Nov. 4, 1952 H. SCHEIBLER 2,616,280

WASHING APPARATUS

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Fig. 1

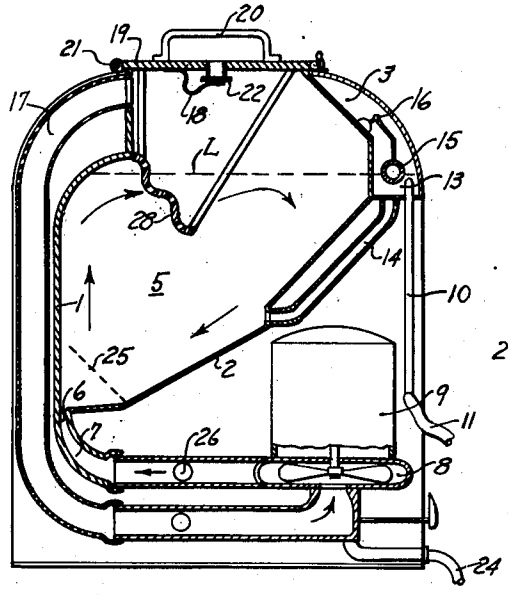


Fig. 2

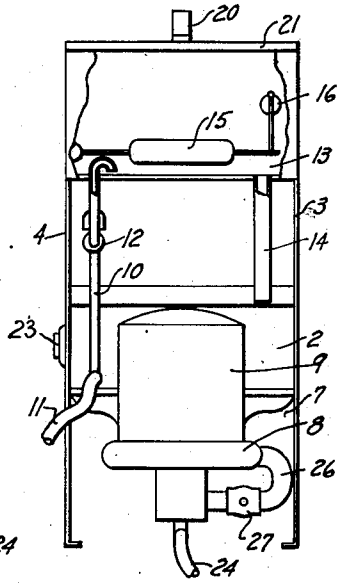


Fig. 4

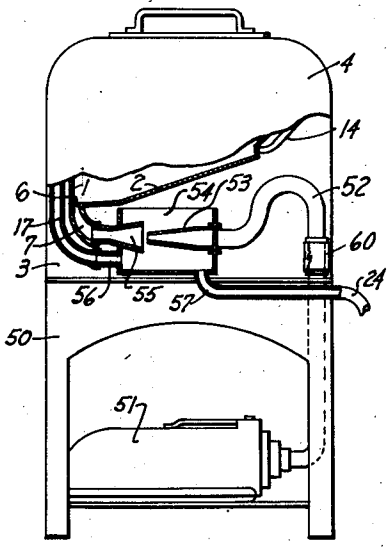
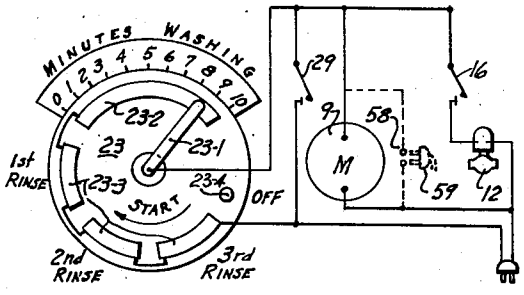


