeding of liquid from the cylinder through the side ports 207.

When water under pressure is admitted to the cylinder 176 through the port 180, the piston head 192 is moved, from its dotted line position (Fig. 6) to a position in which the adjacent ends of the cylindrical portions 198 substantially abut each other. In this position, the water is admitted freely, through the tube 173 and the nipple 166, beneath the diaphragm 55 to push the same upwardly in the tub (during the drying operation). Movement of the head 192, through spring 201, also presses the head 193 against the seat 197.

As the clothes are compressed between the expanding diaphragm and the tub, and especially near the end of the drying operation, the pressure behind the diaphragm builds up equal to the pressure of the incoming fluid, and this pressure occurs against the head 188 holding the washer 193 tightly against the seat 197. As the pressure builds up, the flow of water into the diaphragm space reduces, because the pressure of the incoming water is constant as will be explained later, so that the head 192 returns to the dotted line position (Fig. 6), in which position the water flows through the space between the head 192 and the cylinder 176. When the water supply has been stopped, by the automatic control or the trip mechanism, the bleeder valve 203 allows the water pressure in the cylinder 176 to lessen gradually. After a certain amount of bleeding, in the course of which the water pressure drops sufficiently in a few seconds, the

spring 202 overcomes the residual pressure against the head 192 and quickly moves the piston 188 and head 192 to the right, as viewed in Fig. 6, to the full open position. Upon this action, the contraction of the diaphragm 55 forces the water through the opening in the ring seat 197 and the discharge ports 186 of the spider member 177 into the bottom of the upper housing 41 (Fig. 1), from which it is pumped by the centrifugal pump 67 to a disposal position, such as a stationary laundry tube or drain pipe. It will be appreciated that the water pressure applied behind the diaphragm during expansion being substantially uniform, as indicated, the pressures developed in the drying operations are readily calculable so that the strength of the spring 202 can be properly chosen to effect the desired draining action quickly and in proper sequence.

The presence of the adjustable bleeder valve also enables regulating the duration of the period of high pressure on the clothes or other articles being dried by the compressive action of the diaphragm. That is to say, the rate of bleeding can be so adjusted as to determine the length of time before the piston 188 moves to open position to dump the water from in back of the diaphragm and therefore there is a period of regulable sustained higher pressures during the drying operation.

#### *Tub baffles*

Referring to Figs. 1, 5, and 22 to 29, inclusive, each of the baffles 52, of which there are two in the present machine disposed at diametrically opposite positions on the inner surfaces of the tub side wall 114, comprises a shell, as of cast metal, having a flat upright side wall 211 and an opposite wall 212 which slopes, or is rearwardly convex, from the wall 211, with a curved upper edge portion 213, as viewed in Fig. 23, merging into a straight edge lower portion 214. Viewed in the direction of section lines 24—24 to 28—28, inclusive, the development of the contour of each baffle 52 is shown in Figs. 22 to 28, inclusive, respectively. Lugs 216 receive screws 217 by which the baffle is secured to the tub side wall 114, with the open inner face of the baffle shaped in conformity to the spheroidal side wall 114 thereof. The walls 211 and 212 are joined, at the radially innermost portions thereof from the wall 114, by a rounded edge portion 218, and each of the walls 211 and 212 is provided with apertures 221 open at all times to the interior of the tub for the admission of water to the baffle for the purpose explained in the next section of this specification.

The operation of the tube 46 is such that the water and clothes in the tub move in a clockwise direction, the flat sides 211 of the baffles face in the counter-clockwise direction and extend transversely to the direction of motion in the tub. In the forward action of the tub, the somewhat rotational movement of the clothes and water is interrupted twice as the clothes engage the flat sides 211 of the pair of baffles 52. The sloping sides 212 of the baffles, facing in the direction of rotation, more or less allow the clothes to slide off the baffles.

With the clothes thus affected differently at opposite sides of each baffle, there is the absence of symmetrical or like back and forth movement of the clothes mass during the washing and rinsing operations which would form the mass into a compact ball, as has occurred in former washing machines.

The action of the baffles 52, therefore, is to maintain the clothes mass loose and open, for the free effective flexing thereof and infiltration of the washing and rinsing liquids through and between all parts of the mass, and to similarly allow the infiltration of air for drying and freshening the clothes, after the mechanical drying, or squeezing, action which is effected by the machine of this particular example of the invention. It is obvious that baffles of this type may be used in other tubs in which other principles of securing the washing action are applied.

#### *Baffle valves*

The purpose of the baffle valves about to be described is to control the draining of water from the tub at the bottom thereof. As the baffle valve structures are alike, it is only necessary to described one, and of course only one may be used if desired.

At the lower portion, each baffle is provided with laterally extended shoulders 222, which, in cooperation with the adjacent tub side wall 114, forms a slideway 223 for a valve flap 226, as seen in Figs. 23, 27, 28 and 29. The flap has apertured wings 227 for pivotal connection to a pair of links 231. In its lower position, as indicated in Fig. 29, the flap 226 covers drain outlets 233 in the tub side wall 114 to prevent the escape of water from the interior of the baffle, and consequently, from the interior of the tub 46.

The valve 81, which controls the upward and downward movements of the valve flap 226, comprises a cylinder 236, fixed in position on the tub wall 114 by brackets 235 (Fig. 1). The cylinder 236 has an end cap 237 (Fig. 29) provided with a tubular portion 241 constituting a slide bearing for a piston rod 242, and an end cap 238 which has a tubular inlet 243 from which a water supply hose 246 extends through a suitable opening in the tub side wall 114 to the mechanical automatic control valve 70. A piston head 248 is secured to the rod 242 within the cylinder 236, as by nuts 252. Similarly secured to the piston rod 242, outside the cylinder 236, is a cross piece 253 having ears 254 for pivotally receiving the upper ends of the links 231. The pivotal connections of the links 231 allows the flap 226 to slide in the guide 223 notwithstanding the angular mounting of the cylinder 226 due to the curved contour of the tub.

When the tub is to be drained, water is admitted through the hose 246 into the cylinder 236, the piston head 248 and the rod 242 move upwardly, as viewed in Fig. 29, thus moving the valve flap 226 upwardly to allow water to drain through the apertures 233 into the outer container 41. When the water supply to the cylinder 236 is cut off, the piston head 248 and the flap 226 move to the lower closed position under the action of the spring 255, the water in the cylinder escaping into the outer tub 41 through the small bleeder opening 256.

#### *Tub operating mechanism*

The tub operating mechanism 51, as better seen in Fig. 1, comprises a tubular sleeve having a portion 262 of small diameter fitting in the spider bearing 163, and a portion 263 of large diameter outside the bearing, thereby providing a shoulder 266. A nut 267 cooperating with a screw threaded part of the sleeve 261 secures the sleeve to the bearing 163. An inclined shaft 268, journaled by a ball bearing 271 in the sleeve 263 and at its upper end in the sleeve 262, is adjustably held by a nut 272 in a slot 273 of an arm 276 that is secured,

as by a nut 277, to the upper end of a drive shaft 288.

The shaft 288 is journaled in a bearing 289 that is mounted in a plate 290 on the bottom 98 of the outer container, and in a thrust bearing 291, mounted in the gear housing 65. This housing encloses a worm mounted on the shaft 288, for cooperation with a worm 293 fixed on a shaft 296 of the motor 66. The worm and worm wheel are symbolical of any suitable gear reduction mechanism that may be used between the motor and the tub drive shaft. The motor shaft also extends to the centrifugal pump 67 for driving the latter at the speed of the motor.

At this point it may be mentioned that the shaft 296 is further connected, through a suitable speed reducing mechanism here shown as a belt and pulley device 301, and bevel pinions 302, to a vertical shaft 303 for actuating the mechanical automatic control valve 70, and the booster pump 75 hereinafter described. The shaft 303 is enclosed within a standpipe 304 having a water tight connection with the bottom of the outer tub 41.

