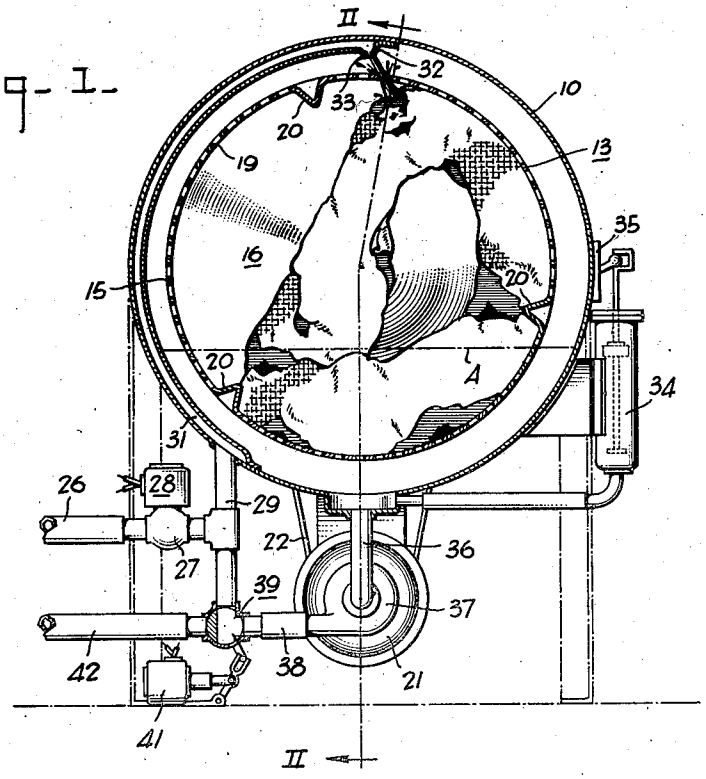
Sept. 12, 1944. R. J. RIDGE 2,357,909

APPARATUS FOR CLEANSING FABRICS AND THE LIKE

Filed June 1, 1940 2 Sheets-Sheet 1

Fig. 1.



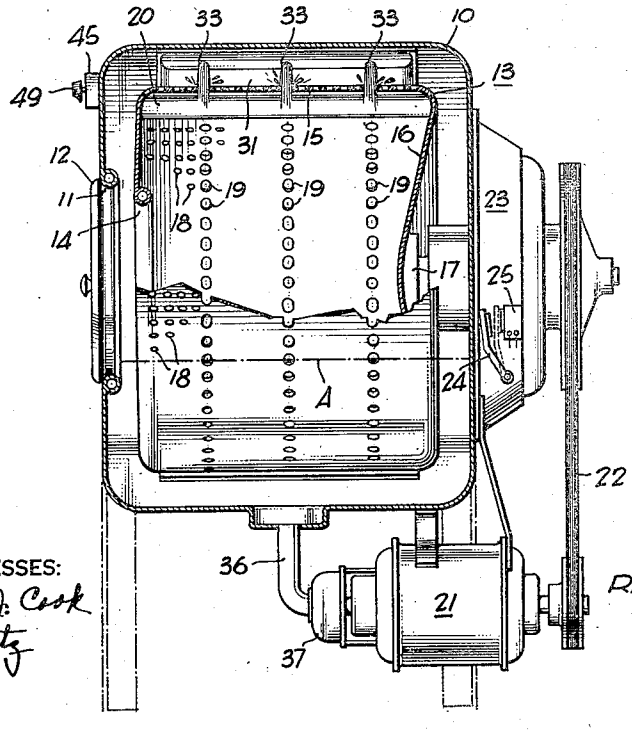


Fig. 2.