Fig. 3



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Fig. 5

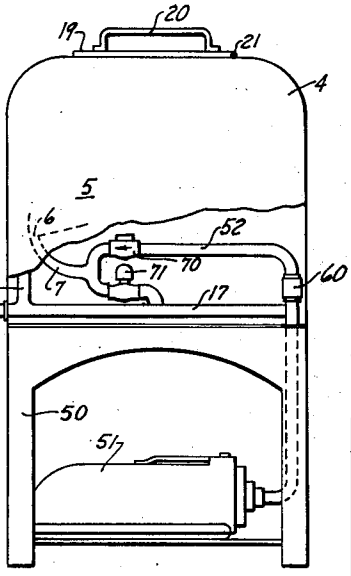


Fig. 4B

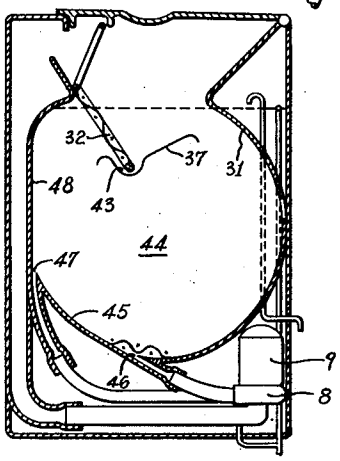


Fig. 4A

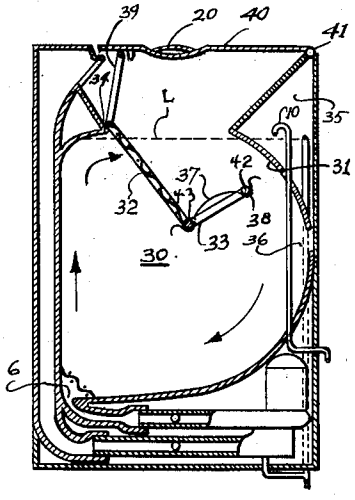


Fig. 6

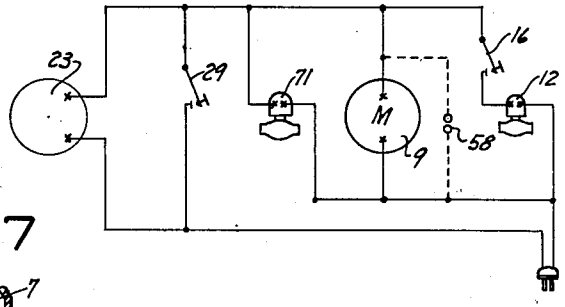
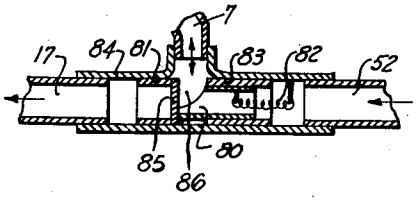


Fig. 7



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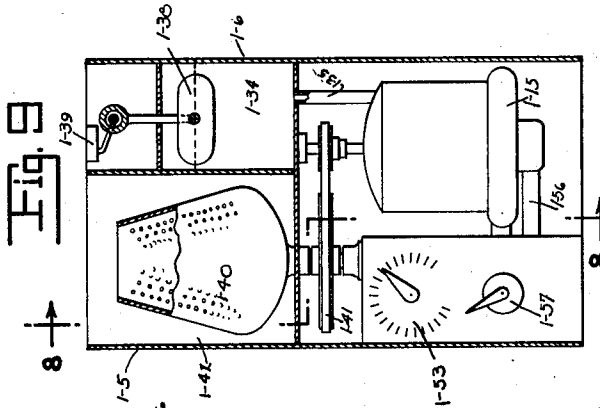


