Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 1

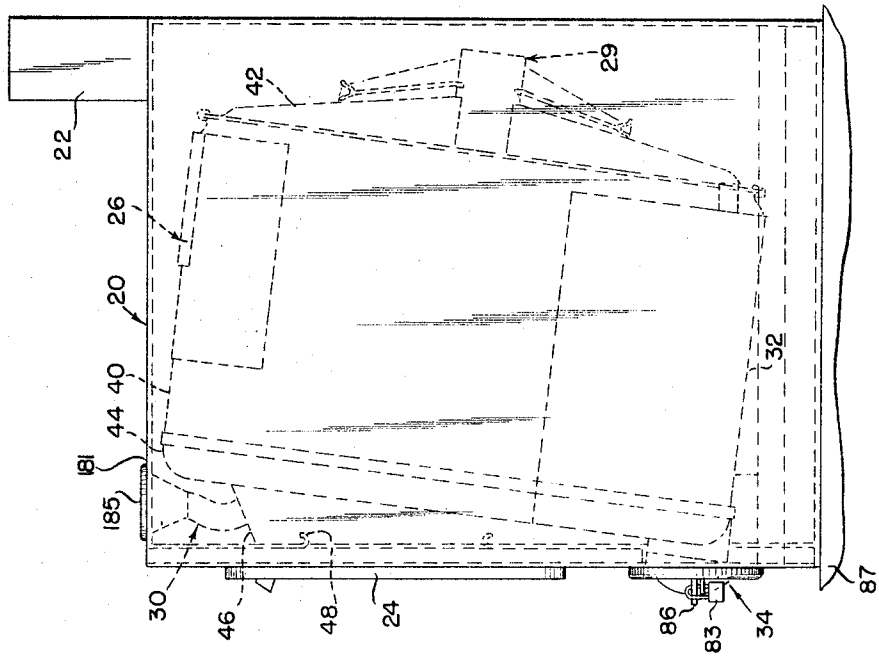


FIG. 2

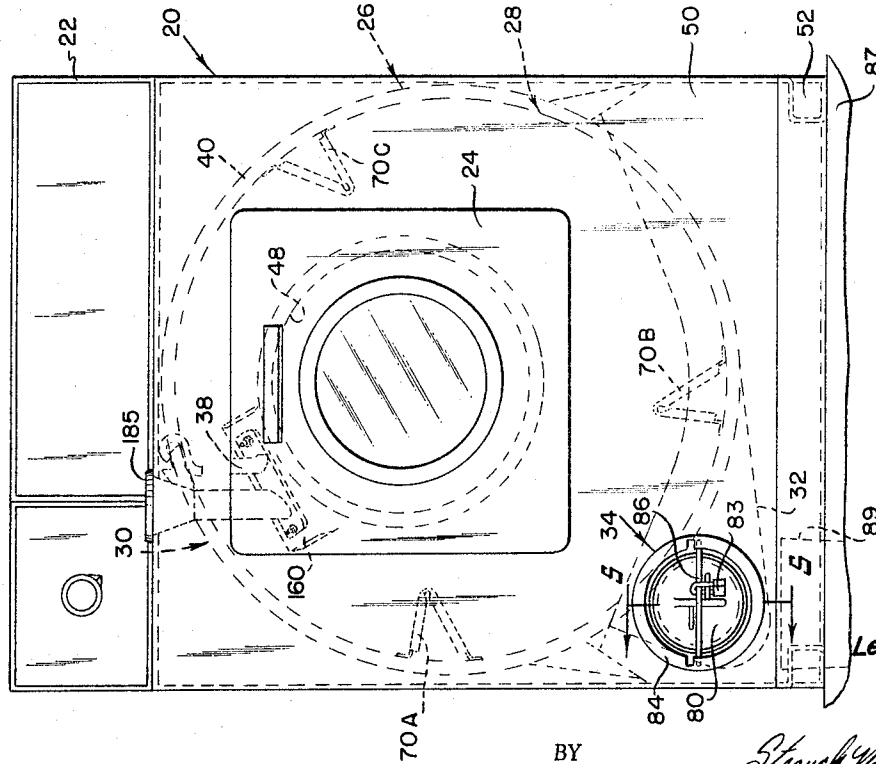


FIG. 1

INVENTOR
Lewis O. Engel

BY

Staudt, Nolan & Neale
ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 2

Fig. 3

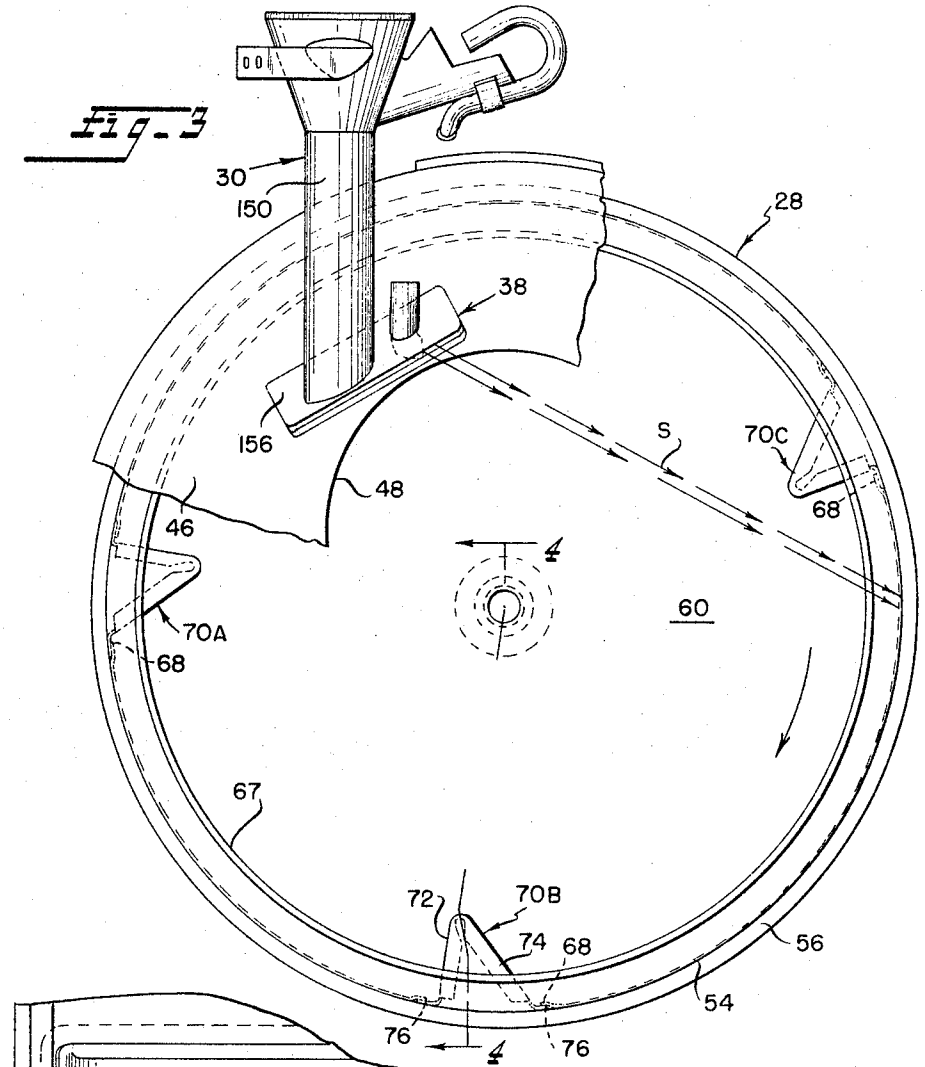
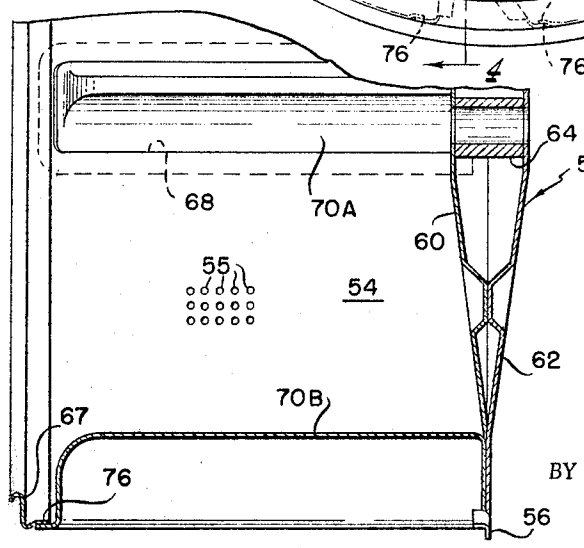