As the shaft 288 rotates the arm 276 revolves which, by reason of the inclination of the shaft 268 produces a gyrating or "wobble" movement of the tub 46 in cooperation with the tub guiding means 60. This guiding means comprises a bracket 281 secured to one of the bosses 152 of the spider 50 and carrying shafts 285 on which are journaled rollers 286 having rubber peripheral rings or tires 287 bearing at opposite sides of the stationary guide plate 57. The latter has an inner edge 288 drawn on an arc about the point of oscillation of the tub, and the guiding rollers 286 are held to vertical movement by the plate 57 so that the tub does not rotate on its own axis.

By loosening nut 272, shafts 268 can be adjusted in arm 276 to vary the inclination of the tub and thereby obtain different degrees of "wobble" movement, resulting in more or less energetic washing action. This means is only symbolical of other adjusting means that may be used to allow for different washing actions according to the types of articles being washed in tub 46.

#### *Mechanical automatic control valve*

The mechanical automatic control valve structure 70 is shown in detail in Figs. 8, 10, 11, 12, 14 and 15. It comprises a cast metal shell 306 (Fig. 12), a top cover 307 and a bottom closure 308 each secured to the shell 306. Secured to the laterally projecting portions of the top and bottom is a valve body housing 316 and a valve header 322, these parts being secured together by screws 323. The assembly has upper and lower side bosses 326 and 327 thereon, for the reception of screws 328, by which the mechanical automatic control valve is secured, as a unit, to one of the upright walls 99 of the housing 41, see particularly Figs. 8 and 11.

Referring again to Fig. 12, the shell 306 has a cam compartment 329. At one side of this compartment are tubular bearings 331, 332, 333 and 334, for push rods 338, 339, 340 and 341, respectively, which carry cam follower rollers 345, 346, 347 and 348, respectively, inside the compartment 329. The followers respectively cooperate with cam discs 351, 352, 353 and 354 each having collars 355 fixed to a cam shaft 356 that is journaled in bearings 357 and 358 on the top 307 and the bottom 308, respectively, of the shell 306. The push rods 338—341 are each prevented from ac-

cidental withdrawal from the bearings 331—334, as by a removable slide 359 (Fig. 20) which extends the full length to cooperate with a slot 360 in each push rod.

The valve body housing 316 comprises a plurality of valve chambers 361, 362, 363 and 364, from which plunger rods 367, 368, 369 and 370 respectively project through cooperating packing glands 373, for end to end abutting engagement with the push rods 338, 339, 340 and 341, respectively.

Valve sleeves 376, 377, 378 and 379, respectively, surrounding the plunger rods 367, 368, 369 and 370, for slidable movement back and forth in the chambers 361, 362, 363 and 364, respectively, between a left hand position and a right hand position, as viewed in Fig. 12, as determined by high and low points on the respective cam discs 351—354.

In the left hand position of each valve sleeve 376—379, a corresponding valve outlet port 381, 382, 383 or 384 (Figs. 8, 10 and 39) is open to the corresponding chamber 361—364, and in the right hand position of each sleeve 376, 378, the corresponding outlet port 381—384 is closed.

Fixed to the valve sleeves 376, 377, 378 and 379 are heads 388, 389, 390 and 391, respectively, each of which has a nose 393, projecting through the corresponding sleeve for engagement with the adjacent end of the corresponding plunger rod 367—370, and a cup like portion 398 which is longitudinally slidable in one of chambers 399—402 of the valve header 322. A helical compression spring 404 serves to bias each of the sleeves 376—379 and the associated plunger rods 367—370 and push rods 338—341 to the right, against the cam discs 351—354.

The chamber 399 communicates with a hot water supply through hose 406; the chambers 400, 401 and 402 communicate with a cold water supply through hose 407, these chambers being open to a surrounding communicating passageway 408 (Fig. 11) and individual passages 409 and 410 (Fig. 12).

Each of the push rods 338, 339 and 340 directly engages its respective plunger rod 367, 368 and 369, but the fourth push rod 341 only actuates its corresponding plunger rod 370 through the intermediary of the arm 487 of a trip latch 411 (Fig. 12) constituting part of the trip mechanism 76, to be hereinafter explained.

The contours and angular relations of the cam discs 352, 353 and 354 relative to each other on the cam shaft 356 and to the associated cam followers 346, 347 and 348 may be as indicated in Figs. 34, 35 and 36. The cam disc 351, with the exception of its collar 355, which is on a side thereof opposite to that of the collar 355 on the cam disc 352, is a duplicate of the latter disc in both contour and angular position on the shaft 356, for which reason it is not shown with Figs. 34, 35 and 36, but is shown in position in Fig. 12.

The cam discs in the latter figures are viewed as they would be seen in the direction of an arrow A in Fig. 12 showing the followers 346, 347 and 348 to the left of the discs on the central horizontal diameters thereof. Each disc has a low point or circumferential contour constituting the major portion of its periphery, these so called low points being the points 416 on the discs 351 and 352, the point 417 on the disc 353, and the point 418 on the disc 354.

Each of discs 351 and 352 has a peripheral cam 421 of short peripheral length, associated with the flushing operation of the machine, and a

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longer peripheral cam 422, in use during rinsing of the clothes. The disc 353 has a short peripheral cam 423 to cause draining of the tub 46 after the above mentioned flushing and during an initial period of the mentioned rinsing, and a longer peripheral cam 424 to cause draining of the tub after the above mentioned rinsing and also during a drying period. The disc 354 has only one cam surface 427, to cause drying of the clothes. The further connections to effect these operations will be explained.

At the lower right hand portions of Figs. 12, 14 and 15 is shown the drive for the cam shaft 356. A driven worm wheel 431 is connected to this shaft through a snubber or one way clutch 432, which comprises a helical spring 433 surrounding the shaft, and secured at one end to the worm wheel 431, as by a screw 434. The upper end of the shaft 356 projects through the cover 307 and is provided with a dial knob 435 for manually turning the shaft 356 relative to the driven worm wheel 431, in clockwise direction, as indicated by arrows in Figs. 14 and 34—36. This action allows the shaft to slip relative to the spring 433 and the worm wheel 431 for changing the angular relation of the cam shaft and cams to the worm wheel and to the cam followers to select the length of the washing period. However, when the worm wheel 431 is itself driven clockwise, the spring 433 tightens or snubs itself to the shaft to turn the shaft in such direction.

The worm wheel 431 is directly driven by a worm 442 (Figs. 14 and 15) fixed on a horizontal shaft 443 that is journaled in bearings 446 constituting the parts of the bottom closure element 308 of the cam compartment shell 306. Also fixed to the horizontal shaft 443, is a worm wheel 447 which cooperates with a worm 448 that is fixed to the reduced end of a stub shaft 451. The latter is journaled in a vertical bearing 453 of the bottom closure element 308 and is detachably coupled to the shaft 303 by a suitable coupling device, here indicated by a sleeve 457 and a key 458. The shaft 303, it will be recalled, is driven from the motor 66, as shown in Fig. 1. The bearing 453 has a suitable packing gland 462 around the shaft 451, to prevent oil leakage into the outer container 41, which oil is admitted to the cam compartment 306 through an opening closed by a cap screw 464.

It will be understood that the illustrated worm and worm gear drive is symbolical of suitable gearing to reduce the speed of the motor 66 so that the cam shaft 356 will be rotated at the required speed for the proper sequential operation of the cam discs thereon.

#### *Trip mechanism*

Referring to Figs. 12 and 14, the trip mechanism 76, which operates in accordance with pressures on the flexible drying diaphragm 55, comprises a cup 466 having an upper flange 467 by which it is secured to the bottom closure 308, as by screws 468. The cup 466 closes an opening in the bottom 308 through which extends a vertical piston rod 471. The latter carries, at its lower end, a piston head 472, between which and the bottom 308 extends a spring 473 for biasing the piston downwardly. At the lower end of the cup 466 is connected a conduit 477, which extends to the check valve 80 (Figs. 13 and 39).