Fig. 9

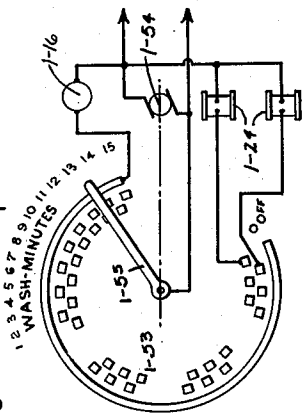


Fig. 12

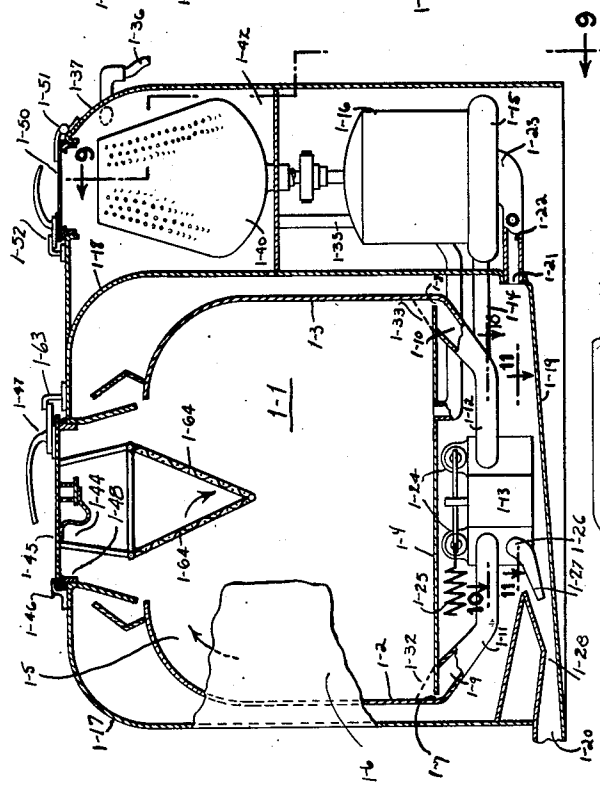


Fig. 8

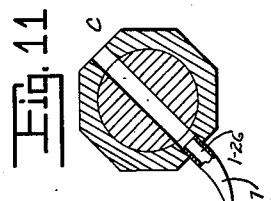


Fig. 11

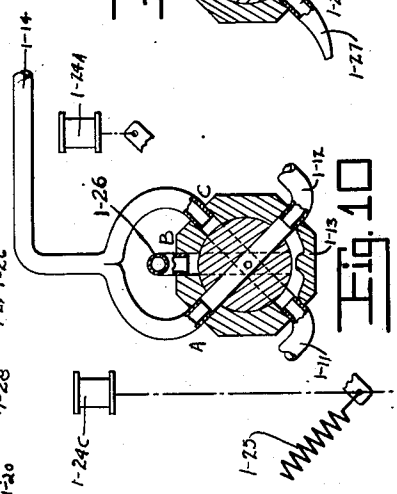


Fig. 10

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WASHING APPARATUS

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Fig. 13

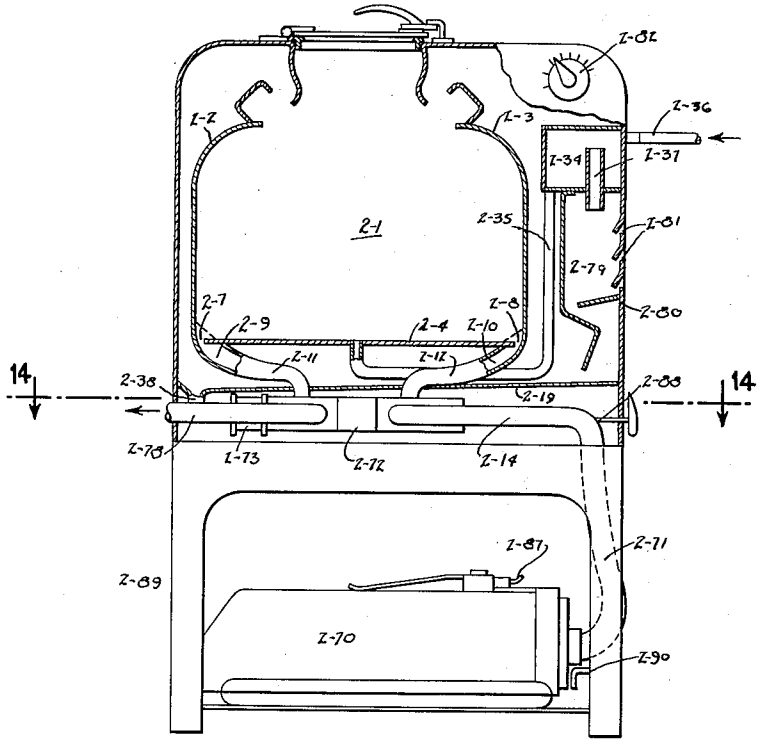
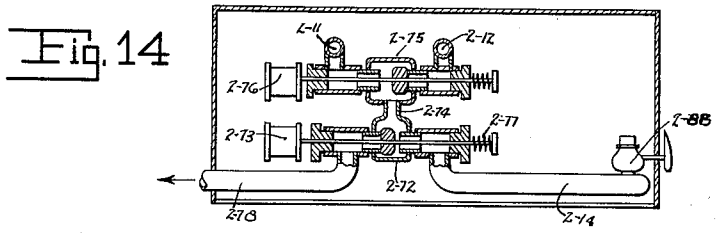