Fig. 4



INVENTOR
Lewis O. Engel

BY

ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 3

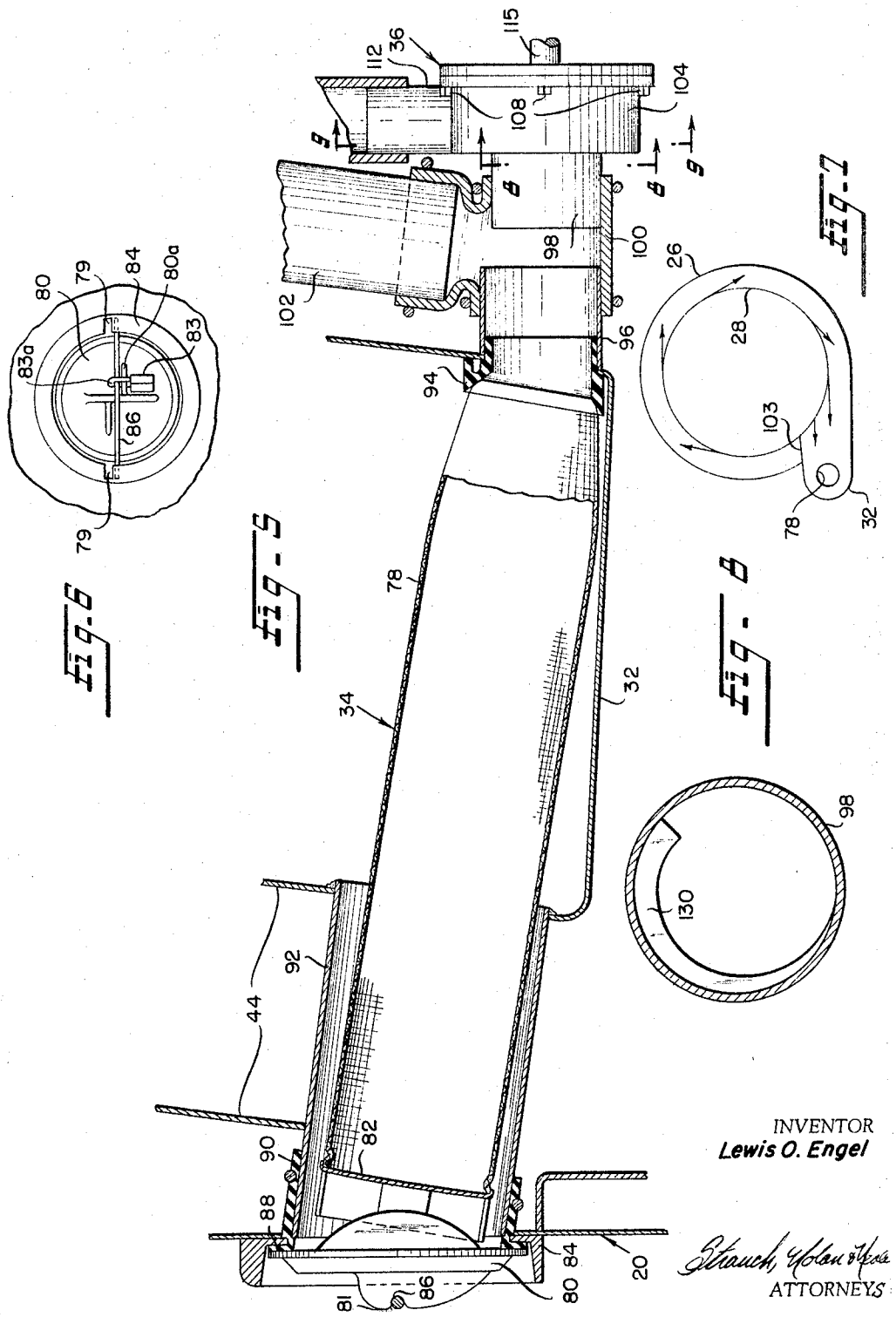


Fig. 6

Fig. 5

Fig. 7

Fig. 8

INVENTOR
Lewis O. Engel

Strauch, Nolan & Hoss
ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 4

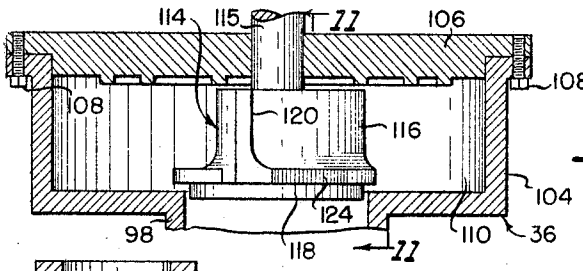


Fig. 10

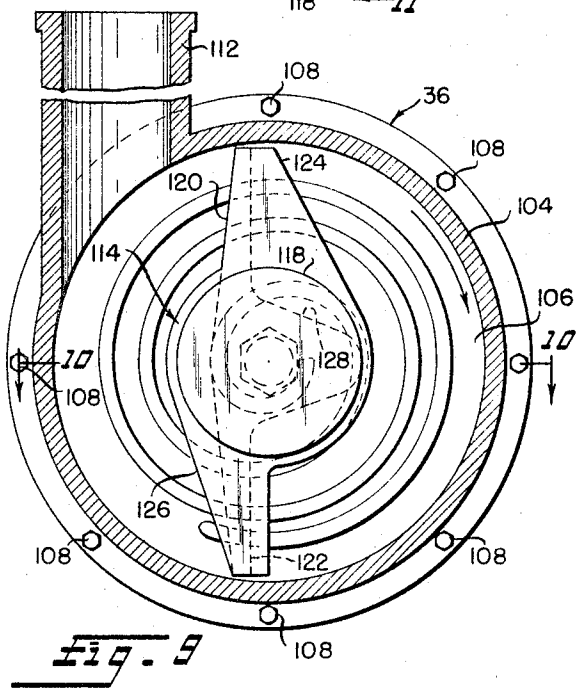


Fig. 9

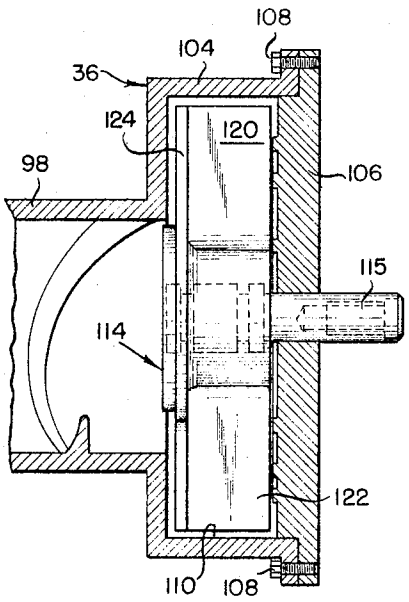


Fig. 11

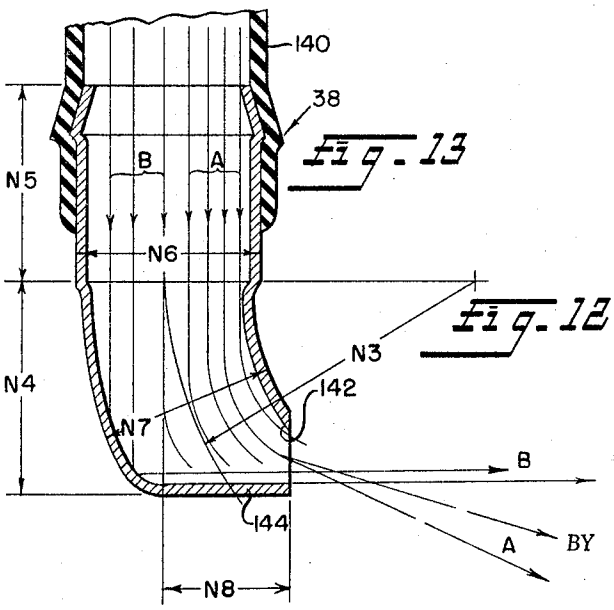
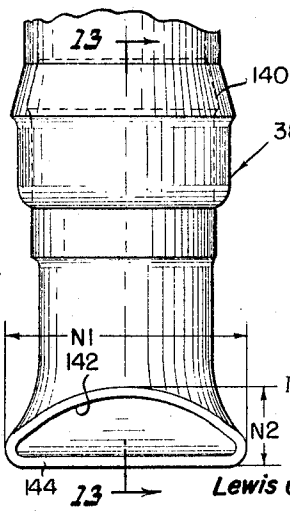


Fig. 13

Fig. 12



INVENTOR

Lewis O. Engel

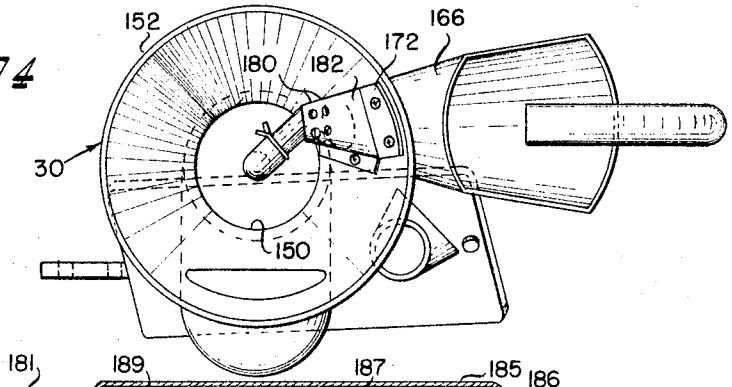
Strauch, Nolan & Neale ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 5

Fig. 14



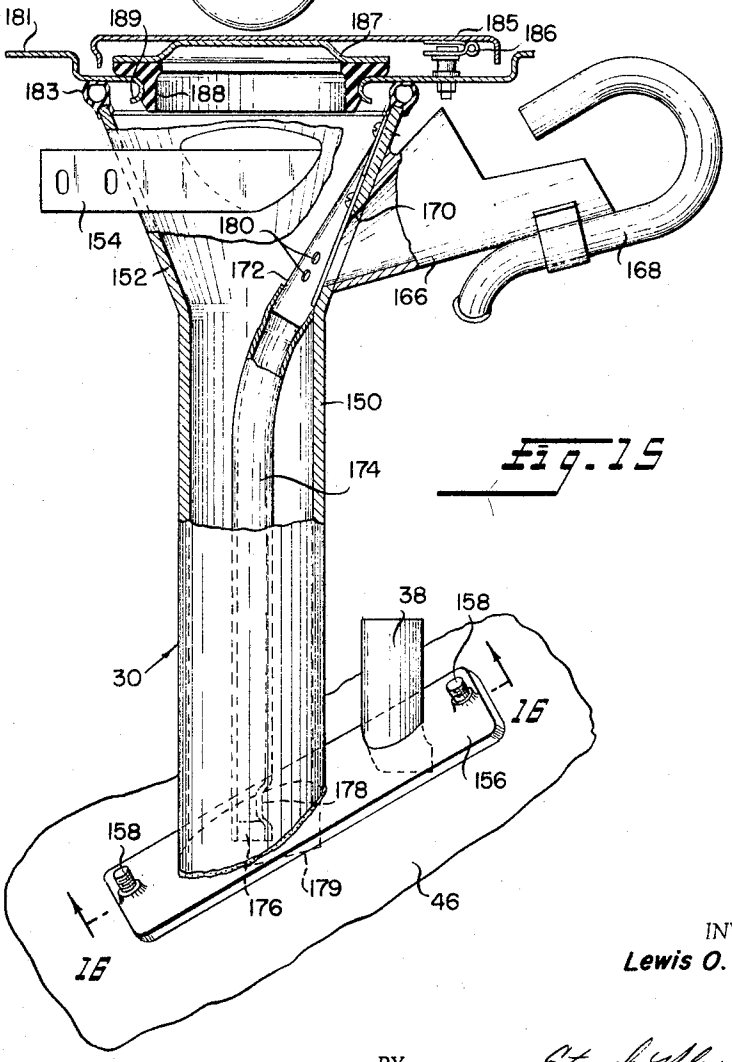


Fig. 15

INVENTOR
Lewis O. Engel

BY Strauch, Nolan & Neale
ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 6