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APPARATUS FOR CLEANSING FABRICS AND THE LIKE

Filed June 1, 1940 2 Sheets-Sheet 2

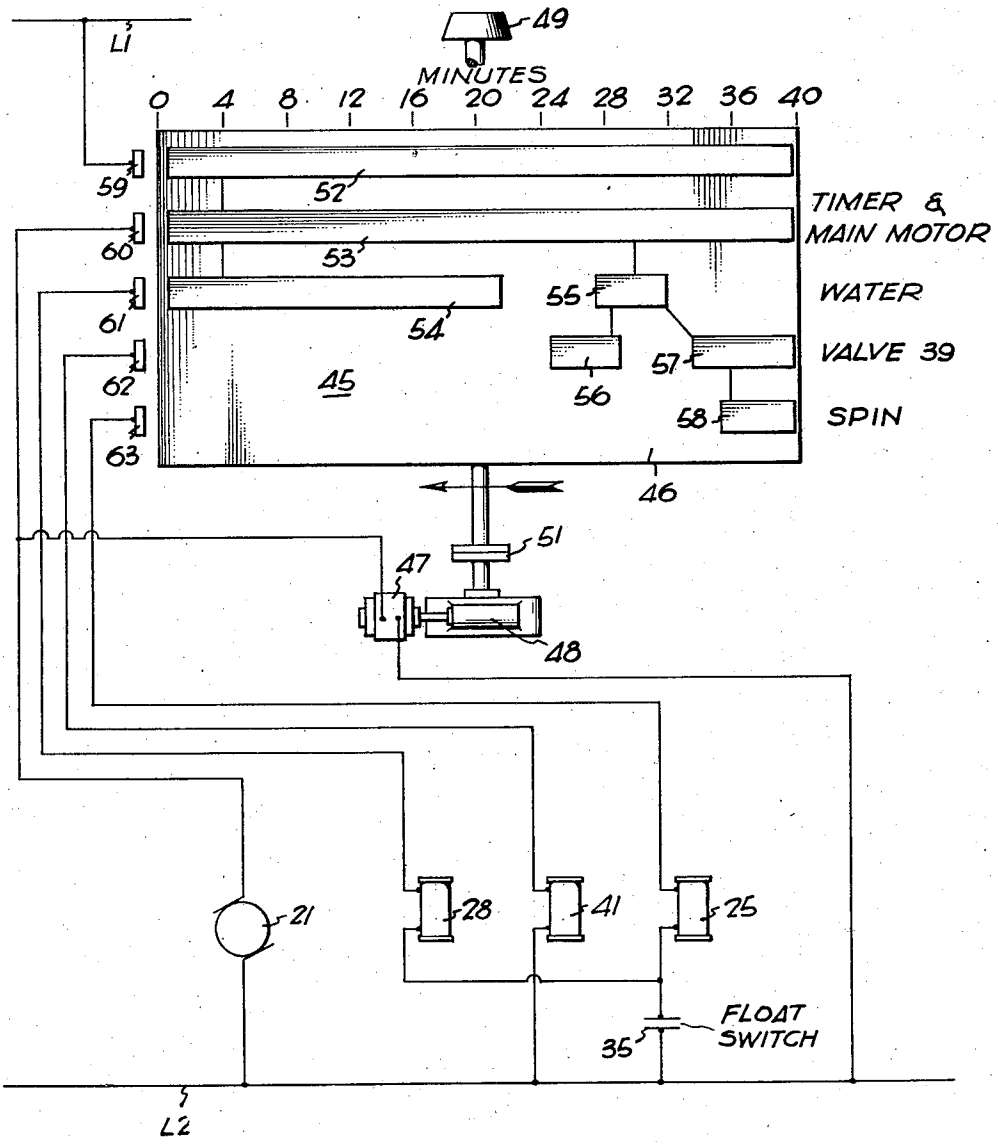

Fig. 3.

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UNITED STATES PATENT OFFICE

2,357,909

APPARATUS FOR CLEANSING FABRICS AND THE LIKE

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Application June 1, 1940, Serial No. 338,336

8 Claims. (Cl. 68—24)

My invention relates to the cleaning of fabrics or the like and has for an object to provide an improved apparatus for cleaning materials of this character.