A trip latch 411, which is actuated by the piston rod 471, comprises a U-shaped sheet metal lever 481 that is pivoted at 482 and rests on the piston 75

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rod 471. Near its free end the lever 481 carries a pin 483, on which is pivotally mounted an arm 486 having a lateral portion 487 at its free end that is normally disposed between the plunger rod 370 and the push rod 341, as shown in Fig. 12.

A spring 488, disposed partially around the pivot 482, operates between a portion of the stationary bottom 308 and the lever 481 to bias the latter downwardly, as viewed in Fig. 12, and another spring 491, disposed partially about the pin 483 similarly operates between the lever 481 and the lever arm 486 to bias the latter toward the right in Fig. 12.

As explained, the pressure builds up on the diaphragm as water is forced behind the same, either by the direct water pressure or the operation of the booster pump, and this pressure increases as the drying operation progresses. When the pressure behind the diaphragm 55 reaches a predetermined amount, such pressure will back up through the check valve 80, and through the conduit 477, as will be further described, to move the piston rod 471 upwardly, whereupon, the lateral portion 487 is pushed from between the plunger rod 370 and the push rod 341 to shut off the supply of water from the mechanical automatic control valve 70 to the diaphragm valve 72, irrespective of the fact that the cam disc 354 may be in such position as to normally cause such supply. That is to say, the cam 427 of disc 354 has initiated the diaphragm action by forcing the valve head 391 to the left in Fig. 12 together with the associated rods 341 and 370 to open the water valve, and when the portion 487 is forced from between these rods as just described, the valve head 391 and associated rod 370 are free to move to the right under the action of spring 404, to close the valve even though cam 427 is holding rod 341 in its left hand position. This movement both closes the valve to shut off pressure to the diaphragm and puts the end of rod 370 under the portion 487 of the trip mechanism. The rod 341 with its cam follower 348 cannot move to the right because of engagement with the cam 427 and the gap between the rods 341 and 370 is too great to enable the cam to open the valve. The only way the trip can be reset is by the turning of the disc 354 so that the cam 427 is moved past the follower 348, which will occur automatically in the normal operation of the control, but which may be done manually, if necessary, by means of the knob on shaft 356. As the cam is passed, the spring 491 acting against the end of rod 341 will push it to the right causing the cam followers 348 to engage the low point thereof. That same movement opens the space between the rods 341 and 370 so that the bar portion 487 can enter therein under the action of spring 488 and thus reestablish the mechanical link whereby the valve head 391 can be operated to open the valve the next time the cam 427 engages the follower 348.

#### *Booster pump*

The booster pump 75, indicated in Figs. 5, 8, 10, 11 and 39, but better shown in Fig. 15, is used to augment the pressure of the normal water supply to the diaphragm valve 72 whenever that pressure is below a predetermined amount. The pump is so arranged that it will idle if the normal supply pressure is at or above the predetermined amount.

The pump comprises a cylinder 497 having a closed outer end wall 501 in which is a discharge port 502 to which is connected a conduit 503 that extends to the check valve 80 (Figs. 13 and 39).

An inlet port 506 connects the cylinder 497 to a conduit 507 that extends to the water supply in advance of the check valve 80.

The cylinder 497 further comprises an outer portion 498 and an enlarged inner portion 508, the latter having a peripheral shoulder 511 joining the two portions and a flange 512 that is fixed to a tubular extension 516 of the cam compartment 306 with the rim of bearing support 517 therebetween.

A piston head 518 is located in the cylinder 497 and is mounted on a piston rod 523, that extends from the head 518 through a packing gland 525, a bearing 526 in support 517 and into a slide bearing or guide 527 which is screw-threadably mounted in a boss 528 on the cam compartment 306. The packing gland 525 is supported on a disc like partition 531 that is screw threadably mounted on the inner end of the outer cylinder length 498, with an outer peripheral flange 532 abutting the shoulder 511.

The support 517 has, in addition to the bearing 526 upper and lower projections 537 and 538, respectively, acting as slide bearings for a carriage 541, that is fixed to the piston rod 523, as by pins 542 (Figs. 16 and 17).

The projection 537 acts only as a slide bearing for the carriage 541, but the projection 538, in addition to acting as a slide bearing for the carriage, has a portion 543 acting as a journal bearing for an extension of shaft 451. The extension has a sleeve 546 cooperating with the bearing 543, and a top disc 547 secured thereto. A trunnion 548 on the disc 547, eccentric to the shaft 451, has an outer end 549 journaled in the carriage 541 so that, when the shaft 451 rotates, the piston rod 523 is reciprocated to operate the piston head 518 back and forth in the cylinder length 497, thus to pump water from the inlet 507 to the outlet conduit 503. It will be recalled that the shaft 451 is connected to shaft 303 that is driven by the motor 66.

Fig. 16 illustrates the position of the carriage 541 at the end of its left hand stroke, and Fig. 17 illustrates the position of the carriage at the end of its right hand stroke, as viewed in these figures.

#### Check valve

The check valve 80 is indicated in Fig. 39 but is better shown in Fig. 13. It is located between the booster pump and the diaphragm valve to control the use of the pump. It comprises a body 556, having five branches including a main inlet 557, for connection as by a nipple 558, to a conduit 561 from the outlet port 384 of the mechanical automatic control valve 70, an auxiliary inlet 562, for connection as by a nipple 563 to the conduit 503 from the discharge side of the booster pump 75, a main outlet 566 for connection as by a nipple 567 to the conduit or hose 181 leading to the diaphragm valve 72, a tertiary outlet 568, for connection as by a nipple 569 to the conduit 477 leading to the trip mechanism 76, and a secondary outlet 571, for connection as by a nipple 572 to the conduit leading to the inlet side of the booster pump 75.

A ball valve 576 is located in a central chamber 577 of the check valve body, the ball thereof being biased toward a valve seat 578 by a spring 581 extending between the ball and a collar 582 that is disposed against the inner end of the nipple 567.

A second ball valve 586, in the outlet portion 562, is biased toward the inner end of the nipple 563, constituting a seat for the ball, by a spring

587 extending between the ball 586 and a shoulder 588 in the inlet portion 562.

If supply water entering from the conduit 561 is of sufficient pressure to be used without boosting, the water pushes the ball 576 off the seat 578 and allows the water to go directly to the diaphragm valve 72 and behind the diaphragm, as above set forth. Under these conditions and the relationship between the valve opening, with its connections leading to the diaphragm, and the outlet port 571, insufficient water passes through the outlet port to enable the booster pump 75 to function effectively, and its piston reciprocates idly.

However, if the pressure of the water supply from the conduit 561 is not sufficient to raise the diaphragm effectively or if for any reason that pressure falls while the diaphragm is being expanded in the tub, the ball 576 will remain seated or will instantly return to its seat, in which case the incoming water will flow through the outlet port 571 and its conduit 507, to the inlet side of the booster pump. The pump will discharge through the conduit 503, lifting the ball 586 from its seat so that the water then passes into the central chamber 577 and through the outlet port 566 to the diaphragm valve 72, thus maintaining the necessary operating pressure on the diaphragm 55.

The trip mechanism 76 is adjusted to remain inactive under the normal pressures for operating the diaphragm 55 to effectively dry the clothes, but when a selected maximum pressure is reached the trip mechanism will be actuated because the pressures on the diaphragm build up through the outlet 568 and conduit 477 to actuate the trip mechanism 76 and the latch 411, as above set forth, to shut off the water supply at the automatic control valve 70.

#### Temperature valve

The temperature valve 82, indicated merely in outline in Figs. 1, 5 and 39, is of any standard construction and needs no specific description beyond the fact that it comprises, in general, a casing 591 having a lower hot water inlet 592, a lower cold water inlet 593, an upper outlet 596 for the tempered water. The hot water inlet 592 is connected by means of pipe 601 (Fig. 39) to the outlet port 381 of the automatic control valve 70. It will be recalled that this port 381 communicates with the chamber 399 of the control valve which in turn is connected by a pipe 406 to a suitable source of hot water supply. The cold water inlet 593 is connected through pipe 602 to the outlet port 382 of the automatic control valve 70 which in turn is connected through the valve chamber 400 to the hose 407 leading from a suitable source of supply.