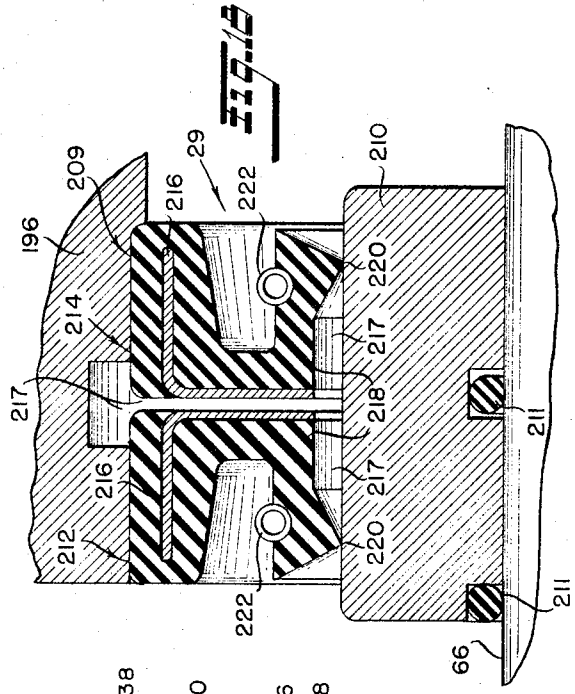


FIG. 18

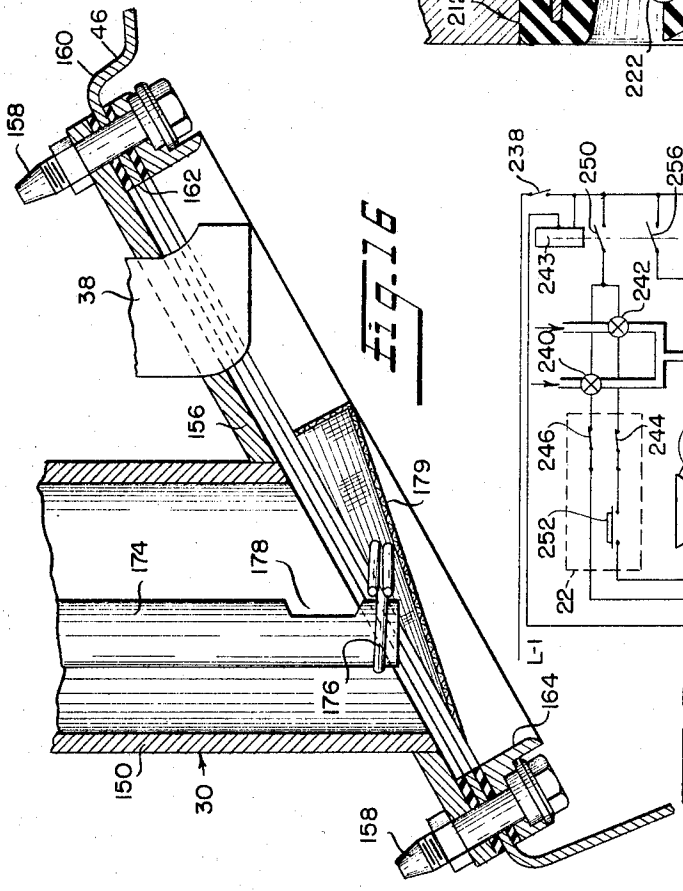


FIG. 16

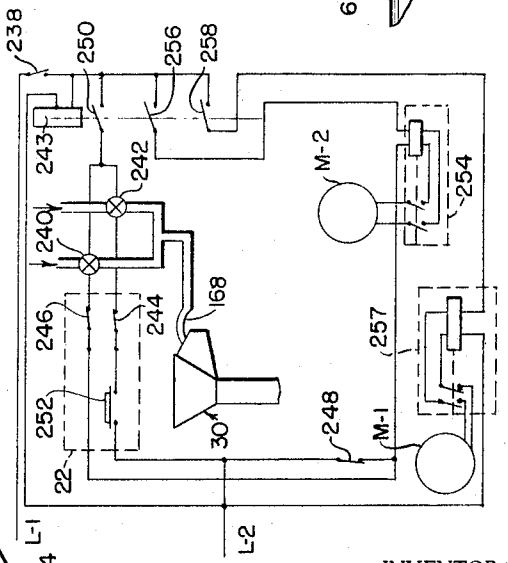


FIG. 17

INVENTOR
Lewis O. Engel

Strauch, Nolen & Hoes
ATTORNEYS

Sept. 6, 1966 L. O. ENGEL 3,270,529

LAUNDRY EQUIPMENT

Filed Feb. 25, 1964 7 Sheets-Sheet 7

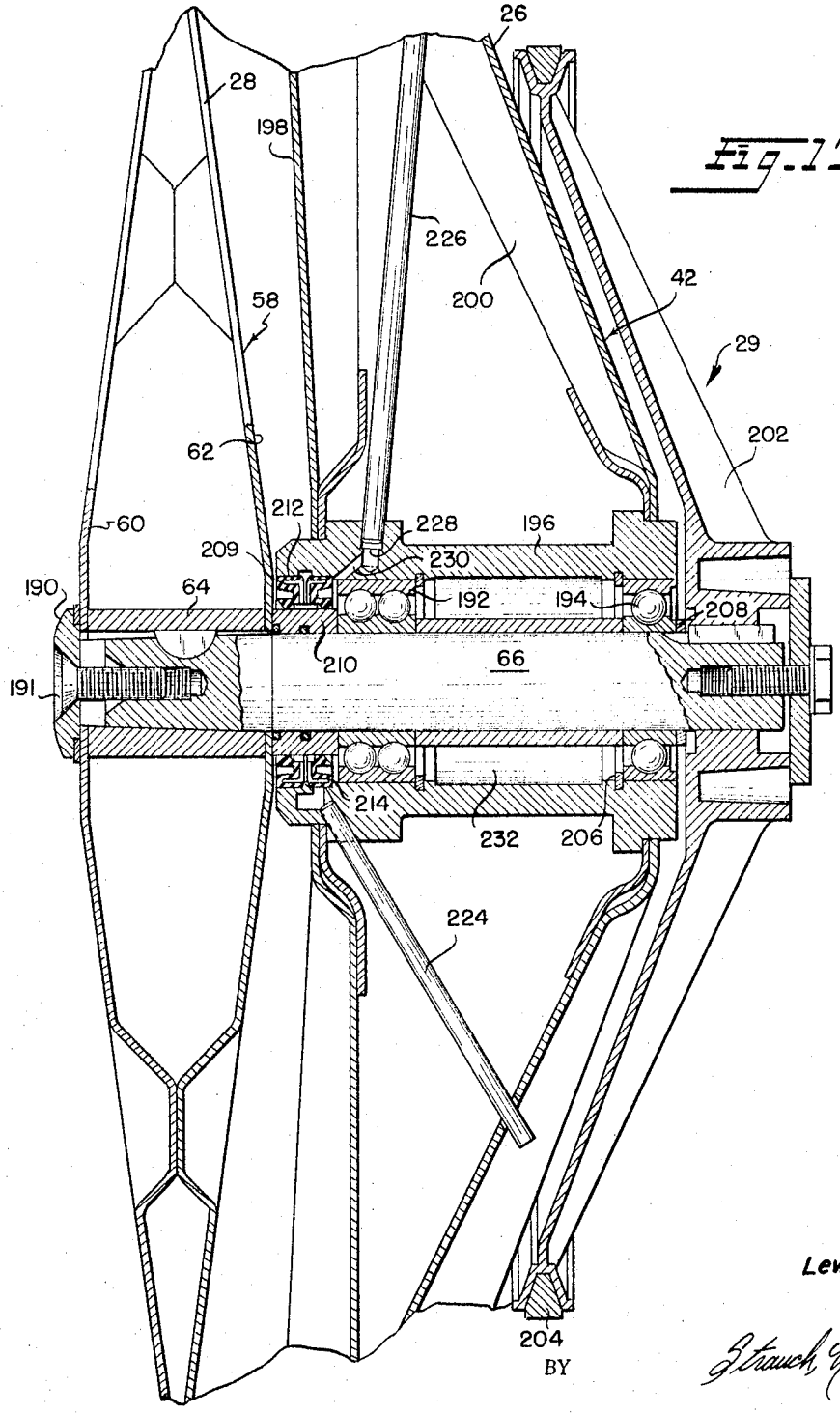


Fig. 17

INVENTOR
Lewis O. Engel

Strauch, Nolan & Neale
ATTORNEYS

United States Patent Office

3,270,529

Patented Sept. 6, 1966

3,270,529

LAUNDRY EQUIPMENT

Lewis O. Engel, Euclid, Ohio, assignor to Hupp Corporation, Cleveland, Ohio, a corporation of Virginia

Filed Feb. 25, 1964, Ser. No. 347,296
9 Claims. (Cl. 68—18)

This invention relates to laundry equipment and more particularly to such equipment of the type in which the clothes or other articles to be treated are tumbled in a receptacle rotated about an essentially horizontal axis.

While the invention is concerned primarily with washing equipment (either using soap or detergent and water or using dry cleaning fluid), it is in certain aspects applicable to other laundry equipment and machines, including drying equipment.

Despite the extensive development of washing machines over the years, certain problems, some of which are quite basic, remain. These problems have been rendered more acute by the advent of the public coin operated laundry facilities in which the equipment is subject to extraordinarily heavy use and occasional abuse. Machines suited for this type of service must be particularly efficient, durable and trouble free, economical in operation and capable of producing superior results consistently over a long period of time.

It is a principal purpose and object of the present invention to provide improved laundry equipment satisfying these requirements to an extent not heretofore attained.

In washing machines of the so-called tumbler type the efficiency of the cleaning action, which is often termed washability, is dependent on a number of factors. Of primary importance is the ability of the tumbler to expose all of the clothes or other articles to the same uniform action. A principal unsolved problem in prior machines is the tendency of the clothes to form balls which rotate at the center of the tumbler receptacle and thus are not exposed to the tumbling and washing action.

It is a further important object of the present invention to provide improved tumbler mechanisms which solve this problem and which, when incorporated in a washing machine, substantially improve the washability and when incorporated in a drying machine substantially reduce the drying time.

Washability is also affected by the manner in which the wash water and detergent or other cleaning liquid is supplied to and circulated through and around the clothes.

It is also an object of the present invention to provide unique water circulation equipment which is effective to establish an optimum flow pattern of water and detergent while simultaneously delivering the detergent in optimum form for effective cleaning action.

It is a further object of the present invention to provide improved laundry machines which are exceptionally rugged and which have an extended trouble free life.