It is a further object of the invention to provide improved washing and rinsing actions in a laundry machine of the horizontal, rotatable cylinder type.

A further object of the invention is to provide an improved cleaning machine of the type wherein cleansing of fabrics and centrifuging cleaning fluid therefrom is accomplished in a single container rotatable about a substantially horizontal axis.

A still further object of the invention is to provide substantially uniform distribution of the fabrics in a rotatable container of the type set forth, prior to acceleration of the container to its centrifuging speed, whereby vibration of the apparatus is reduced to a minimum.

It is another object of my invention to provide an improved cleansing and centrifuging machine of the type set forth which may be readily and economically adapted for automatic operation, wherein the various steps in a washing and damp-drying program may be carried into effect without manual attention.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application in which:

Fig. 1 is a vertical sectional view of a cleaning machine constructed in accordance with the invention;

Fig. 2 is a vertical sectional view of the machine shown in Fig. 1 and taken along the line II—II thereof; and

Fig. 3 is a diagram of the electrical connections between the various electrical translating and control devices employed by the machine shown in Figs. 1 and 2.

In practicing my invention, I provide a perforate drum or basket structure which is rotatable about a substantially horizontal axis within a fluid-containing tub. During washing or cleaning periods, the drum is rotated at relatively low speed with its bottom portion immersed in the body of cleaning fluid. During spinning or centrifuging periods, the drum is rotated at relatively high speed in the absence of the body of fluid for centrifugally extracting the fluid from the fabrics contained therein.

The drum is provided with a suitable vane structure therein for scrubbing the clothes and for elevating the fabrics from the body of fluid during rotation of the drum. The speed at which the drum is rotated at this time is so related to the diameter of the drum that the fabrics elevated from the fluid by the vanes are maintained centrifugally in contact with the inner surface of the drum as it rotates. The speed is such that, if unobstructed, the fabrics would continue their excursion within the drum in a circular path and would be returned to the body of fluid in contact with the drum. As is well understood to those skilled in the art, a cleaning action having maximum efficiency is obtained in a drum of this type if the fabrics are dropped or plunged into the fluid after being elevated therefrom. The greatest efficiency is obtained where the fabrics are carried to the uppermost part of the drum and then dropped clear of and across the drum into the body of fluid.

In order to effect the latter operation, I provide means for disengaging the fabrics from the inner surface of the drum adjacent the uppermost portion thereof and for directing the fabrics generally diametrically of the drum into the body of fluid. Preferably, this disengagement of the fabrics is effected by directing one or more jets of the cleaning fluid inwardly of the drum and into engagement with the fabrics as they approach the uppermost region thereof. The jets of fluid reduce the peripheral speed of the portion of the rotating bundle of fabrics adjacent the top of the drum while directing them inwardly of the drum, whereby gravity overcomes centrifugal force and effects a movement of the fabrics across the drum into the body of cleaning fluid. In other words, the kinetic energy of the jets imparts a centripetal force to the body of fabrics for moving the same diametrically of the drum and into the body of fluid.

Cleaning of the fabrics is expedited also by the jets of fluid which are directed at high velocity into engagement with and in part through the fabrics, which operation is effective in loosening and removing the soils from the fabrics.

After the cleaning operation is completed, the body of fluid is removed from the drum and the disengaging action effected by the jets of fluid is terminated. Rotation of the drum is continued at substantially the same speed so that the fabrics are carried within the drum in a circular path and in engagement with the walls of the drum. Substantial uniform distribution of the fabrics within the drum is effected at this time. After a period of distribution, the drum is accelerated to a relatively high speed whereby a substantial

portion of the fluid contained in the fabrics is centrifugally extracted therefrom.