A shaft 597 projects upwardly from the thermostatic control means inside the casing 591 that regulates the mixing of the hot and cold water. The lever 598 is mounted on the shaft 597, and is adjusted by the operator of the machine so that water of the desired temperature will be delivered to the inner tub 46 through a conduit 603 to the soap container 83, which is connected by the tube 156, above described (Fig. 33), into the tub 46.

#### Soap container

The soap container 83, indicated in Figs. 1, 5 and 39, comprises a removable top cover 606 for a casing having a side wall 607, as of glass, and a base 608, that is secured to the side wall 99 of the outer container by one or more brackets 609.

The conduit 603 connects with an inlet 611 in the base, and an outlet 612 connects to the tub inlet tube 156.

The inlet 611 communicates with a chamber 613 which is covered by a ring shaped apertured plate 614. The inlet is closed from the outlet by cylinder 615 which is surmounted by a screen 616.

Dry soap, in powdered or flaked form and sufficient in quantity for one washing cycle, is placed in the casing 607. The incoming water enters the casing 607 through the apertured plate, and in passing through the screen to the outlet 612 dissolves the soap and carries the same into the center tub 46.

With the side wall 607 of glass, and since all water entering the tub 46 for washing, flushing and rinsing, passes through the soap container, the operator can observe therefrom the operating condition of the machine. If the upper lid 45 is used upon the outer container while the machine is in operation, then a window 617 may be provided in the side thereof so that the operator can see into the soap container 607.

#### Float valve and linkage

The float valve and linkage are used to automatically control the initial filling of the tub by cutting off the supply of water when the required water level has been obtained in the tub 46, and to automatically start the cycle of operations by closing the switch to complete the circuit to the motor 66.

Referring to Figs. 1, 5, 18, 19 and 39, the float valve 85 comprises a cylindrical casing side wall 621, secured to the outer housing wall 99 as by a bracket 622, a top cover 623, and a bottom 626. A nipple 627, depending from the bottom 626, is constituted both as a hose connector 628 and as a slide bearing for a rod 631 carrying a cylindrical drum float 632 inside the casing. The connector 627 receives the end of hose 628 which leads to a tube 630 that is open to the interior of the tub 46 and is mounted similarly to the tube 156.

The rod 631 is pivotally connected at its upper end, outside the casing, by a pin 633 (Fig. 19) to one end of a lever 636 that is pivotally mounted at an intermediate point to an upright 638 on the cover 623. The outer end of lever 636 is pivotally connected to a link 642 constituting part of the linkage mechanism 92. The link 642 extends closely adjacent to a substantially L-shape lever 648 which is pivotally mounted on a horizontal axis between arms 652 of a U-shape bracket that is secured to wall 99 of the outer housing. Lever 648 has a lateral arm 647 and an upright arm 649.

A latch arm 656 (Fig. 18) has one end 657 beside the upright arm 649 and its other end secured to a detent 658 that is pivotally mounted, as by a pin 661, on the top of the cam compartment shell 306. A leaf spring 662 connected to the detent arm 658 normally bears against one of the housing walls 99 to oppose clockwise movement of the latch arm 656 and detent arm 658 about the axis of the pivot pin 661, as viewed in Fig. 18.

One arm of a bell crank 667, fixed to a shaft 668 that is journaled in the cam compartment shell 306, constitutes a latch finger arranged to be held by the detent arm 658. The other arm of the bell crank has a bifurcate end 681 which embraces the end of the operating arm of the auxiliary switch 87. This switch is of any usual construction with its arm spring pressed to nor-

mally bias the switch to closed circuit position, which will normally hold the bell crank 667 out of engagement with the detent 658.

On top of the shaft 668 is a handle 683 which works over a suitable dial 684. Within the shell 306 the shaft 668 (Figs. 19 and 20) has a pair of radial pins 686 and 687 extending into recesses 688 and 689 in the push rods 338 and 339, respectively, for moving these rods independently of the corresponding cams 351 and 352, and coincidentally with the movements of the handle 683 and the bell crank 667, to start the flow of the hot and cold water, to fill the tub 46 at the start of operations.

Inasmuch as the operations of the entire automatic mechanism are about to be described, no further description will be made of the functioning of this float valve and linkage mechanism at this point.

#### Main automatic switch trip

Referring to Figs. 18 and 21, and particularly to Figs. 8 and 9, the automatic trip mechanism 90 for the main switch 86, comprises an upright rod 692 pivotally connected at its lower end to a movable switch operating member and having at its upper end an operating handle 696. The switch is not shown in detail because it is of the ordinary type with the operating member 693 working through a toggle link. A collar 698, fixed to the rod 692, is connected to the upper end of a tension spring 701 that also is connected, at its lower end, to a stationary guide 702, thus normally tending to pull the rod 692 downwardly to open the circuit through switch 86.

A lever 706 is pivotally mounted by a horizontal pin 707 in a lug 708 on the cover of the cam compartment housing 306, and has a bifurcated free end 712 straddling the rod 692 and resting on top of the collar 698. The lever 706 has a dog 713 depending from its pivot for cooperation with an arm 716 (Fig. 8) that is fixed to the vertical cam shaft 356.

To close the switch 86 the rod 692 is pulled upwardly which operates the toggle switch arm 693 and at the same time raises the collar 698 and the lever 706 which brings the dog 713 to its lowermost position, in which position the parts remain during operation of the machine. The arm 716 is so positioned with respect to the cams on discs 351-4 that after a complete cycle of operations, which may or may not be a complete revolution of the cam shaft 356, the arm 716 strikes the dog 713 to cause the rod 692 to move downwardly to open the switch 86 and thus to interrupt the circuit to the motor 66.

#### Operation

At the start of operations, the dry clothes are put in the tub 46 and its cover 47 is clamped in place, after which the proper amount of soap is placed in the soap container 83 and its cover 606 replaced.

The temperature control valve handle 598 (Fig. 5) is adjusted so as to supply water to give the desired wash water temperature. For this purpose, the dial of the handle 598 may be appropriately marked.

Next the knob 435 with its index finger 438 is adjusted to the setting to indicate on the scale 439 (Fig. 38) the period of time it is desired to subject the clothes to washing action, which period depends upon such factors as the nature, color, condition and quantity of the clothes, the degree of hardness or softness of the water, or

other considerations that may be found from experience to affect the particular period of washing time. The turning of the knob 435 adjusts the positions of the cams on discs 351—354 with respect to the associated followers, as explained above in connection with Figs. 12 and 15.

Next, the handle 683 is turned to the "Fill" position which opens the hot and cold water valves of the mechanical automatic control valve 70, independently of the cams 351 and 352 as above set forth, and also opens the auxiliary switch 87 (Fig. 21) in the motor circuit.

The main switch handle 696 is then lifted to close the motor circuit through the main switch 86.

At this point the operator can leave the machine, for the several described automatic controls will govern the operation of the machine through the entire cycle of (a) filling the tub 46 with the required amount of water, (b) shutting off the water supply, (c) energizing the motor to operate the tub 46, (d) opening one or more valves to admit additional water to flush off the scum and top wash water, (e) closing the water valves, (f) opening the drain valves, (g) opening the water valves to admit rinse water, (h) closing the drain valves, (i) closing the rinse water valves, (j) opening the drain valves, (k) admitting water to the diaphragm valve for drying the clothes by expansion of the diaphragm, (l) dumping the water from behind the diaphragm, (m) closing the drain valves, (n) operating the tub to loosen or "fluff" the clothes, (o) draining all water from the outer container, and (p) stopping the operation of the machine by opening the main switch at the completion of this entire cycle so that the operator can remove from the tub 46 the washed and "dried" clothes.