Additional objects will become apparent as the description proceeds in connection with the accompanying drawings in which:

FIGURE 1 is a front view of the laundry machine embodying the present invention with parts broken away to show interior details;

FIGURE 2 is a side view of the machine of FIGURE 1;

FIGURE 3 is an enlarged front elevation of the inner rotating tub with parts of the surrounding structure removed for clarity;

FIGURE 4 is a fragmentary section taken along line 4—4 of FIGURE 3;

FIGURE 5 is a vertical section taken along line 5—5 of FIGURE 1 showing details of the sump filter and a portion of the water recirculation system;

FIGURE 6 is a front view of the filter assembly in the assembled position shown in FIGURE 5;

FIGURE 7 is a diagrammatic view showing the inner tub, outer tub, sump and filter in reduced scale;

FIGURE 8 is a transverse section taken along line 8—8 of FIGURE 5 showing additional details of construction;

FIGURE 9 is a central vertical section taken along line 9—9 of FIGURE 5 showing the interior of a water recirculation pump;

FIGURE 10 is a horizontal section taken along line 10—10 of FIGURE 9;

FIGURE 11 is a vertical section taken along line 11—11 of FIGURE 10;

FIGURE 12 is an enlarged view of the water recirculation nozzle shown removed from the remainder of the apparatus;

FIGURE 13 is a central vertical section taken along line 13—13 of FIGURE 12;

FIGURE 14 is a top plan view of a detergent dispensing mechanism;

FIGURE 15 is an enlarged front view of the dispensing mechanism partly in section;

FIGURE 16 is a section taken along line 16—16 of FIGURE 15 showing additional details of the dispensing mechanism;

FIGURE 17 is an enlarged fragmentary vertical section showing a bearing and seal construction for rotatably supporting the inner tub;

FIGURE 18 is an enlarged fragmentary vertical section through the seal of FIGURE 17; and

FIGURE 19 is a simplified wiring diagram of a portion of the wiring diagram for this laundry machine, which includes a flushing circuit for the detergent dispenser and a holding circuit for continuing the extraction cycle in spite of suds pressure within the machine.

The laundry machine of the present invention is the front loading type in which the clothes to be washed are received in a drum or tub which is mounted for rotation in one direction about an essentially horizontal axis. All of the washing action is effected by either tumbling or spinning the clothes in the inner drum, tht drum being rotated at a relatively slow speed for effecting the tumbling action and the drum being rotated at a relatively higher speed for effecting the spinning action which is employed for extracting moisture from the clothes.

By the utilization of essentially conventional controls and timing equipment, which are well known in the art and will not be described in detail here, the machine is operated automatically through a cycle of approximately 30 minutes.

The machine is first filled to a predetermined level with heated water, the water being supplied in such a manner that the detergent is automatically introduced. The inner tub is then rotated at a relatively slow speed, for example 51–53 r.p.m. for an inner tub having an inner diameter of 24 inches, during which time the water and detergent are constantly recirculated through and around the clothes in a novel manner to be described below. The wash water is then drained and the tub is rotated at an elevated speed, for example 200 or 400 r.p.m., to extract the moisture from the clothes. A fresh supply of water is then introduced into the machine and the wash-drain, spin and drain cycles are repeated. In a typical cycle the clothes are rinsed twice by continuing the tumbling action at a relatively low speed with the introduction of additional water while the tumbling action is changed in a manner described below.

The machine of the present invention is housed in an essentially cubical cabinet **20** having a control panel **22** projecting upwardly from its rear surface and a bottom hinged access door disposed centrally of its front face. The principal structural components of the washing machine, which will be described in detail below, include the outer fixed drum or tub **26**, inner rotating tub **28**, which

is supported for rotation in a novel bearing and seal construction indicated generally at 29, a novel detergent dispenser apparatus 30 and a water recirculation system including a sump 32 formed integrally with the outer tub 26, a filter construction 34, a pump 36 and a recirculation nozzle 38 to which water is delivered by the pump 36.

The mechanism for driving the inner tub at two speeds, portions of the control apparatus including thermostats, valves, and the like may be of wholly conventional construction and have been omitted since they do not by themselves form a part of the present invention.

With continuing reference to the drawings, the outer tub 26, which is of water tight construction, includes a generally cylindrical body 40 which is closed at its rearward end by a conical bottom wall structure 42. The front of the drum 26 is formed by a face plate 44 having a central embossment 46 in which a circular access opening 48 is formed. The front face of the embossment 46 is suitably secured to the front panel of the cabinet 20 and the tub per se is also securely mounted within the cabinet by a mount structure indicated generally at 50 welded to the tub 26 and secured as by screws to the lower frame 52 of the cabinet. It will be noted that the form of the embossment 46 and the mounting structure 52 are such that the tub 26 is supported at an angle with respect to the horizontal. Preferably the angle is such as to give the rotational axis of tub 26 a rearward inclination of about 7° with respect to the horizontal.

The inner tub assembly 28, which is supported by the bearing and seal assembly 29 to be described in detail below, comprises an essentially cylindrical body member 54 provided with a number of relatively small perforations 55 over the entire member 54 (only a few perforations 55 being shown in FIGURE 4 for purposes of illustration) to permit the passage of water therethrough. At its rearward edge the cylindrical tub member 54 is provided with a radial flange 56 to which a panel and hub assembly 58 is peripherally welded. The assembly 58 includes inner and outer walls 60 and 62 providing a rigid support for a hub 64 to which a drive and support shaft 66 is rigidly secured. To impart additional rigidity to the inner tub assembly it is provided with an inwardly projecting stiffening lip 67 around its forward edge. The cylindrical wall 54 of the tub is provided with three identical rectangular cutouts 68 for the reception of three identical clothes engaging baffles 70A, 70B, and 70C generically called hereafter baffles 70. The baffles are triangular in section and are preferably formed from a single piece of metal bent to the desired shape. As best shown in FIGURE 3 each of the baffles is shaped to provide a forward radial surface 72 and a rearwardly facing inclined surface 74. The bases of the baffles are provided with outwardly projecting flanges 76 which are spot welded to offset portions of the tub 28 forming the margins of the cutouts 68.

The unique disposition of the baffles 70 within the inner tub 28 forms an important feature of the present invention to which many of its advantages are attributable. As best shown in FIGURE 3 the spacing between adjacent baffles is increased in a direction opposite to the direction of rotation indicated by the arrow in FIGURE 3. More specifically, proceeding around the drum in a direction opposite to the direction of rotation, the spacing between the baffles 70A and 70B is 90°, the spacing between the baffles 70B and 70C is 120° and the spacing between the baffles 70C and 70A is 150°. Thus, as the drum is rotated, the clothes deposited therein are subject to driving impulses applied in a series of regularly increasing intervals, the series of driving impulses being repeated in a regular sequence. The many advantages of this unique arrangement of the baffles are realized in combination with other features of the apparatus as will become apparent as the description proceeds.

Throughout the washing and rinsing cycles the wash water is constantly recirculated by a system including a number of novel components, which, in cooperation contribute significantly to the improved performance of the subject equipment. This system which includes the filter assembly 34, the pump 36, the nozzle 38 and an automatic suds vent will now be described in detail.

It has long been recognized as highly desirable, if not essential, that a trap or filter be provided in coin operated laundry machines to prevent the passage of foreign objects into the inlet of the pump or into the building drain system. Most prior machines are equipped with a box type sump located in the lower quadrant of the outer tub to collect water and to facilitate draining of the machine and include a screen trap or filter in the sump region. However, it has been found that such screens, especially when located on the bottom of the sump, often become clogged with filtrate so as to seriously obstruct the flow of water after a short period of usage. Accordingly, frequent cleaning of the screen, which in many cases is an awkward and time consuming task, is required to maintain the performance of the equipment. The filter end sump arrangement of the present invention is essentially self cleaning because of its unique configuration and location and it is so constructed and positioned that on rare occasions when manual cleaning is required it may be readily removed from the front of the machine, the removal of the filter or trap also exposing the inlet side of the pump for inspection and repair.

As best shown in FIGURE 5, the filter assembly 34 comprises a cylindrical screen 78, the major portion of which is located above the level of the bottom of the sump 32. At its forward end the screen is secured to opposite ends of a strap-type, spring clip 82 secured at its midportion to cover 80 adapted to be detachably secured to circular flange member 84 carried by the front panel of housing 20. Cover 80 is held in place telescopically in member 84 by a stiff bail or wire 86 of arcuate shape, having opposite ends dropped into and detachably received by inverted L-shaped notches 79 in flange member 84, and having a convex center portion swung like a bail downwardly into notch 81. Wire 86 is of sufficient strength to require the use of a tool such as a screw driver to remove the cover 80 to prevent tampering. The firm engagement between the cover 80 and the flange member 84 also compresses a radial flange 88 of a rubber boot 90 clamped to the forward end of the sump tube 92 which surrounds the forward end of the filter 34. Thus leakage in this area is effectively prevented. When the cover 80 is installed the parts are so dimensioned that the spring clip 82 urges the filter sleeve 78 to the right as viewed in FIGURE 5 to urge the tapered, right-hand end of the sleeve into tight engagement with the conical bore of annular rubber seat member 94 carried by the rear wall of the sump 32 and having a cylindrical portion projecting into a sump outlet tube 96 welded to the rear wall of the sump. The sump outlet tube 96 is connected to the inlet conduit 98 of the pump 36 by a flexible T fitting 100 having a side opening clamped to a vent pipe 102, the function of which will be described below.

Since the screen 78 is located above the bottom of the sump 32 it is not subject to clogging by small articles of clothing nor by small articles such as nails, screws, key chains, knives and so forth which are often found in washing machines. It has been established by actual tests that screen 78 is largely self cleaning because of its location above the bottom of sump 32, its configuration, and the fact that water and other fluid is centrifugally thrown at high speed from inner tub 28 outwardly against the screen during high speed rotation of the inner tub during the water extraction portion of the cycle. During this portion of the cycle the baffles 70 incorporated on the inner tub develop a pumping action which is effective to direct a stream of water and air against the adjacent side of the filter screen assembly 78 which keeps at least this side of the filter screen clear to permit substantially unimpeded flow of water and suds. The screen 78 may be removed periodically by detaching the spring wire 86 and

withdrawing the cover **80** together with the filter screen by axially pulling cover **80** toward the left in FIGURE 5. When screen **78** and cover **80** are removed, the dimensions of the tubes **92** and **96** are such as to permit the machine operator to insert his arm through tube **92** with free access to reach into sump **32**, to reach into the inlet side of pump **36** through the bores of member **94** and tube **96**, and to remove readily by hand through the hole in member **84** any articles found in either pump **36** or sump **32**. Accordingly, the screen **78** may be quickly cleaned and all foreign objects may be quickly and easily removed from the machine.

Assembly **80**, **84**, **86** has a number of additional advantages. First, wire **86** is easily swung about a horizontal axis through its bail ends between locked and unlocked positions to either lock screen **78** in the position shown in FIGURE 5 or to permit axial removal of screen **78** for cleaning. Second, a padlock **83** is easily secured thereto in the position shown in FIGURE 6 to prevent removal of the screen **78**. The shank **83***a* of the padlock extends around bail wire **86** and through a hole in a horizontal flange **80***a* on cover **80**. Third, it is simple in construction. Fourth, it has no projecting parts against which a part of the human body may collide for causing bodily injury. Fifth, the opening in member **84** is located high enough above the floor when the machine is mounted at normal height on a platform **87** to permit nearly complete draining of the machine through this hole into a pail **89** positioned on the floor in front of the machine. Also, rubber seat member **94** is preferably made of magnetic rubber stock so as not only to collect nails and other metallic foreign objects before they reach pump **36** to thus protect the pump but also to center and to pull into firm seating engagement the right end of screen **78** within the conical mouth of member **94**.