The clothes may be subsequently rinsed in the same drum by the admission of clear rinsing fluid thereto; the agitation of the fabrics, distribution and centrifuging of the same being similar to the steps described in connection with the cleaning program. A highly efficient rinse is obtained in accordance with this invention, by the high velocity jets of fluid which are directed into engagement with and through the fabrics. It is unnecessary for the operator to handle the clothes being cleaned except for the admission and removal of the fabrics from the drum. As the fabrics are evenly distributed within the drum prior to the centrifuging operation, vibration because of unbalanced load is reduced to a minimum.

In order to insure that the fabrics are carried to the uppermost portion of the drum during the washing and distributing periods, the speed in revolutions per minute of the drum should be in excess of

$$\sqrt{\frac{2933}{\text{drum radius in feet}}}$$

The speed of the drum in revolutions per minute should be slightly in excess of the speed derived in accordance with the foregoing formula, but should not greatly exceed this value as the energy required to disengage the fabrics from the drum is opposition to the centrifugal force would necessarily have to be increased. The speed which is optimum is that which will carry the fabrics to the top of the drum, at which point the centrifugal force of the fabrics is just slightly in excess of gravity. When operating under these conditions the amount of energy required to direct the fabrics radially of the drum is maintained at a minimum.

Reference will now be had to Figs. 1 and 2 of the drawings, wherein I have chosen to show my invention applied to a laundry machine, although, in this connection, it will be understood that the invention may be applied equally well to other forms of cleaning and centrifuging apparatus such as, for example, dry cleaning machines. The apparatus which I have illustrated is particularly adaptable for carrying my improved method into effect, but it will be understood that means other than that shown may be employed for effecting the various steps in the washing, distributing and spinning program.

The laundry machine which I have shown includes a substantially cylindrical tub member 10 having an access opening 11 formed in one end thereof for the ingress and egress of fabrics to be treated. A gasketed door 12, which is suitably hinged to the tub 10, is employed for closing the opening 11 during periods of operation. Arranged within the tub 10 is a perforate drum or basket 13 having an axis of rotation disposed substantially horizontal and about which rotation of the drum 13 is effected. An opening 14 is provided in an end wall of the drum 13 and registers substantially with the opening 11 in the tub 10. The drum 13 includes a substantially cylindrical side wall 15 and an end wall 16 at the inner end thereof, the latter being secured to a rotatable member 17. The drum 13 is perforate throughout substantially the extent of the side wall 15, a number of perforations being shown at 18. The drum 13 may also be provided with a series of perforations 19 which are circumferentially spaced around the sidewall 15 in groups which are spaced axially of the drum 13. Further reference to the openings 19 is made hereinafter. The drum 13 is also provided with a plurality of circumferentially - spaced inwardly - extending protuberances or vanes 20 which engage the fabrics for providing a scrubbing action and also assist in elevating the fabrics from the water as the drum is rotated.

Rotation of the drum 13 is effected by a motor 21, suitably carried by an underportion of the tub 10 and belted, as shown at 22, to a two-speed mechanism, generally indicated by the reference numeral 23. As the specific construction of the two-speed mechanism 23 forms no part of the present invention, it has not been shown in detail for the sake of brevity, but it will be understood that any suitable mechanism having provisions for effecting low and high speed rotation of the driven member 17 may be employed.

The mechanism 23 is adjustable to provide said different speeds and, in this connection, a movable lever 24 may be employed for adjusting the mechanism 23 to its selective positions. The member 24 is normally biased to the position shown, wherein low speed rotation of the member 17 is effected and is movable to the position shown in dotted lines to effect high speed operation of the member 17. Movement of the lever 24 is effected by an electro-magnet 25 which, when energized, moves the lever 24 to the position shown in dotted lines.

In accordance with my invention, fresh water is admitted to the tub 10 from a suitable source, defined by the conduit 26, under control of an electrically-operated valve 27, the latter normally being closed, and movable to its open position by an electro-magnet or solenoid 28, when energized.