The operations of the several mechanisms will now be described in the above sequence.

With the hot and cold water valves of the control valve 70 manually opened independently of the cams, as above indicated, the hot water will then flow through the conduit 406 (Fig. 39), the control valve 70, and the conduit 601 to the temperature valve 82, and the cold water will flow through the conduit 407, the valve 70 and the conduit 602 to the temperature valve 82. Water of the desired temperature will then flow from the temperature valve 82 through the conduit 603, the soap container 83, and the conduit 164 into the tub 46.

When the manual lever 683 was turned to open the valves in the automatic control valve 70 to permit filling of the tub, the same operation placed the end of the bell crank 667 (Fig. 18) in engagement with the latch 658 against the tension of spring 662 so as to condition the apparatus for automatic stopping of the filling operation and starting of the motor 66 by the float valve 85.

As the water rises in the tub, the float 632 (Fig. 19) rises with it causing the rod 631 to tilt the lever 636 about its pivot pin and lower the link 642. When the desired water level is reached, the link 642 has moved the lever 648 about its pivot pin to cause the upright arm 649 to engage the free end of the latch arm 656. This action moves the arm 656 clockwise, as viewed in Fig. 18, to release the detent arm 658 from the bell crank lever 667 which then turns counter-clockwise, as viewed in Fig. 18, closing the hot and cold water valves and returning the push rods 338 and 339 (Fig. 12) to normal position with the followers 345 and 346 thereof against the cam

discs 351 and 352, respectively, and closing the auxiliary switch 87 to complete the electrical circuit to the motor 66.

This action sets the tub 46 in operation in the aforementioned wobble action, and also starts operation of the centrifugal pump 67 (Fig. 1) to maintain the latter ready for draining all water reaching the bottom of the outer housing 41. The rotary motion of the motor is further transmitted to the shaft 303, which rotates the cam shaft 356. The shaft 303 also acts to turn the eccentric disc 547 (Figs. 15-17) to cause pumping action of the piston head 518 of the booster pump 75, as above set forth.

Concerning the manual adjustment of the cam discs for a predetermined washing period, this simply means adjusting the position of the cams with respect to the followers so that a certain amount of time elapses before the first cams 421 engage their followers. Referring to the chart, Fig. 37, if the indicator 435 is set at the "0," the cams 421 are then engaging the followers 345 and 346 and there would be no washing period because these cams open the water valves to begin the "flushing" operation, in the form of machine here illustrated. If the indicator 435 is moved to the point marked "5," then the cams 421 are located so that it will take five minutes for them to reach their followers and thus there will be a five minute washing period. Similarly for any of the other positions indicated up to "20," which will allow a washing period of twenty minutes, the maximum for which the present machine is designed, although this maximum may be for any desired time.

Reference has been made above to cams 421 and it will be recalled that cams discs 351 and 352 are duplicates respectively controlling the hot and cold water supply valves. After the operator adjusts the position of the cam shaft 306 for the washing period desired, the sequence and duration of the subsequent operations is fixed by the fixed positions of the cams that initiate and stop the respective operations.

When the cams 421 engage the followers 345 and 346 the hot and cold water valves of the mechanical automatic control valve 70 are opened and maintained open to admit enough water, through the same path as in filling the tub, to float off the scum which accumulates on top of the wash water. This step is known as "flushing" and the flushed water, etc., passes off through the apertures 126 (Figs. 2-4) at the top of tub 46, with or without lifting the tub cover 47, as described in connection with those figures. The peripheral length of the cams 421, as of all the cams, will be chosen to suit the desired duration of the particular operation, so that when the cams 421 pass the followers 345 and 346, the associated water valves close, thus terminating the "flushing" period.

At this time, the cam 423 of the disc 353 engages its follower 347 to open the valve chamber 401 to its outlet port 383, whereupon cold water flows from the cold water valve chamber 400, through the passageway 408, into the chamber 401, through the outlet port 383, and through the conduits 246 (Fig. 39) to the baffle or drain valves 81. This action raises the piston head 248 (Fig. 29) to raise the valve flap 226, whereupon the flushed wash water drains from the tub 46, through the apertures 233, and into the housing 41, from which it is removed by the continuously operating centrifugal pump 67 to a point of disposal, such as a laundry tub or drain. It will be

noted that the tub is continuously gyrating during the draining, so that the tub is quickly and thoroughly emptied.

Shortly before the drain valves 81 are closed, by the passing of the cam 423 from engagement with its follower, the cams 422 of the cam discs 351 and 352 cause a second engagement of the followers 345 and 346 to actuate the water valves to again cause hot and cold and tempered water to flow through the system, as above set forth, and into the tub 46. This is the beginning of the "rinsing" operation and the first rinse water is free to drain out of the tub carrying with it any minor amount of wash water that may have remained in the tub and any sediment that may have settled down with the clothes as the wash water drained off. When the cam 423 passes its follower the drain valves close, and the tub fills with rinse water and overflows through the top apertures 126 and 127, with or without lifting the cover 47 as the case may be. All the time this rinse water is flowing the tub is continuing its gyrating or wobbling so that the clothes are thoroughly rinsed by being tumbled about in the fresh, clear water. As shown in Fig. 37, I have indicated a period of nine minutes for the flow of rinse water before the cams 422 pass their followers to shut off the supply of rinse water.

At this time, the cam 424 of the disc 353, and the cam 427 of the disc 354, simultaneously engage their respective followers 347 and 348. The cam 424 again actuates the baffle valves 81 to drain the tub, as above set forth, and the cam 427 actuates its plunger rod 370, etc., to admit cold water from the passageway 408, into the chamber 402, through the outlet port 384, the conduit 561, and the check valve 80, from which it flows through the conduit 181, to the diaphragm valve 72, which admits the water behind the diaphragm 55 to raise it and press it against the rinsed clothes mass to dry the same. (It has previously been explained how the booster pump will augment the incoming water pressure if and when necessary.)

This action presses the clothes against the tub cover 47 and the side walls of the tub. Water escapes from the top of the tub through the apertures 126 and from the bottom of the tub through the drain ports 233. The same squeezing of the clothes will lift the cover of the tub, if that is necessary in order to bring the apertures 126 and 127 in register to effect draining. Again, the movements of the tub have been continued during these operations so that all water is quickly drained off.

As shown in chart Fig. 37, four minutes are allowed for this drying operation. When the pressure in back of the diaphragm actuates the trip 411 of the trip mechanism 76, or the follower 348 rides off the cam 427, the supply of water to the diaphragm valve is shut off and the valve 72 operates to dump the diaphragm actuating water, as above set forth, and the diaphragm contracts and resumes its place on the tub bottom. Before this action, the bleeder valve 203 has delayed the release of the diaphragm valve 72 for an appreciable interval so that the tightly squeezed clothes are held under the higher pressures while the last bit of water is drained off. After this action, the follower 347 remains on the cam 424 for an additional two minutes during which the dried clothes are tumbled around and loosened or fluffed, after which all of the followers are on the low points of the cams, all valves are closed and all water is shut off.

The further movement of the shaft 356 causes the lever 706 to engage the dog 713 to open the main switch 86, and to stop the machine by interrupting the motor circuit. The operator then removes the dried clothes from the tub 46. If the drying has been so designed, these clothes are hung up to finish drying and "airing," or the clothes are what is known as "ironer damp," which means that they are ready to be ironed.

It will be understood that various of the automatic features can be omitted if desired, such as the float control for automatic starting, for which a time control mechanism could be substituted since the apparatus is designed to admit water at a known rate, and that various other elements may be omitted such as the temperature valve, and the soap container. Furthermore, in some localities where the water pressure would never be too low for the operation of the diaphragm, the booster pump may be omitted. Likewise, if the machine is permanently connected to the pumping system of a house, there would be no need for the centrifugal pump. Again, the drying might be accomplished by other means than the expansible rubber diaphragm, and other mechanisms could be provided for carrying out the several intended functions. Several of the functions above described could be combined, for example, the auxiliary switch could be eliminated, and that mechanism applied to the main switch to automatically start the motor; and the flushing and rinsing operations could be combined, which would eliminate the first draining operation. In this latter case, the admission of the rinse water at the bottom of the tub and the drain openings at the top would be relied upon to remove all of the wash water during the combined flush and rinse periods.