The pump **36**, which returns the water after it is passed through the filter assembly to the recirculation nozzle **38**, is of unique construction and is uniquely effective in maintaining a flow of water despite the presence of excessive suds in the system. Pumping suds causes difficulty because suds is a combination of liquid and gas. Gas is not normally pumped well by a pump able to handle liquids efficiently.

This pump assembly is shown in detail in FIGURES 9–11, and comprises a pair of housing members **104** and **106** peripherally secured together as by screws **108** to form an essentially circular impeller chamber **110**. The front housing member **104** includes the inlet conduit **98** and a tangential outlet conduit **112**. It will be noted that the axis of the inlet conduit **98** is below the axis of the impeller chamber **110**. An impeller assembly **114** is mounted for rotation on a shaft **115** within the impeller chamber **110** coaxially thereof. Portions of the pump housing and the means for supporting and sealing the impeller shaft **115** and for driving this shaft have been omitted for clarity and preferably take the form shown in Patent 2,934,023 granted April 26, 1960, for Centrifugal Pumps.

The impeller **114** comprises a hub **116** extending across the chamber **110** and having a cylindrical portion **118** extending slightly into the inlet conduit **98**. Because of the offset of the inlet passage **98**, the projection **118** forms a flow restriction or rotary seal around the portion of the inlet conduit **98** closest to the outlet **112**. Formed integrally with the hub **116** are oppositely extending vanes **120** and **122**, which as shown in FIGURE 9 are offset to the same side of the axis of the supporting shaft **115**. Satisfactory results have been obtained with blades **120**, **122** having an outer edge thickness of 0.125 inch, having the right hand face thereof offset 0.156 inch to the left from the axis of rotation of shaft **115**, and rotating in bore **110** of about 3¼ inch diameter. The vanes or blades **120** and **122** extend substantially entirely across the impeller chamber **110** and the edges facing the inlet **98** are provided with flat side portions **124** and **126**, respectively, which with the main body of the blades **120** and **122** form cup sections opening toward the direction of rotation shown by the arrow in FIGURE 9, and which serve as a rotary seal between blades **120**, **122** and inlet **98** to trap air, liquid and suds within chamber **110**. Because of the offset of the blade structure a counterweight **128** is provided in the hub.

Actual tests have shown that pump **36** pumps liquid and suds very well even when excessive amounts of the suds are entrained in the wash liquid. Because of the offset and configuration of the blades the pump has many of the characteristics of a positive displacement pump for pumping water and other liquids efficiently. Because of the diametrical orientation of the blades the pump has many of the characteristics of a centrifugal pump for pumping suds and air efficiently, but the pump establishes an internal pressure pattern which is quite different from that encountered in the usual centrifugal pump. For example, it has been found that impeller **114** having the aforesaid dimensions will double the outlet pressure from the pump when it is substituted for the impeller shown in aforesaid U.S. Patent No. 2,934,023. More specifically, tests have shown that the pressure in the region at the top of the pump in the quadrant extending to the right from the outlet **112** (FIGURE 9) is very low, i.e., 0 gauge. As the fluid proceeds clockwise around the pump its pressure is increased and in the quadrant preceding the outlet **112** the pressure in a typical case is 2.75 p.s.i.

This is believed to be the mode of operation of this pump based on observations under actual operating and test conditions. Because of the offset positions of blades **120** and **122**, the leading side of blade **120** scoops up the majority of the fluid entering inlet **98** and throws it in a clockwise direction as viewed in FIGURE 9 toward outlet **112** to provide part of the pumping action. Due to the slip involved, some of the fluid bypasses impeller **114** on the left side as viewed in FIGURE 9 but is thrown by the leading side of blade **122** toward outlet **112** to provide further pumping action. The amount of the pumping action is of course governed by the viscosity of the fluid.

It has been found in practice that the efficiency of the pump is further increased by the inclusion of a lunar, helical baffle **130** in the bore of inlet conduit **98**. This baffle has a radially inwardly directed, helical form advancing in the downstream direction and in the direction of rotation of impeller **114** and decreasing in helical pitch in the downstream direction for imparting a preliminary spin to the water and detergent in the same direction as the direction of rotation of the impeller. This action reduces splash back and cavitation.

The problem of oversudsing, which has been a particular problem in prior constructions is further minimized by the inclusion of the vent pipe **102** connected to the side arm of T fitting **100** located between the sump and the inlet of the pump **36**. Actual experience has shown that coin operated machines frequently become totally inoperative because of suds lock, a condition which can be cured in prior machines only by a complete manual flushing of the machine.

It has been found that even the most extreme case of excessive suds can be readily corrected by the combination of the vent pipe **102**, the pump **36** and the suds breaking nozzle **38**. In most cases, the excessive suds will be adequately handled by the pump **36** which delivers a stream of liquid and suds to the nozzle **38** which, by action to be described below, breaks up the suds and substantially cures the problem of excess sudsing.

Vent pipe **102** minimizes the problem of over-sudsing. When inner tub **28** is spinning, for example during the water extraction cycle, vanes **70**, acting as a centrifugal blower, pull air in through detergent dispenser orifice **170** (described below) and through any conventional suds overflow or vent hose (not shown) leading from the atmosphere into inner tub mouth **67** so as to establish a substantial flow of fluid (air and/or suds) from inside

tub 28, through tub perforations 55, toward sump 32 and through filter screen 78, seat 94, tube 96 and T fitting 100 so as to establish a positive pressure in the region of the lower inner end of vent pipe 102. This pressure is sufficient to positively force the suds upwardly through vent pipe 102, which is of adequate cross sectional area to permit this flow and which has its outlet (upper) end always open to an appropriate drain. The pumping action is sufficiently strong when inner tub 28 is spun at high speed so that the machine may be cleared in a very short time of all excessive suds.

If the user desired to remove a larger amount of suds, the construction in FIGURE 7 may be used. Here, deflector plate 103 is secured to the inner surface of outer tub 26 above sump 32, extends axially throughout the length of inner tub 28 and has its inner distal end in close proximity to the periphery of inner tub 28. Then, as inner tub 28 rotates clockwise at high speed in the direction of the arrow in FIG. 3 during the extraction cycle, vanes 70 create in the direction of the arrows in FIG. 7 by centrifugal force a still higher pressure in sump 32 for driving at higher pressure more suds out of vent pipe 102 (FIG. 5) because plate 103 acts as a cutoff to eliminate clockwise passage of fluid therepast.

To take maximum advantage of this feature the usual control system is modified as explained below in connection with FIGURE 19 to permit the inner tub to be spun at its relatively higher extraction speed at any time during the cycle so that the problem of excess sudsing can be cured whenever it occurs.

The action of nozzle 38 is also important in reducing the problem of excess suds, breaking up large soap bubbles, and increasing the concentration of small soap bubbles. This action increases the washing capacity of the machine with a given quantity of water and detergent.

The structure and mode of operation of nozzle 38 will be considered in detail in connection with FIGURES 12 and 13. The substantially vertical, lower right, side outlet opening of nozzle 38 is formed by a curved upper wall 142 and a flat bottom wall 144, the resulting action of which is best illustrated in FIGURE 13. The sudsy water is delivered from the pump 36 through conduit 140 to the recirculation nozzle at relatively high velocity. The sudsy water is forced by the configuration of the lower end of the nozzle and the location of the exit opening to assume or follow intersecting paths. For example, a portion of the stream indicated by the letter A tends to exit from the nozzle in a downwardly projecting path while the portion of the stream indicated by the letter B tends to exit from the nozzle in a horizontal path. The effective intersection of these two paths disperses and breaks up the large bubbles in the water.

This nozzle construction has shown a marked ability to combat oversudsing, to reduce the size of the suds bubbles, and to increase washing efficiency. Nozzle 38 breaks up the suds in the recirculated water being dispensed by the nozzle and the jet from nozzle 38 breaks up any residual suds located in inner tub 28. Since the soil suspension ability of the suds is dependent on the suds area, the reduction in size of the bubble increases the suds area. This action increases the soil holding ability of the suds and the washing efficiency of the apparatus and reduces the total amount of wash water required.

This superior action has been obtained by nozzle 38 having the following flow characteristic and structure: sudsy water pumped downwardly through conduit 140 at 1–7 p.s.i., but preferably about 6 p.s.i., gauge pressure to flow out through nozzle 38 at high velocity. Walls 142 and 144 of nozzle 38 have a wall thickness of approximately 0.049 inch; and dimension N1 being 1.25 inches, dimenison N2 being 0.38 inch, radius N3 being 1.50 inches, dimension N4 being 1.00 inch, dimensions N5 being 1.00 inch, diameter N6 being 0.94 inch, diameter N7 being 0.88 inch, and dimension N8 being 0.63 inch.

The action of the nozzle will be further described in connection with the description of the overall machine.

The laundry product dispenser apparatus 30 will now be described with particular reference to FIGURES 14, 15 and 16. The dispenser mechanism is effective to handle soap, detergent or bleach in liquid, cake, powder or tablet form with equal efficiency. The dispensing mechanism herein disclosed replaces the devices currently in use such as the solenoid operated buckets, liquid pumps, trays and rotating trap chamber type centrifugal dispensers.

Because these prior devices have not been satisfactory, commercial machines have incorporated an opening located in the top of the outer tub through which the laundry products are simply introduced manually. Use of this opening has several disadvantages since it depends on the operator to introduce the detergent or bleach at the correct time. It also leads to the accumulation of residual soap around the loading opening which is unsightly and may eventually create clogging.

All of the components of the dispenser are incorporated in the unitary assembly, the principal component of which is a soap chute 150 of tubular form having a flared mouth 152 at its upper end. The dispenser is supported with the upper end of the mouth 152 contiguous to the top panel of the cabinet 20 by an upper strap 154 which is welded to the mouth 152 and detachably secured to internal support structure in the cabinet not shown. At its lower end the chute 150 is welded to a mounting bracket 156 secured by a pair of screws 158 to an embossed rim 160 surrounding a rectangular cutout 162 in the front panel 46 of the outer tub. To increase the rigidity of the assembly an annular backup flange 164 is clamped by the screws 158 to the inner surface of the embossed rim 160. The bracket 156 is cut away in the region surrounded by the lower end of the chute 150 to place the latter in communication with the interior of the outer tub. The bracket 156 also supports the nozzle 38 in position to direct a stream of water and detergent into the interior of the inner tub as more fully explained below.