The downstream side of the valve 27 is connected by means of a conduit 29 to a water passage 31 formed in the tub structure and terminating at its upper end in a manifold 32. The manifold 32 is provided with a plurality of water nozzles 33 which are spaced apart and disposed, respectively, in the planes of the axially-spaced groups of openings 19. The operation of the jets of water issuing from the nozzles 33 will be described hereinafter.

The level of fluid in the tub 10 during the cleaning operation is indicated by the dotted line A. A conventional float switch structure 34 is employed for controlling the amount of water admitted to the tube and actuates a switch 35 to its open position when the proper amount of water has been admitted to the tub. When the tub 10 is substantially devoid of water, the float-actuated switch 35 is moved to the closed position. The switch 35 is connected in series with the solenoid 28, as shown in Fig. 3, further reference to which will be made hereinafter.

During the washing operation, the cleaning fluid from the tub 10 is withdrawn through a conduit 36 by means of a pump 37, which is preferably driven by the motor 21, and is translated through a conduit 38 to a two-way valve structure, generally indicated at 39. The two-way valve 39, when disposed in the position shown in Fig. 1, conveys the fluid withdrawn from the tub 10 to the conduit 29 and thence through the passage 31 to the nozzles 33. An electro-magnet 41 is employed for rotating the two-way valve structure 39 to its other position wherein the water translated through the conduit 38 is passed to a conduit 42 which connects with a suitable drain.

Operation of the motor 21 and the electro-magnets 25, 28, and 41 may be hand or automatically

controlled by a series of switches. Since my invention is particularly adaptable for automatic operation, I have elected to show an automatic control system for effecting the various steps in a cleaning program. The control system as shown in Fig. 3 includes a timer, generally indicated at 45, suitably carried on the front of the tub structure 10 wherein it is convenient to the operator. The timer 45 includes an insulating barrel 46 which is rotated by a motor 47 of the type commonly employed for driving clocks, through a speed-reducing mechanism 48. The barrel 46 is shown in development, and when driven by the motor 47 is actuated in the direction of the arrow. A knob 49 is provided for manually adjusting the barrel 46 when initiating operation of the apparatus. A clutch, generally indicated at 51, is interposed between the barrel 46 and the speed-reducing mechanism 48 in order to permit rotation of the barrel 46 relative to the two-speed mechanism 48 when the former is manually adjusted, and which functions to drive the barrel 46 at other times.

The barrel 46 carries a plurality of electrically-connected segments 52 to 58, inclusive, which are engageable with a plurality of stationary fingers 59 to 63, inclusive. The source of power for the various electrically-operated instrumentalities is indicated by line conductors L_1, L_2, the former of which is connected to a contact finger 59 and the latter of which is connected to one terminal of each of the motors 21 and 47 and the electromagnet 41. The line conductor L_2 is also connected to one terminal of each of the electromagnets 28 and 25 through the float switch 35. The contact finger 60 is connected to the opposite terminals of the motors 21 and 47 and the fingers 61, 62, and 63 are respectively connected to the opposite terminals of the electro-magnets 28, 41, and 25, respectively.

Operation

At the beginning of a cleaning cycle, the fabrics to be treated and a detergent are placed within the drum 13 and the closure 12 is moved to its closed position. The timer 45 is then advanced manually by the knob 49 until the segments 52, 53, and 54 engage their respective fingers 59, 60, and 61. This operation energizes the timer motor, which then functions to drive the timer barrel 46, and the main motor 21 is energized for rotating the drum 13 at the relatively low or washing speed, it being understood that the two-speed mechanism 23 is adjusted at this time for low-speed operation, its magnet 25 being deenergized. Engagement of the segment 54 and its finger 61 energizes the electro-magnet 28 to admit water to the conduit 29. At this time the magnet 41 is deenergized so that the two-way valve 39 is in the position shown in the drawings.