An alternate method of accomplishing the flushing operation without adding water to the article receiving chamber would be to add a short cam to the disc 354 to partially expand the diaphragm which would raise the body of water in the tub to overflow through the top drain openings. After this operation is continued for a definite interval the diaphragm valve 72 would function to release the water from in back of the diaphragm so that the remainder of the entire cycle could proceed as described. Of course, with this method of flushing, the cams 421 now used to open the supply valves for the flushing operations would be omitted.

Various structural changes could be made. For example, other methods of agitating the clothes and water for washing purposes could be substituted for the method described in this application. Furthermore, the cover 47 need not be concave, as shown, but could be flat or convex.

These and other modifications may be made within the spirit and scope of my invention, and all such modifications are intended to be covered by the appended claims.

This application is a continuation of my co-pending application Serial No. 286,303 filed July 25, 1939, now abandoned.

I claim:

1. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply under pressure connected to said machine, motor op-

erated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, means connected to said latter means for boosting the pressure of said water supply to said drying means and arranged automatically to be inactive if the pressure of said water supply is sufficient, and a control arranged to sequentially operate said emptying means, said valve controlled means, and said drying means.

2. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply under pressure connected to said machine, motor operated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, mechanism actuated by the pressure on said drying means to interrupt said water supply to said drying means, and a control arranged to sequentially operate said emptying means, said valve controlled means, and said drying means.

3. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply connected to said machine, motor operated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, means connected to said latter means for boosting the pressure of said water supply to said drying means, mechanism actuated by the pressure on said drying means to interrupt said water supply to said drying means, and a motor operated control unit comprising a cam element, a follower therefor connected to actuate the means for emptying the tub of fluids, a second cam element, a follower therefor connected to actuate the valve means for admitting rinse water to said tub, a third cam element, and a follower therefor connected to actuate the means for drying the articles, said latter connection including a portion actuated by said pressure actuated mechanism.

4. A washing machine wherein articles are washed, the machine is flushed, the washing fluid is drained off, the articles are rinsed in newly supplied water, the articles are dried, and the machine is stopped, these several actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply connected to said machine, manually operated

valve control means connecting the supply to said tub for filling the same, motor operated means for effecting a washing action in said tub, means for closing said valve means and starting said washing action after the tub has been filled to a predetermined level, one or more openings in said tub for draining fluids therefrom, valve controlled means for closing said drain openings, and expansible diaphragm in said tub, valve control means for flexing said diaphragm to dry said articles, and motor operated control means for operating said means in sequence automatically, said control means comprising an element actuated after a predetermined washing interval to again operate the water supply valve means to admit sufficient water to the tub to flush away the wash water scum, a second element actuated after a predetermined flushing interval to cause the drain valve control means to uncover the drain openings, a third element actuated after the drain openings are closed to again operate the water supply valve means to admit a fresh supply of water for rinsing the washed articles, a fourth element actuated after a predetermined rinsing interval to operate the valve control means to cause the drying of the articles, and a fifth element arranged to stop the operation of the motor operated means after the drying action is completed.

5. A washing machine wherein articles are washed, the machine is flushed, the washing fluid is drained off, the articles are rinsed in newly supplied water, the articles are dried, and the machine is stopped, these several actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply connected to said machine, manually operated valve control means connecting the supply to said tub for filling the same, motor operated means for effecting a washing action in said tub, means for closing said valve means and starting said washing action after the tub has been filled to a predetermined level, one or more openings in said tub for draining fluids therefrom, valve controlled means for closing said drain openings, and expansible diaphragm in said tub, valve control means for flexing said diaphragm to dry said articles, and motor operated control means for operating said means in sequence automatically, said control means comprising a shaft, a first cam disc on said shaft, a follower engaging said disc, a cam on said disc for causing the follower to operate the water supply valve means for a predetermined period to flush away the wash water scum, and another cam on said disc for causing the follower to again operate the water supply valve means for a predetermined rinsing period after the wash water is drained off, a second cam disc on said shaft, a follower engaging said disc, a cam on said disc for causing the follower to operate the drain valve control means for a predetermined period after the flushing operation is completed, and another cam on said disc for causing the follower to again operate the drain valve control means for a predetermined period after the rinsing operation is completed, a third cam disc on said shaft, a follower engaging said disc, a cam on said disc for operating the diaphragm valve control means to dry the articles, and a switch to stop the operation of the motor operated means after the drying action is completed.

6. In a washing machine, a tub, a cold water supply, a control unit including a casing, a cold

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water valve chamber therein connected to said supply, a plurality of other valve chambers therein connected to said supply, valves in said chamber for controlling the passage of the water through the corresponding valve chambers, connections from said chambers to said tub, one of said connections including a booster pump mounted upon said casing, a cam compartment in said casing, a motor operated shaft therein, a connection from the shaft to said booster pump, a second shaft, gear reduction means between the said shafts, a cam element for each of said valves and operated by said second shaft, and followers extending between said cam elements and said valves, the cams being arranged so as to actuate the valves in sequence.

7. A washing machine, a tub, motor operated mechanism for agitating the contents of said tub, adjustable means for controlling the operation of said mechanism, a fluid connection to the tub, a control for operating the fluid connection at the termination of the washing action to admit fluid to the tub to cause overflowing and to interrupt said connection after a predetermined interval, valve means for draining the tub, a control for opening said drain means for a predetermined interval, a control for again opening said fluid means prior to the termination of the drain interval for again admitting fluid to the tub for a predetermined period during which the fluid again overflows from the tub, the agitation mechanism continuing to operate during this latter interval, expansible and contractable means for drying the contents of the tub, a control for actuating said drying means, another control arranged to simultaneously open the drain means for a predetermined period, the mechanism for agitating the clothes operating for an interval after the drying operation is completed, and a control for stopping the operating of said mechanism and said controls.

8. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising an expansible and contractable tub for containing the articles, motor operated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the wash fluid from said tub after a predetermined washing interval, valve controlled means for admitting fluid to said tub for rinsing the washed articles, valve controlled means for contracting said tub for drying the articles after the rinsing action is completed, and a motor operated control comprising an element mechanically actuated by said control to empty the tub of fluids, another element mechanically actuated by said control for mechanically operating the valve controlled means for admitting rinse fluid to said tub, and control means effecting the contraction of said tub to dry said articles and expanding said tub after the drying operation is completed, said latter means including a mechanical connection to the valve control therefor and pressure responsive means for interrupting that mechanical connection.

9. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, comprising a tub for containing the articles, a water supply under pressure connected to said machine, motor operated means for effecting a washing action in said tub,

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one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, and means connected to said latter means for boosting the pressure on said drying means beyond that of said water supply.

10. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, comprising a tub for containing the articles, a water supply under pressure connected to said machine, motor operated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, means connected to said latter means for boosting the pressure of said water supply to said drying means, and mechanism actuated by the pressure on said drying means to interrupt said water supply to said drying means.

11. A washing machine wherein articles are washed, the washing fluid is drained off, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, a water supply under pressure connected to said machine, motor operated means for effecting a washing action in said tub, one or more openings in said tub for draining fluids therefrom, means for emptying the washing fluid from said tub after a predetermined washing interval, valve control means for admitting water to said tub for rinsing the washed articles, means operated by the water supply for drying the articles after the rinsing action is completed, means connected to said latter means for boosting the pressure on said drying means beyond that of said water supply, and a control mechanism comprising an element connected to the washing action motor for starting and stopping the same, a second element connected to the emptying means to open and close the same, a third element connected to said rinse water valve control means to open and shut off the supply of rinse water, and a fourth element controlling the water supply to said drying means, whereby the washing, rinsing and drying operations of said machine are automatically sequentially controlled.