Welded to the outer surface of the upper end of the soap chute is a funnel 166 which carries a water inlet tube 168 supplied with clean water from any suitable source and has its delivery end arranged to direct a stream of water into the funnel 166 (shaped to prevent water splashing) and through an opening 170 into the flared portion 152 of the soap chute 150. An air gap is provided between the outlet end of the conduit 168 and the funnel 166 to satisfy local plumbing codes which require an anti-syphon construction to prevent suds from being sucked back into conduit 168 in case of water supply failure where water is sucked back thru conduit 168. The inner surface of the opening 170 is partially covered by a deflector 172 to the projecting lower end portion of which a small tube 174 is secured. Tube 174 projects downwardly and terminates adjacent the bracket 156 where it is provided with a closure 176 below a side outlet opening 178 which is directed to the interior of the inner tub across a detergent (granular type) supporting screen 179 which extends across the lower end of the chute 150.

Liquid flow from outlet end 168, through funnel 166 and out of deflector 172 is permitted to take any of these three different paths at deflector 172: (1) flow downwardly between the right hand side of deflector 172 and funnel 152 (FIG. 15) and downwardly into tube 174; (2) flow upwardly to the left (FIG. 15) through a plurality of jet openings 180 in deflector 172; or (3) flow by a counterclockwise swirling motion through space 182 (FIG. 14) provided between the side edge of deflector 172 and the inner wall of the soap chute mouth 152, for flow in a circular direction in the conical bore surface of funnel 152.

The valve means controlling the flow of water through the tube 168 is operated by suitable controls, such as

shown in FIG. 19, to permit water to flow through the tube only during the laundry tub filling or detergent dispensing portion of the cycle. Accordingly, either before the machine is started or when the machine is in operation and before the second filling cycle is initiated, detergent in the form of a tablet, cake, granular, flake or powder is dropped into the mouth **152** of the tube **150**.

When powdered, flaked or granular detergent is dropped into mouth **152**, this detergent falls by gravity to the bottom of tube **150** where it is retained by screen **179**, and it will remain there until water is supplied by tube **168** at the proper time in the filling portion of the cycle, such as before the first or second wash cycle. When this occurs, the liquid entering funnel **166** from tube **168** will begin to flow past deflector **172** in two different directions: (1) downwardly through tube **174** and out opening **178** onto screen **179**, and (2) out through opening **182** to swirl around and downwardly through the conical mouth portion **152** of tube **150**, both because of the offset of the funnel **166** and because of the opening **182** at the side of the deflector **172**. The swirling water will rise almost to the top of the mouth **152** but deflector **172** prevents the swirling water from re-entering cone **166**. At this time little water will exit through the openings **180** because of the passage of the swirling water over these openings. This swirling action assures that any previously deposited detergent will be removed from the apparatus. The substantial volume of water flowing downwardly through the tube **174** leaves the side exit opening **178** in a manner to undermine and blow the detergent off or out of the screen **179** into the interior of the inner tub, the screen **179** may be about 32 mesh to prevent the accumulation of water in dispenser chute **150** and to prevent all but dissolved detergent from passing therethrough. This action assures positive removal of the detergent from screen **179** and assures that chute **150** will remain open to the flow of water at all times.

When the detergent or other laundry product in the form of a tablet or cake is deposited into mouth **152**, it will come to rest on deflector **172** in mouth portion **152** where it will remain until water is supplied by tube **168** at the proper time in the cycle. Then, the water emerging from space **182** in a swirling pattern on the inner surface of mouth **152** is interrupted by striking the tablet or cake so that the flow of water over the outer surface of deflector **172** is discontinued or reduced. This permits water to exit in the form of jets from openings **180**, which jets rapidly pierce and disintegrate the detergent tablet which then passes downwardly in granular form through tube **150** for injection into the inner tub by the stream flowing downwardly through tube **174** and out opening **178**. After the tablet or cake has disintegrated, the circular swirl of the liquid in mouth **152** will resume, and the swirling water will rise almost to the top of mouth **152** so as to clean dispenser **30** by removing any previously deposited detergent, as explained above.

After the detergent is dispensed into the machine, the swirling water will always clean dispenser **150** in preparation for subsequently receiving detergent again to be later dispensed at the proper time in the filling portion of the cycle.

It is important that dispenser **30** be designed so that, if either tube **150** is filled with powdered detergent or a large detergent tablet is located in mouth **152**, dispenser **30** will empty its detergent sufficiently fast so that the swirling water emerging from opening **180** does not overflow the top of cone **152**. The following dimensions have been found to provide a satisfactory dispenser **30** with a water inlet pressure of 60 p.s.i. in conduit **168**; screen **179** of 32 mesh; hole **178** having an outlet area of 0.11 square inch minimum; tube **174** having an inside area of 0.1105 square inch; tube **168** having an inside area of 0.1503 square inch; the hole for supporting screen **179** being the same width as tube **150** and having a lengthwise dimension of approximately 2⅝ inches; jet ports **180** being six in number and each approximately 0.140 inch diameter; inverted frustum of a cone **152** being formed from a cone having a base diameter of 4.75 inches and an altitude of 5.93 inches with the frustum having an altitude of 3.68 inches, opening **170** having (measured along the surface of cone **152**) a 1⅛ inch dimension in the intersecting vertical plane and a ¾ inch dimension in the intersecting horizontal plane; gap **182** being triangular in shape, formed by an edge approximately 2 inches long on having its lower distal end ⅝ inch away from the inner surface deflector **172**, of cone **152**, and extending downwardly and inwardly on an angle of about 13° in FIG. 15 with respect to the inner surface of cone **152**; and the inner diameter of chute **150** being approximately 1⅞ inch.

Dispenser **30** can also readily handle liquid detergents. At the present time liquid detergents are not available which have the necessary characteristics for effective action in a front loading laundry machine of the type with which the present invention is concerned. However, when they are available, they may be readily poured into the mouth of funnel **152** at the appropriate time in the washing machine cycle, and they will travel downwardly through screen **179** into inner tub **28**.

To permit the addition of bleach or detergent at other times a manual control may be provided as shown in FIG. 19 which permits a momentary supply of additional water through the tube **168**.

The structure shown at the top of FIGURE 15 provides an operative connection between top cabinet panel **181** of cabinet **20** and dispenser funnel **152**. Here, a rubber, resilient, annular gasket **183** has straddling legs secured to the upper end of funnel **152** and is held in sealing compression against the lower surface of top panel **181** after the panel has been swung into its horizontal position about a hinge (not shown) at the rear of the cabinet. Lid **185** is secured by hinge **186** to panel **181** and is adapted to cover the top entrance hole to funnel **152** when in the position shown in FIGURE 15. Annular retainer flange **187**, secured to the bottom surface of lid **185**, has secured to its lower surface an annular, rubber, resilient seal **188** adapted to detachably engage and seal with an opening formed by an annular flange **189** of top panel **181** located concentrically with the top opening of funnel **152**.

This structure has the following advantages. First, when lid **185** is raised, a smooth, porcelain covered, metal flange surrounds the opening through which detergent is introduced. No gasket is located in this inlet opening for collecting dirt, congealed detergent or soap, etc. Second, lower leaf of hinge **186** is raised above surface of top panel **181** to permit cleaning of dirt, detergent, etc. from below the hinge. Third, seals **188** and **183** effectively seal the interior of dispenser funnel **152** from the outside atmosphere. The water entering funnel **166** through conduit **168** has an injector action sucking air from around conduit end **168** into funnel **152** so as to build up air pressure within funnel **152** by a venturi action to help feed the detergent downwardly through chute **150** and screen **179** and to help blow the detergent into the washing machine. Seals **188** and **183** assure that this air pressure will not leak out of funnel **152**. Seal **188** assures that lid **185** will not be blown upwardly to an open position by internal pressure by securely and firmly locking the lid in the closed position.

Essentially an automatic washing machine comprises a closed fluid circuit which must be carefully sealed against leakage. While the sealing of the major portion of this system presents no major problem since the seals are all static, the seal in the region where the support and drive shaft for the inner tub passes through the outer tub has continued to present a problem which has not been effectively solved.

The sealing problem here is particularly acute for two reasons. First, the product to be sealed is itself a detergent which tends to readily wash out lubricants to damage sealing structures and which often contains abrasive dirt

causing abnormal wear and rapid deterioration of prior sealing constructions. Second, tub 28 is rotated at two different speeds during each cycle—a high speed for extraction and a slow speed for washing—so that the tendency to leak is increased.

Bearing and sealing construction 29 disclosed in FIGURES 17 and 18 has been found by actual tests to provide an effective solution to these problems and to have an effective life from 25 to 55 times as long as prior competitive designs.

Referring now in greater detail to FIGURES 17 and 18, the shaft 66, to which the end wall of the inner tub 28 is secured by a detachable cap 190 and screw 191, is rotatably supported in inner and outer bearing assemblies 192 and 194, respectively, carried by an annular support ring 196 which, in turn, is supported by the inner and outer reinforced panels 198 and 200 of the wall structure 42. The drive shaft 66 projects outwardly through the end wall 42 of the outer tub 26 for attachment to the drive pulley 202 driven through a belt 204 by the usual fractional horsepower electric motor (not shown).

Conventional bearing retainer rings 206 and 208 are provided to locate bearing 194 axially in the assembly.

The critical sealing area is the region inboard of bearing 192. In this region, novel seal 209 is formed by a combined spacer and seal ring 210 and a pair of annular seal rings 212 and 214. Seal rings 212 and 214 are stationary in the machine because they are supported by stationary support ring 196. Seal ring 210 is rotated with shaft 66 and O-rings 211 seal against leakage between ring 210 and shaft 66 because screw 191 axially pulls right hand wall 60, 62 of inner drum 28 and ring 210 tightly against the inner race of bearing 192. The seal rings 212 and 214 each comprise a body of fiber glass filled tetrafluoroethylene resin ("Teflon") reinforced with a metallic L-shaped liner or core 216, such as steel. The seal rings each have an annular peripheral surface of substantial area resiliently urged against the inner surface of the support 196. The seal rings 212 and 214 also each have inner resilient portions 218 provided with sealing ridges 220 which are urged into sealing contact with the outer surface of the spacer 210 by annular garter springs 222. Suitable lubricant, such as grease is located in pockets 217.

It has been discovered that a ring 210 made of 440 C Stainless Steel machined to rough size, heat treated to 58 to 62 Rockwell C, finish ground to size and honed, and finally nitrided to 0.005 inch case thickness and to 95 on Rockwell 15–N scale has all of the necessary properties, is rust resistant, and has a tough abrasion resistant surface which cooperates with the non-metallic outer seal rings 212, 214 to provide a seal having a remarkably long life.