Water conveyed to the conduit 29 through the valve 27 enters a passage 31 and is discharged through the nozzles 33 into the drum through the circumferentially - spaced openings 19. When the proper amount of water has been admitted to the tub, as indicated by the dotted line, the float switch 35 is actuated to its open position wherein the magnet 28 is deenergized and the valve 27 is closed. At this time the pump 37 functions to withdraw water from the tub and convey it through the conduit 38, the two-way valve 39, and eventually to the nozzles 33 where it is projected at high velocity through the openings 19 into the drum.

The speed of the drum 13 at this time and the diameter of the drum 13 are so related that the fabrics elevated from the washing water by the vanes 20 are carried centrifugally in engagement with the inner surface of the side wall 15 to the uppermost region of the drum or basket 13. The speed is such that, if unobstructed, the fabrics would be rotated around the drum in engagement with the side wall. In other words, centrifugal force of the fabrics is sufficient to overcome gravity at all times and, under the conditions stated, they would be carried in an annular bundle around and around within the drum. The minimum speed in revolutions per minute which would effect this operation is equal to

$$\sqrt{\frac{2933}{\text{drum radius in feet}}}$$

It is well understood that in a machine of the type employing a drum rotatable about a horizontal axis, the best efficiency is obtained when the fabrics are elevated to the uppermost region of the drum and are than projected substantially the full diameter of the drum downwardly into the body of cleaning fluid.

In accordance with my invention, the jets of washing fluid are employed for disengaging the fabrics from the drum in the uppermost region thereof and directing them substantially diametrically across the drum into the body of cleaning fluid. The kinetic energy of the jets retards movement of that portion of the bundle of fabrics which is adjacent the uppermost part of the drum 13 so that the centrifugal force of this portion of the bundle is reduced. Accordingly, this portion of the bundle moves downwardly diametrically across the drum by gravity. The jets are also so disposed that they impart an inward or centripetal force to the portions of the fabrics which are engaged by the jets.

The movement of the fabrics is best shown in Fig. 1, and it will be apparent that I obtain a washing action which is optimum, as the distance that the fabrics drop is substantially the entire diameter of the drum 13. Furthermore, the cleaning of the fabrics is expedited by the high velocity jets of cleaning fluid which are projected into engagement with and in part through the fabrics.

The speed at which the drum 13 is rotated at this time should be just in excess of the value derived in accordance with the formula set forth heretofore in order that the amount of energy required of the jets is maintained at a minimum. In other words, a speed should be employed which is effective to impart just enough centrifugal force to the fabrics that gravity would be overcome at all times. Another feature of this washing action resides in the prevention of balling or knotting of the fabrics within the drum 13. It is believed apparent that, when actuated as described heretofore, rolling or balling of the fabrics within the side wall 15 of the drum is precluded. In other words, when agitated as described, the fabrics are maintained in a free or loose condition at all times.

The cleaning operation continues for a predetermined time determined by the position to which the timer is initially moved by the operator. The cleaning operation is terminated when the segment 56 engages the finger 62. This operation energizes the magnet 41 which actuates the two-way valve 39 to its position wherein the water discharged by the pump 37 is passed to the drain conduit 42. This operation terminates the passage of water to the nozzles 33 so that the fabrics, as they are rotated within the drum 13,

are not subjected to the disengaging action afforded by the jets. Therefore, the fabrics move around and around within the drum centrifugally in engagement with the side wall 15 thereof during and after the discharge of water from the tub 10.

Engagement of the segment 55 and the finger 61 sets up a circuit, including the inlet valve 28, which circuit is completed when the float switch 35 is closed. Completion of this circuit energizes the inlet valve solenoid 28 for the admission of rinse water to the nozzles 33. Preferably, the two-way valve 39 is maintained in its drain position for a short period of time during which the water admitted through the nozzles 33 is employed for flushing away soap scum and lint, which are immediately discharged through the drain 42. This operation is obtained by slight overlapping of the contacts 56 and 55 on the barrel 46. At the end of the flushing operation, the segment 56 is disengaged from the finger 62 so that the magnet 41 is deenergized and the valve 39 returned to the position shown in Fig. 1. The admission of rinse water continues until terminated by the float switch 35, as described heretofore. The operation during the rinse period is the same as described in connection with the cleaning portion of the cycle, except that this time any detergent remaining in the fabrics is dissolved in the rinse water. The movement of the fabrics within the drum 13 is, however, the same as described in connection with the cleaning cycle.