12. In a washing machine, a tub, a hot water supply, a cold water supply, means for agitating clothes and water in the tub, a drain outlet in the upper portion of said tub, and means for producing an operating cycle in the tub of washing, flushing, rinsing, flushing and drying in the order named, said latter means including a control unit having a casing, a valve chamber therein connected to the hot water supply, a valve chamber therein connected to the cold water supply, a plurality of other valve chambers therein communicating with said cold water supply, a valve in each of said chambers for controlling the passage of the hot and cold water through the corresponding valve chambers, motor operated cam means mounted in said casing and connected to said valves so as to actuate the same, a tempera-

ture control valve receiving hot and cold water from the control unit and delivering tempered water therefrom and having means for controlling the temperature of the delivered water, a connection to the tub receiving the tempered water, and separate connections to the tub from said other valve chambers.

13. In a washing machine, a tub, a hot water supply, a cold water supply, means for agitating clothes and water in the tub, a drain outlet in the upper portion of said tub, and means for producing an operating cycle in the tub of washing, flushing, rinsing, flushing and drying in the order named, said latter means including a control unit having a casing, a valve chamber therein connected to the hot water supply, a valve chamber therein connected to the cold water supply, a plurality of other valve chambers therein connected to said cold water supply, valves in said chambers respectively controlling the passage of the water through the corresponding valve chambers, an inlet connection in said tub connected to the hot and one of said cold water supply valves, connections from said other cold water supply valves to said tub, a cam compartment in said casing, a motor operated shaft therein, a cam element for each of said valves and operated by said shaft, and followers extending between said cam elements and said valves, the cams actuating said valves.

14. In a washing machine, a tub, a hot water supply, a cold water supply, means for agitating clothes and water in the tub, a drain outlet in the upper portion of said tub, and means for producing an operating cycle in the tub of washing, flushing, rinsing, flushing and drying in the order named, said latter means including a control unit having a casing, a valve chamber therein connected to the hot water supply, a valve chamber therein connected to the cold water supply, a plurality of other valve chambers therein connected to said cold water supply, valves in said chambers respectively controlling the passage of the water through the corresponding valve chambers, an inlet connection in said tub connected to the hot and one of said cold water supply valves, connections from said other cold water supply valves to said tub, a cam compartment in said casing, a motor operated shaft therein, a cam element for each of said valves and operated by said shaft, followers extending between said cam elements and said valves, the cams actuating said valves to operate the several controls, a manually operated connection by which said hot and cold water supply valves may be opened independently of said motor operated control therefor, means for retaining said manual control in position with the valves open, and means actuated by the quantity of water admitted to the tub after the manual operation of the hot and cold water supply valves to release the retaining means and condition the apparatus for control by said cams.

15. A washing machine wherein articles are washed, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, means operable to supply washing liquid to said tub, motor operated means for effecting a washing action in said tub, openings in at least the upper portion of said tub arranged for draining liquids therefrom, controlled valve means operable to admit liquid to said tub for rinsing the washed articles, fluid operated expansible and contractable means for

flushing at least a portion of the washing and rinsing liquids through said upper openings and for drying the articles, and motor operated control means comprising a plurality of elements connected to said valve means and to said expansible and contractable means for effecting said flushing, rinsing and drying.

16. A washing machine wherein articles are washed, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, means operable to supply washing fluid to said tub, motor operated means for effecting a washing action in said tub, openings in at least the upper part of said tub arranged for draining fluids therefrom, valve controlled means operable to flush at least a portion of the wash fluid through said upper openings after a predetermined washing interval and for admitting fluid to said tub for rinsing the washed articles, fluid operated expansible and contractable means for drying the articles after the rinsing action is completed, and motor operated control means comprising a plurality of elements connected to said flushing, rinsing and drying means to effect operations thereof respectively.

17. A washing machine wherein articles are washed, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, means operable to supply washing fluid to said tub, motor operated means for effecting a washing action in said tub, openings in the upper and the lower portions of said tub for draining fluids therefrom, valve controlled means operable to flush wash fluid from said tub through said upper openings after a predetermined washing interval and for admitting fluid to said tub for rinsing the washed articles, fluid operated expansible and contractable means for drying the articles after the rinsing action is completed, the lower openings being operable for draining the tub prior to the rinsing operation and in the drying operation, and a motor operated control unit comprising a plurality of cam elements and followers respectively connected to said means for effecting said flushing, rinsing and drying.

18. A washing machine wherein articles are washed, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions occurring in sequence automatically, comprising a tub for containing the articles, a source of water supply under pressure and connected to said tub, motor operated means for effecting a washing action in said tub, openings into the upper portion of said tub for draining fluids therefrom, the tub having a movable wall element operable by said pressure water to flush at least a portion of the wash fluid from said tub through said upper openings after a predetermined washing interval, valve controlled means for admitting fluid to said tub for rinsing the washed articles, said flushing means being operable to dry the articles after the rinsing action is completed, a motor operated control means comprising an element effecting movement of said wall element for flushing, another element operating the valve controlled means for admitting rinse fluid to said tub, and another element operating the movable wall for effecting the drying of said articles.

19. A washing machine wherein articles are washed, the articles are rinsed in newly supplied fluid and afterwards are dried, these actions oc-

curing in sequence automatically, comprising a tub for containing the articles, a source of fluid supply connected to said tub, motor operated means for effecting a washing action in said tub, openings in at least the upper portion of said tub for draining fluids therefrom, means admitting fluid to the machine for flushing at least a portion of the wash fluid from said tub through said upper openings after a predetermined washing interval, valve controlled means operable to admit fluid to said tub for rinsing the washed articles, expansible and contractable means for drying the articles after the rinsing action is completed, and a motor operated control means comprising a plurality of elements for operating the means for flushing, the means for admitting rinse fluid to said tub, and the means for effecting the drying of said articles.

20. A washing machine wherein articles are washed, flushed, rinsed, flushed and dried, these actions occurring in sequence automatically, comprising a tub for containing the articles and washing and rinsing liquids, a water supply under pressure connected to said machine, means for effecting washing action in said tub, an opening in said tub for flushing liquid and the floating and suspended foreign matter therefrom, means for admitting washing and rinsing liquids to said tub, means for contracting the space in the tub and operated by the pressure water supply for drying the articles after the rinsing action is completed, means connected to said latter means for boosting the pressure of said water supply to said drying means, and a control arranged to sequentially operate said means to wash, flush, rinse, flush and dry said articles.

21. A washing machine wherein articles are washed, flushed, rinsed and dried comprising a tub for containing the articles and washing and rinsing liquids, a water supply under pressure connected to said machine, means for effecting a washing action in said tub, an opening into the upper portion of said tub for flushing therefrom liquid and the floating and suspended foreign matter therein, means for admitting washing and rinsing liquids to said tub, means for contracting the space in the tub and operated by the pressure water supply for drying the articles, and means connected to said latter means for boosting the pressure of said water supply to said drying means.

22. A washing machine wherein articles are washed, flushed, rinsed and dried comprising a tub having a space for the reception of articles and liquids, means for effecting a washing action in said tub, an opening in the upper portion of said tub, means for supplying washing and rinsing liquids to said space, means for contracting said space, and means for admitting water in large volume at low pressure and in small volume at high pressure for operating said contracting means to flush out of said space liquid and floating and suspended foreign matter therein and to squeeze the articles to dry the same.

23. A washing machine for clothes and the like comprising a tub for the clothes and washing and rinsing liquids and having a drain outlet opening into the upper portion of the tub, means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means having a marginal portion sealed to the tub and being operable to raise the liquid to cause liquid and floating and suspended foreign matter therein

to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, and means for controlling the agitation of the clothes during washing and rinsing, and the operation of the contracting means to secure a flushing operation after a washing interval and a squeezing operation after a rinsing interval.