In prior art seals wherein a seal lip engages the periphery of the shaft (corresponding to seal lip 220 here engaging ring 210 carried by shaft 66), water, detergent and dirt tend to enter the seal structure from the left end as viewed in FIGURE 17 by flowing between the seal lip and the periphery of the shaft, and tend to wear a groove on the surface of the shaft at the seal lip. After this action begins, rapid wear and failure soon occur. The present construction resists these tendencies so as to increase wear life 25 to 55 times over prior art seals.

Water, detergent and dirt tend to enter the seal structure from the left end as viewed in FIGURE 17 and to the extent the seal ring 212 permits the passage of such material, it is drained to the exterior of the stationary tub through a pipe 224 which communicates at its inner end with the space between the two seals 212 and 214. Thus even if minor leakage occurs at the inner seal 212, the integrity of the outer seal ring 214 is maintained to provide full protection for the bearings 192 and 194.

Grease is supplied to pocket 217 and for the bearings through a tube 226, the upper end of which extends to any accessible location and is provided with a grease fitting and the lower end of which is secured to the support sleeve 196 in communication with drilled passages 228 and 230, the latter leading to the region between the bearing 192 and the outer seal ring 214. When grease is introduced through the tube 226 it passes into the cavity 232 through the main inner bearing assembly 192 and into the tube 224 and bore 232 to thus purge this bearing 192 and to provide clean, fresh lubricant in this region to bearings 192 and 194 and in grease pockets 217.

The overall operation of the machine will now be considered. Reference will be made hereafter to an electrical diagram in FIG. 19 portraying a portion of one suitable control circuit. After the clothes are loaded into the machine and detergent is put into the dispenser the machine is started by operation of a manual control of any suitable construction incorporated in the control panel 22, such as switch 238 in FIG. 19. Water then begins to flow through the inlet pipe 168 which automatically introduces the detergent into the machine. The flow of water is continued to clean the inside of dispenser 30 by the swirling action of the liquid and is continued until the water reaches a level approximately two inches above the bottom of the inner tub, which in a typical case requires two and a half gallons of water. The flow of water is discontinued by a pressure switch 248 described in more detail hereinafter. The rotation of the tub is begun at about 51–53 r.p.m. and the pump 36 is placed into operation to establish the flow of recirculating water which is introduced into the inner tub through the nozzle 38 which directs the water through the cut-out 162 in the front panel of the outer tub and through the open front of the inner tub.

As the inner tub is rotated in a clockwise direction as viewed in FIGURES 1 and 3 the clothes are engaged by the baffles 70 and are lifted to a drop-off point which varies as a function of the speed of the tub, the amount of water in the tub and the disposition and spacing of the baffles. An increase in speed of the tub increases the lifting action of the baffles and if the speed is increased sufficiently the clothes are held by centrifugal force against the tub and the falling action is eliminated. An increase in the level of the water within the tub decreases the lifting action. It will be noted that a variation in either of these factors changes the path followed by the clothes falling within the tub from one constant pattern to another constant pattern.

The unique arrangement and spacing of the baffles 70A, 70B and 70C produces an entirely different type of action in that it changes the path followed by the clothes in a regularly varying sequence. Actual tests have established that this constantly varying path of the clothes has constant variation in the drop-off point, constant variation in the zone of impact when the clothes reach the bottom of the tub, and constant variation in the pulling action as the clothes are again engaged and lifted. This constant variation produces substantially improved washability and achieves a remarkable degree of uniformity in the washing action. Specifically, the unique action effected by the disposition of the baffles 70A, 70B and 70C produces rapid and constant migration between the inner and outer rings or layers of clothing which tend to develop in this type of tumbling action.

In prior machines lacking the baffle arrangement of the present invention, the clothes tended to stratify into an outer ring of clothes arcuately spaced between the baffles and an inner ring of clothes located inwardly from the distal ends of the baffles. The inner ring often formed a ball of clothes at the center of the tub where the clothes were not subjected to substantial mechanical action or tumbling and were not properly exposed to the action of the detergent and wash water. Consequently, clothes in this position were not subjected to any significant cleaning action.

The problem of having balls of clothes is entirely elimi-

nated by the present invention. Baffles **70** not only do not cause the balls to form but also break up any balls or bundles formed if the clothes are loaded into the machine in such balls or bundles by the laundry machine operator.

While all of the factors which contribute to the improved tumbling action are not fully understood, nevertheless there are certain observable phenomena which are believed to be of importance in achieving the improved result. For example, it can be observed that the drop-off point varies in a regular sequence, which promotes migration of clothes between the inner and outer rings. More specifically, when the clothes are engaged between baffles **70A** and **70B**, they tend to rise to a higher drop-off point than clothes engaged between the other baffles. The space between baffles **70B** and **70C** produces an intermediate drop-off point and the space between baffles **70C** and **70A** produces the lowest drop-off point. This constant change in drop-off point is accompanied once in every rotation of the tub by an abrupt increase in this drop-off point tending to throw the clothes in the inner ring toward a clean surface in the bore of inner tub **28** into the outer ring during the next clothes lifting cycle. This action promotes migration of the clothes and rapidly breaks up any balls or bundles which tend to form at the center of the drum.

It is believed that this is the action taking place. It should be remembered that the object of this mode of operation is to pull apart and break up any balls of clothes formed in the inner or outer rings or inside the inner ring, to promote the migration of the clothes between the inner and outer rings, and to open up the clothes so that better washing or drying action occurs. First, consider the clothes located in the 90° spacing between baffles **70A** and **70B** in the outer ring. These clothes are positively driven by baffle **70B** with little space (between the leading end of this arc of clothes and lead baffle **70A**) caused by slippage during the lifting action. In contrast, the inertia of the clothes in the inner ring resist the driving action by baffle **70B** and the inner ring tries to stay stationary, or at least moves more slowly than the outer ring in the clockwise direction. The result is that the largest, or maximum, slip occurs between the inner and outer rings between baffles **70A** and **70B**. Also, the clothes in the outer ring are carried to the highest drop-off point, for example they drop off at 11 o'clock and fall at 5 o'clock on the inner surface of tub **28**. Second, consider the clothes within the 150° spacing between baffle **70A** and **70C**. Here, there is less relative slip between the inner and outer rings because during the lifting action, the clothes tend to arcuately slip back from baffle **70C** toward baffle **70A** by their inertia. Also, drop-off occurs sooner so that the clothes drop-off at about 10 o'clock and fall at 6 o'clock. Third, it should be apparent therefore that the clothes in the 90° arcuate spacing between baffle **70A** and **70B** have the best chance of falling on a clean inner surface on inner tub **28** because they are carried farther up in the lifting action and are dropped farther to the right than the clothes earlier dropped from between baffle **70A** and **70C**. The small relative slip between the inner and outer rings between the 150° spaced baffles **70A** and **70C** permits tentacles from clothes in either the inner ring or a center ball to readily fall into the gap caused by slip between the lead end of the clothes and the leading baffle **70C**. As the clothes move progressively into decreasing baffle gaps from 150° through 120° to 90°, relative slippage between the inner and outer ring is increased and tentacles on the same clothes or ball of clothes in these two rings are pulled apart by a larger force to spread the clothes more fully or to open up the ball more readily. As some tentacles of the clothes fall into the 90° gap between baffles **70A** and **70B**, this pull to open up the clothes by relative slippage between the rings is the *greatest* and the clothes are subsequently carried the *farthest* by suddenly moving the drop-off point from 10 o'clock to 11 o'clock so that there is the greatest likelihood of having the clothes fall in the inner surface of tube **28** with some of the tentacles thereof in the inner and outer rings. As this sequence repeats, the forces continue to open up the ball or to spread the clothes so that good washing action results.

There are three other theories on why the balls break up, why the clothes spread out, and why the clothes migrate between the inner and outer rings. First, this action is explained by stating that, since different quantities of rotational energy are applied to the clothes at different times and during different intervals of time, the direction of movement of the clothes is frequently changed by the frequently changing forces. Second, rotation of inner tub **28** causes any ball of clothes on the inside of the tub to be continuously expanded and subsequently dispersed within the clothes of the outer ring. This ball is expanded by being lifted to a high drop-off point by the 90° spacing between baffle **70A** and **70B** and by being subsequently dropped. The ball is also expanded by the clockwise movement of the baffles between the six and nine o'clock position (FIG. 3) tending to lift, expand and disperse the ball. Then, after the ball is sufficiently expanded, tentacles thereof are caught and intermingled with the clothes falling at the low drop-off point (from between the 150° spaced baffles **70A** and **70C** at 10 o'clock) so that the clothes in the ball become dispersed with the clothes in the outer ring of the tub. Third, it is also believed that the constant cyclical variation in slip between the inner and outer rings of clothes produced by this cyclical variation in baffle spacing also tends to promote migration of the clothes and promotes the gripping of portions of the clothes in the inner ring by the clothes in the outer ring.

In any event it has been determined that the sequence which is regularly repeated of engaging the clothes at intervals of regularly increasing length produces many of the benefits of the present invention. This conclusion is supported by the fact that the advantages discussed above are not achieved when the spacing between baffles **70** of 90°, 120°, and 150° proceeds in the direction of rotation, which is opposite to the angle sequence illustrated here wherein this angle sequence proceeds in the direction opposite to the direction of rotation.

The unique action of the irregularly spaced baffles has many additional advantages. First, a substantially increased clothing life is obtained since the baffles are extremely gentle during washing of the clothes. Tests indicate two to three times as much clothing life obtained with this construction as compared with the finest other automatic washing machines. Second, the baffles create a very high state of detergency so as to cause extremely effective washing action. Third, the baffle construction is effective to establish a reasonable state of rotational balance of the clothes during the extract cycle. Fourth, this construction is economical to manufacture and does not require the use of moving parts or special controls, for example, which have been used in prior units to periodically reverse the direction of rotation or to vary the speed of the tub. Fifth, the baffles give a good washing action by the use of only small amounts of water and detergent. Hence, savings is obtained by requiring less water, detergent and water heating. Sixth, the baffle construction provides superior results not only in a washing machine but also in a dryer. In any of these environments, it tends to open the clothes to permit better, more uniform and freer circulation of drying air, dry cleaning fluid or sudsy water through the clothes so as to give a significant increase in washability or a more efficient drying action.

It is also to be noted that the placement and disposition of the recirculation nozzle **38** is so correlated with the tumbling pattern of the clothes within the tub **28** that during each cycle of the machine, stream S (FIGURE 3) of liquid issuing from nozzle **38** is properly directed with

respect to the clothes in rotating inner tub 28. During the wash cycle, stream S passes *through* the load of clothes, while during the rinse cycle stream S passes *over* the load of clothes so as to give certain desirable advantages.