It will be apparent to those skilled in the art that a very effective rinse is provided by my invention, as the clear rinse water passing through the nozzles 33 is in part driven through the fabrics for dissolving and removing any particles of lint or the detergent employed.

The agitating rinse is terminated by engagement of the segment 57 and finger 62 which energizes the magnet 41 and moves the two-way valve 39 to its drain position, wherein water conveyed by the pump 37 is discharged to the drain conduit 42. In the absence of the jets of water issuing from the nozzles 33, the fabrics are rotated around the drum in engagement with the side wall 15 and are distributed in a substantially uniform manner circumferentially of the basket. Acceleration of the drum to a relatively high speed is initiated upon engagement of the segment 58 and the finger 63 and the resulting energization of the magnet 25 and the two-speed mechanism 23. Preferably the circuit including the magnet 25 is controlled by the float switch 35 so that acceleration is not initiated until substantially all of the water has been drained from the tub 10.

In accordance with this invention, vibration of the washing and spinning structure, because of an unbalanced load within the drum 13, is minimized by the uniform distribution of the fabrics within the basket prior to acceleration. Rotation of the drum 13 at relatively high speed effectively centrifuges a substantial portion of the cleaning fluid from the fabrics, which is well understood. The centrifuging operation is terminated by disengagement of the segment 58 from the finger 63 at the end of the cycle of operation, at which time the apparatus is rendered inactive by the disengagement of the other contact segments from their respective fingers.

The damp-dried fabrics may then be removed from the drum through the openings 11 and 14, after which the drum may again be loaded for a second operation. In this connection, both the drum and tub will be found in a clean condition, as any deposits formed during the cleaning cycle are effectively washed away and discharged during the agitating rinse and particularly during that part of the rinse referred to heretofore as the flushing rinse.

From the foregoing description, it will be apparent that I have provided an improved cleaning machine wherein fabrics are effectively cleaned, distributed and centrifuged in a single drum or basket structure which is rotated in a single direction about a substantially horizontal axis. While I have described the axis as horizontal it will be understood that my invention may be applied to a machine having its axis slightly inclined from the horizontal provided the inclination is not so great as to interfere with the washing action described herein.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In apparatus for cleaning fabrics, the combination of a substantially cylindrical drum for containing a body of cleaning fluid and the fabrics to be treated, means for rotating said drum about a substantially horizontal axis at a speed in revolutions per minute in excess of

$$\sqrt{\frac{2933}{\text{drum radius in feet}}}$$

so that the fabrics are elevated from the cleaning fluid and carried centrifugally to an upper region of the drum, and means for disengaging the fabrics from the drum in said upper region thereof and for directing them generally across the drum into the body of cleaning fluid.

2. In apparatus for cleaning fabrics, the combination of a substantially cylindrical drum for containing the fabrics to be treated, means for rotating said drum about a substantially horizontal axis with the bottom of the drum immersed in a body of cleaning fluid and at such speed that the fabrics are elevated from the body of fluid and carried centrifugally to the uppermost region of the drum, and means for projecting cleaning fluid into engagement with the fabrics in said upper region of the drum for directing the fabrics inwardly of the drum and into the body of fluid of the bottom of the drum.

3. In apparatus for cleaning fabrics, the combination of a basket for containing a body of cleaning fluid and the fabrics to be treated, means for rotating the basket during cleaning periods about a substantially horizontal axis at such speed that the fabrics are carried centrifugally to an upper region of the basket, means for projecting fluid into engagement with the fabrics in said upper region of the basket for directing the fabrics inwardly of the basket and into the body of fluid, and means for translating fluid from within the basket to said projecting means.