24. A washing machine for clothes and the like comprising a tub for the clothes and having an imperforate liquid containing portion, means in the tub for agitating the contents thereof, a drain outlet opening into the portion of the tub beyond the imperforate portion, means for admitting washing and rinsing liquids to the tub, means for contracting the space in the tub, the contracting means being operable to move liquid from said imperforate portion to cause liquid and floating and suspended foreign matter therein to be flushed out from said tub through said drain outlet and to squeeze the clothes in the tub to dry the same, and means for controlling the agitation of the clothes during washing and rinsing, and the flushing and squeezing by the contracting means.

25. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means being operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes in the tub to dry the same, means operable after a washing interval to control the admission of rinsing liquid to overflow the tub for an interval of rinsing, means arranged to control the agitation of the clothes and water in the tub to agitate the same during the washing and rinsing intervals and also in the course of the flushing out operation, and means arranged to control the flushing and squeezing by the contracting means.

26. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means being operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes in the tub to dry the same, means operable after a washing interval to control the admission of rinsing liquid, means arranged to control the flushing and squeezing by the contracting means, and means arranged to control the agitation of the clothes in the tub during the washing and rinsing intervals and to continue the agitation of the clothes in the tub after the squeezing operation.

27. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub, a further drain outlet opening into the lower portion of the tub, and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means being operable to cause liquid in the tub and floating and suspended foreign matter therein to be

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flushed out from said tub through said upper drain outlet and to squeeze the clothes in the tub to dry the same, means operable after a washing interval to control the admission of rinsing liquid with at least a portion of the rinsing liquid being admitted while said bottom drain outlet is open and thereafter continuing the admission of rinse water to overflow the tub through said upper drain outlet for an interval of rinsing, means arranged to control the flushing and squeezing operations of the contracting means, and means arranged to control the agitation of the clothes in the tub during the washing and rinsing intervals.

28. A washing machine for clothes and the like comprising a tub for the clothes, the tub having an access opening in the upper portion thereof, a cover for said opening, a drain outlet comprising apertures disposed about said opening, and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleans the clothes, means for contracting the space in the tub, the contracting means having a marginal portion connected in fluid-tight relation to said tub and being operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said apertures and to squeeze the clothes in the tub to dry the same, and means for controlling the admission of the rinsing liquid after a washing interval, the agitation of the clothes during washing and rinsing, and the operation of the contracting means to secure a flushing operation after a washing interval and a squeezing operation after a rinsing interval.

29. A washing machine for clothes and the like comprising a tub for the clothes, means in the tub for agitating the contents thereof, the tub having an access opening in the upper portion thereof, a perforated cover for said opening and comprising an upper drain outlet for the tub, and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means being operable to move the liquid in the tub to cause liquid and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes in the tub to dry the same, and means for controlling the agitation of the clothes during washing and rinsing, and the flushing and squeezing by the contracting means.

30. A washing machine for clothes and the like comprising a tub for the clothes, having a portion against which the clothes are squeezed, a drain outlet in the tub adjacent said portion, and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a diaphragm having a marginal portion sealed to the tub and operable to contract the space in the tub so as to move the body of liquid from the tub to said drain outlet and to squeeze the clothes in the tub to dry the same, and means for controlling the admission of the rinsing liquid after a washing interval, the agitation of the clothes in the course of the washing, rinsing and flushing intervals, and the operation of said diaphragm to secure a liquid removal after a washing interval and a squeezing of the clothes in the tub after a rinsing interval.

31. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting wash-

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ing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in the tub to normally overlie the bottom of the tub and being operable to raise the contents of the tub to cause the body of liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes against the tub adjacent the upper drain outlet to dry the same, and means for controlling the agitation of the clothes in the course of the washing, rinsing and flushing intervals, and the operations of the diaphragm to secure a flushing operation after a washing interval and a squeezing operation after a rinsing interval.

32. A washing machine for clothes and the like comprising a tub having separate wall parts and arranged for the reception of the clothes, the tub also having an access opening in the upper portion of the tub, a drain outlet opening into the upper portion of the tub, and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm having its edges clamped between parts of the tub walls, a ring of channel section securing the parts and diaphragm together in water-tight relation, the diaphragm being operable to cause liquid and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, and means for controlling the admission of the rinsing liquid, the agitation of the clothes to cleanse the same, and the flushing and squeezing operations of the diaphragm.

33. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in the tub to divide the tub into a space for the reception of clothes and liquids and a pressure space, said diaphragm normally extending adjacent a wall of the tub, the diaphragm being operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, an opening into the tub behind said diaphragm, a source of pressure fluid connected to the tub behind said diaphragm, an outlet opening for the pressure fluid, means associated with the latter opening to prevent the diaphragm from sealing said opening whereby the pressure fluid may escape from behind the diaphragm, and means for controlling the admission of rinsing liquid to said tub, the agitation of the clothes to cleanse the same, and the admission and removal of the pressure fluid to operate said diaphragm for said flushing and squeezing.

34. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in the tub to divide the tub into a space for the reception of clothes and liquids and a pressure space, said diaphragm normally extending adjacent a wall of the tub, the diaphragm being operable to cause liquid in the tub and floating and suspended foreign mat-

ter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, an opening into the tub behind said diaphragm, a source of pressure fluid connected to the latter opening, a plurality of passageways interconnecting the latter opening and the pressure space, and means for controlling the admission of rinsing liquid to said tub, the agitation of the clothes to cleanse the same, and the admission and removal of the pressure fluid to operate said diaphragm for said flushing and squeezing.

35. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, means for contracting the space in the tub, the contracting means being operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, a source of fluid under pressure and including a pump connected to said machine and arranged to operate said contracting means, a valve controlling said pressure fluid, control means for actuating said valve, said control means including a displaceable link, and connections to actuate said link in accordance with the pressure on the contracting means for preventing excess pressure being developed upon said contracting means by said pressure fluid.

36. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in said tub and operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, an inlet connection to said tub behind said diaphragm, a source of fluid under pressure and including a pump connected to said inlet, and a bleeder valve in communication with the space behind the diaphragm to which the pressure fluid is admitted and arranged to by-pass a portion of the pressure fluid from said space.

37. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in said tub and operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, an inlet connection to said tub behind said diaphragm, a source of pressure water connected to said inlet connection and arranged to operate said diaphragm, a pump connected to said inlet and arranged to supply fluid under pressure behind said diaphragm to augment the pressure of said water supply, and a valve connected to said inlet and having an element movable in accordance with the pressure on the diaphragm for reducing the flow of pressure fluid to the diaphragm.

38. A washing machine for clothes and the like comprising a tub for the clothes, the tub having a drain outlet opening into the upper portion of

the tub and means for admitting washing and rinsing liquids to the tub and for agitating the contents of the tub to cleanse the clothes, a flexible diaphragm mounted in said tub and operable to cause liquid in the tub and floating and suspended foreign matter therein to be flushed out from said tub through said upper drain outlet and to squeeze the clothes to dry the same, an inlet connection to said tub behind said diaphragm, a source of pressure water including a pump connected to said inlet and arranged to operate said diaphragm, a valve connected to the space behind the diaphragm having a movable valve element which element is movable in response to a decreasing fluid pressure on the diaphragm to open said valve to drain the pressure fluid from the space behind said diaphragm.

39. A laundry machine comprising a container adapted to receive material to be cleaned, means for directing washing fluid and rinsing fluid to said container and for washing and rinsing the material in said container, diaphragm means in said container for removing the washing fluid and rinsing fluid therefrom and extracting the same from said material, pump means for directing a pressure fluid to said container and against said diaphragm means to effect said extracting operation, a valve controlling the supply of pressure fluid to said container, a valve controlling the draining of the pressure fluid from the container, and control means for delaying the operation of said draining valve while maintaining the diaphragm means subject to said fluid pressure.

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