During the wash cycle outer tub 26 is filled to a level of about 2 inches above the bottom of inner tub 28. This low water level causes baffles 70 to lift the clothes to a high position for drop-off at about 11 o'clock and fall at a 5 o'clock position. The clothes are thus lifted high enough to be carried over the top of stream S so that stream S from nozzle 38 is directed underneath the inner surface of the tumbling load of clothes, and outwardly *through* these dropping clothes. The spray water from stream S not only travels through the clothes so as to wash the clothes clean but also strikes cylindrical sheet 54 of inner tub 28 so as to wash the dirt from this cylindrical sheet and disperse the suds therefrom if inner tub 28 is suds-locked. The detergent is mixed by the wash action and by the pump; and the clothes are constantly washed in high concentration of water, detergent and small bubbles, the size of the bubbles being decreased by the action of the nozzle 38 described in detail above. The small bubbles are retained in the sump 32 and together with a small amount of water hold the dirt in suspension until it is pumped out of the machine at the end of the wash cycle. Thus, the correlation of the tumbling action, the construction and disposition of the nozzle 38 and the water recirculation system permits one to get an excellent washing action while using a minimum amount of hot water as compared to prior machines of comparable capacity.

After the initial wash cycle, the clothes are rinsed by filling outer tub 26 to a level of about 7 inches above the bottom of inner tube 28. Now stream S is directed *over* and perhaps even against the outer surface of the clothes, instead of through, the clothes. The high water level in tub 28 tends to reduce the lifting action of baffles 70, and the clothes are tumbled in a low path, dropping off at about 9 o'clock and falling to 6 o'clock with this path located below stream S produced by nozzle 38. Now stream S washes clean the outer surface of the clothes and the inner surface of cylinder sheet 54 of inner tub 28 but the dirty water sucked from sump 32 by pump 36 and recirculated through nozzle 38 as stream S does not pass through the load of clothes so will not soil the rinsed clothes. Hence, the clothes are rinsed only by the relatively clear water located well above sump 32.

Subsequently, as the rinse water is drained from the tub, the lifting action of the baffles is effectively increased and the original pattern set up in the wash cycle is reestablished and the clothes are distributed more or less uniformly for a subsequent water extraction cycle during which the inner tub is spun at a relatively high speed for example 400 r.p.m.

It has been found in practice that this superior washing and rinsing action can be obtained with stream S by having a washing machine having these characteristics: Inner tub 28 rotates at 51–53 r.p.m., the bore diameter of inner tub 28 is approximately 24 inches and stream S is directed through front opening 67 of inner tub 28 and along a plane extending parallel to the rotational axis of inner tub 28 and along stream S from the outlet of nozzle 38 (located approximately 15° left of the vertical and at about a 9 inch radius from the center of rotation of inner tub 28) to strike cylindrical sheet 24 at about 3 o'clock half-way back in tub 28.

As indicated above, the machine of the present invention is equipped with controls which are effective at timed intervals to cause water to flow through the conduit 168 to automatically introduce a detergent or bleach at the proper time in the washing cycle. In addition, the machine is equipped with a novel manual control which permits the user to introduce water through the conduit 168 to permit the introduction of additional detergent or bleach at other points in the cycle. A simplified circuit for performing this function is shown schematically in FIGURE 19 to which detailed reference will now be made.

The introduction of water through inlet pipe 168 is controlled by a pair of hot and cold water valves operated by solenoids 240 and 242, respectively. During normal operation, after starting switch 238 is closed, timer motor 243, energized in any suitable manner by lines L–1 and L–2 for controlling the operational cycle of the machine, closes normally open switch 250 to introduce a regulated amount of water at a predetermined temperature by forming a circuit from line L–1 through closed switch 250, parallel paths through solenoid 240 and normally closed switch 246 and through solenoid 242 and normally closed switch 244, and normally closed switch 248 to line L–2. If hot or cold water are not wanted, either switch 246 or switch 244 on control panel 22 may be opened. When the water in outer tub 26 reaches the desired level, it opens normally closed water level switch 248 to break this circuit, to discontinue water flow and to prevent over-filling the machine.

When it is desired, however, to introduce additional water for the purpose of introducing additional detergent or bleach into the machine, normally open bypass switch 252, which may be termed a flush switch and which is located at a convenient and accessible position on control panel 22 of cabinet 20, may be closed manually to bypass water level switch 248 and to permit introduction of water at any desired point in the wash or rinse cycle, whether switch 248 is open or closed as long as timer switch 250 is closed to indicate that detergent can then be properly introduced.

Flush button 252 has an additional important function. It is also effective to control rotation of inner tub 28 by high-speed spin motor M2 controlled by relay 254. These are normally controlled by a circuit from line L–1 through normally open timer contact 256 closed by timer motor 243 during the spin portion of the cycle, the coil of relay 254 and the spin motor M2, and water level switch 248 closed when water pressure falls below a predetermined level to line L–2. Switch 248 is provided to prevent rotating inner tub 28 at high speed except when tub 26 is substantially drained of water. Note that at low speed tumbling or washing action, motor M1 drives inner tub 28 independently of switch 248 and as long as timer switch 258 is closed to energize relay 257 controlling motor M1. If desired, switch 258 may energize motor M1 when motor M2 is energized during spin with motor M1 driving tub 28 through an over-running clutch so that tub 28 will be driven at high speed whenever motor M2 is energized.

Occasionally, if tub 26 contains an excessive amount of suds, operation of inner tub 28 at high spin speed produces a pumping action, as described above, sufficiently strong to raise the pressure within tub 26 enough to open pressure switch 248. This stops the extraction cycle and causes on-off cycling of the machine. If, under these conditions, the operator presses and closes flush button 252, it will form an energizing circuit for the coil of relay 254 and motor M2 in parallel with a bypassing switch 248. Then, spin motor M2 continues rotating inner tub 28 at high speed for thus quickly and positively freeing tub 26 of suds by forcing the suds out vent pipe 102.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A laundry machine comprising an outer fixed receptacle, an inner receptacle for clothes, means mounting said inner receptacle for rotation within said outer receptacle about an axis sufficiently inclined from the vertical to produce tumbling of clothes received therein, means for rotating said inner receptacle in a predetermined direction, and baffle means for subjecting said clothes to a series of driving impulses applied in regularly increasing intervals, said baffle means including a series of baffles carried by said inner receptacle and projecting inwardly thereof, said baffles being essentially parallel to the axis of said inner receptacle and the circumferential spacing between adjacent baffles progressively increasing in a direction opposite to said direction of rotation, and the length of each of said baffles being sufficient to intercept and displace said clothes as said inner receptacle is rotated.

2. The combination according to claim 1 wherein said series of baffles consists of first, second and third baffles, the spacing between said first and second baffles being substantially 90°, the spacing between said second and third baffles being substantially 120°, and the spacing between said third and first baffles being substantially 150°.

3. A receptacle for tumbling clothes or the like in a washer or dryer upon rotation of said receptacle in a predetermined direction, said receptacle having an essentially cylindrical wall, and baffle means for subjecting said clothes to a series of driving impulses at regularly increasing intervals including first, second and third clothes engaging baffles projecting inwardly from said wall, the circumferential spacing between said baffles in a direction opposite to said predetermined direction being such that said first and second baffles are spaced less than said second and third baffles, said second and third baffles are spaced less than said third and first baffles, said baffles extending essentially parallel to the axis of said receptacle essentially the full length of said receptacle.

4. The receptacle according to claim 3 wherein each of said baffles has a front face extending essentially radially of said receptacle and a rear face inclined with respect to said front face.

5. A washing machine comprising an outer fixed receptacle, an inner receptacle for clothes or the like mounted for rotation within said outer receptacle, means for rotating said receptacle in a predetermined direction about an axis sufficiently inclined from the vertical to produce tumbling of clothes received therein, said inner receptacle having an opening at one end and a perforated essentially cylindrical wall, means for imparting a series of driving impulses to said clothes in regularly increasing intervals comprising a plurality of baffles carried by said inner receptacle and projecting inwardly from said cylindrical wall, said baffles being generally parallel to the axis of the said inner receptacle, the length of each of said baffles being sufficient to intercept and displace said clothes as said inner receptacle is rotated and the circumferential spacing between adjacent baffles being progressively increasing in a direction opposite to said direction of rotation, means for recirculating water through said inner receptacle comprising a nozzle positioned to direct a stream of water through said front opening at a point above the axis of said inner receptacle for impingement on said perforated wall of said receptacle and passage therethrough into said outer receptacle.

6. The combination according to claim 5 together with means for returning said water from said outer receptacle to said nozzle.

7. A washing machine comprising an outer fixed receptacle of generally cylindrical form and having a sump formed integrally in the lower portion thereof, an inner receptacle for clothes or the like, means mounting said receptacle for rotation within said outer receptacle about an axis sufficiently inclined from the vertical to produce tumbling of clothes received therein, said inner receptacle having an opening at one end and a perforated essentially cylindrical wall, baffle means for subjecting said clothes to a series of driving impulses applied in regularly increasing intervals, said baffle means including a plurality of baffles carried by said inner receptacle and projecting inwardly from said cylindrical wall, said baffles being generally parallel to the axis of said inner receptacle and the circumferential spacing between adjacent baffles being progressively increasing in a direction opposite to said direction of rotation, the length of each of said baffles being sufficient to intercept and displace said clothes as said inner receptacle is rotated, a nozzle positioned to direct a stream of water through said front opening at a point above the axis of said inner receptacle for impingement on said perforated wall of said inner receptacle and passage therethrough to said sump, a pump connected to remove water from said sump and deliver it under pressure to said nozzle, and a filter positioned in said sump in the path of water flowing to said sump.

8. A receptacle for tumbling clothes or the like in a washer or dryer by rotation in a predetermined direction about a generally horizontal axis, said receptacle having an essentially cylindrical wall, and means for imparting a series of driving impulses to said clothes at regularly increasing intervals comprising first, second and third baffles carried by said wall and projecting inwardly thereof, said baffles extending essentially the full length of said wall and being adapted to engage said clothes sequentially when said receptacle is rotated in said predetermined direction, said baffles being identical, each baffle having a front face extending essentially radially of said receptacle and a rear face inclined with respect to said front face, the circumferential spacing between said first and second baffles being less than the circumferential spacing between the second and third baffles and the spacing between said second and third baffles being less than the circumferential spacing between said third and first baffles.

9. The receptacle according to claim 8 wherein the spacing between said first and second baffles is approximately 90°, the spacing between said second and third baffles is approximately 120° and the spacing between said third and first baffles is approximately 150°.

References Cited by the Examiner

UNITED STATES PATENTS

2,360,278	10/1944	Robertson	68—18
2,538,200	1/1951	Johnston	68—208
2,589,247	3/1952	Guzzetti et al.	68—184
2,643,537	6/1953	Woodson	68—17
2,758,462	8/1956	Moss	68—142
2,963,892	12/1960	Edwards	68—140
2,966,052	12/1960	Syles	68—58

WILLIAM I. PRICE, *Primary Examiner.*