4. In apparatus for cleaning fabrics, the combination of a basket for containing a body of cleaning fluid and the fabrics to be cleaned, means for rotating the basket during cleaning periods about a substantially horizontal axis at such speed that the fabrics are carried centrifugally to an upper region of the basket, means

for projecting fluid into engagement with the fabrics in said upper region of the basket for directing the fabrics inwardly of the basket and into the body of cleaning fluid, a first conduit for conveying fluid to the fluid-projecting means, a pump having inlet and outlet ports, the former communicating with the body of fluid in the basket, a second conduit for discharging fluid translated by the pump, valve means for selectively connecting the outlet port of the pump to said first and second conduits and means for admitting fresh cleaning fluid to said fluid projecting means.

5. In apparatus for cleaning fabrics, the combination of a basket for containing a body of cleaning fluid and the fabrics to be cleaned, means for rotating the basket during cleaning periods about a substantially horizontal axis at such speed that the fabrics are carried centrifugally to an upper region of the basket, means for deflecting the fabrics from the upper region of the basket and for directing the same inwardly of and across the basket into the body of cleaning fluid, means for draining the body of fluid from the basket, means for rendering said deflecting means inactive whereby the fabrics are rotated in engagement with the basket and distribute therewithin, and means for accelerating the basket to a relatively high speed for centrifuging fluid from the fabrics.

6. In apparatus for cleaning fabrics, the combination of a basket for containing a body of cleaning fluid and the fabrics to be celaned, means for rotating the basket during cleaning periods about a substantially horizontal axis at such speed that the fabrics are carried centrifugally to an upper region of the basket, means for projecting fluid at relatively high velocity into engagement with the fabrics in said upper region of the basket for disengaging the fabrics from the basket and for directing the same across the basket into the body of cleaning fluid, means for draining the body of fluid from the basket and for terminating operation of the fluid-projecting means, whereby the fabrics rotate within the basket and are distributed therewithin, and means for accelerating the basket to a relatively high speed for the extraction of fluid from the fabrics.

7. In apparatus for cleaning fabrics, the combination of a tub structure for containing a body of cleaning fluid, a generally cylindrical, perforate basket disposed within the tub and rotatable about a substantially horizontal axis with its bottom portion immersed in the cleaning fluid, said basket enclosing the fabrics to be treated, means for rotating the basket during cleaning periods at such speed that the fabrics are carried centrifugally to an upper region of the basket, means disposed within the tub for projecting fluid at relatively high velocity through the perforate basket and into engagement with the fabrics in said upper region of the basket whereby the fabrics are directed inwardly of the basket and into the body of cleaning fluid, a pump for translating fluid from the tub to said fluid-projecting means, means for draining the body of cleaning fluid from the tub and for terminating operation of the fluid-projecting means, whereby the fabrics are rotated for distribution within the basket, and means for accelerating the basket to a relatively high speed for centrifugally extracting cleaning fluid from the fabrics.

8. In apparatus for cleaning fabrics, the combination of a tub structure for containing a body of washing water, a generally cylindrical basket for containing the fabrics to be treated and disposed within the tub structure, said basket being rotatable about a substantially horizontal axis, agitating means for circulating the fabrics in said body of washing water, whereby the fabrics are cleaned, means for draining the body of washing water from the tub structure at the conclusion of the washing operation, means for rotating the basket, subsequent to the drainage of washing water from the tub structure, at such speed that the fabrics are carried centrifugally in engagement with the basket to an upper region thereof, means effective after the washing water is drained away for projecting rinse water into engagement with the fabrics in said upper region of the basket for disengaging the fabrics from the basket and for directing the fabrics inwardly of and across the basket, means for terminating operation of the water-projecting means whereby the fabrics are rotated with the basket for distribution therein, and means for accelerating the basket to a relatively high speed for centrifuging rinse water from the fabrics.

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