Fig. 14



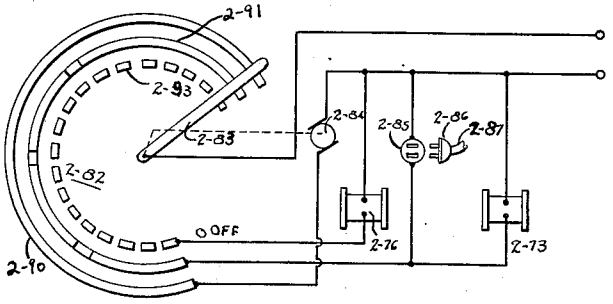


Fig. 15

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Fig. 16

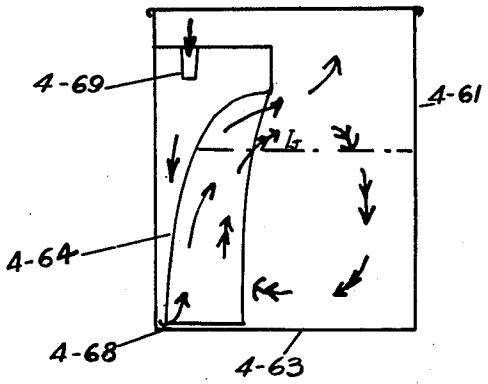
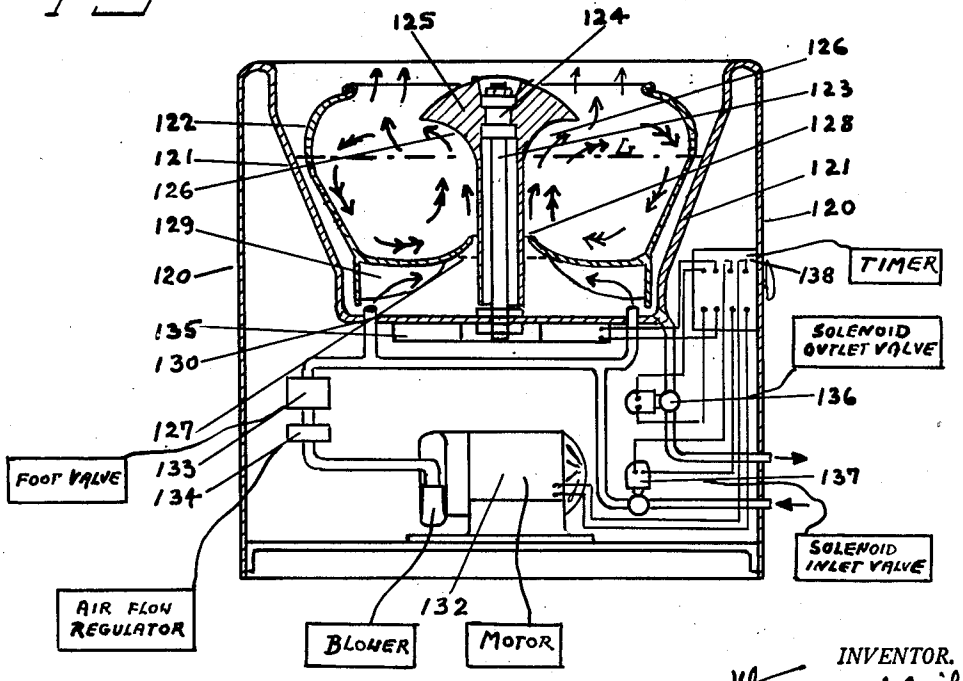


Fig. 17



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Attorneys

Patented Nov. 4, 1952 2,616,280

UNITED STATES PATENT OFFICE

2,616,280

WASHING APPARATUS

Hermann Scheibler, Greenwich, Conn.

Application November 1, 1946, Serial No. 707,291

7 Claims. (Cl. 68—183)

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This invention relates to domestic appliances. An object of the invention is to provide a washing machine capable of effecting the thorough and vigorous washing of coarse laundry items, such as heavy cottons, etc., as well as the careful washing of fine silks or rayons and delicate lace.

Among the further objects of the invention are various novel washing machine arrangements which simplify the construction and reduce the cost of manufacture of washing machines; which permit the operation of the washing machine as an attachment to any type of vacuum cleaner such as used in most households; which permit the transformation of the washing machine into a self-operated unit by simple attachment of a motor and blower; and which enable the performance of the washing, rinsing and drying operations in an automatically controlled sequence.

The foregoing and other objects of the invention will be best understood from the following description of various exemplifications thereof, reference being had to the accompanying drawings wherein:

Fig. 1 is a vertical section of one form of washing machine embodying the invention;

Fig. 2 is a side view partly broken away of the washing machine of Fig. 1;

Fig. 3 diagrammatically illustrates the electrical circuit that may be used in the apparatus of Fig. 1;

Fig. 4 is a front view partly broken away of another form of washing machine according to the invention;

Fig. 4A is a view similar to Fig. 1 of a third form of the invention.

Fig. 4B shows a modified form similar to that shown in Fig. 4A;

Fig. 5 is a view with parts broken away of a further modification of washing machine according to the invention;

Fig. 6 is a wiring diagram that may be used with the apparatus of Fig. 5;

Fig. 7 is a check valve arrangement suitable for the apparatus of Fig. 5;

Fig. 8 is a sectional view along line 8—8 of Fig. 9 of a still further form of washing machine according to the invention;

Fig. 9 is a partly sectional view along line 9—9 of the apparatus of Fig. 8;

Figs. 10 and 11 are sectional views along lines 10—10 and 11—11, respectively, of Fig. 8;

Fig. 12 is a diagrammatic representation of the wiring of the apparatus of Fig. 8;

Fig. 13 is a sectional view of a further modification of the invention;

Fig. 14 is a sectional view along the line 14—14 of Fig. 13;

Fig. 15 is a wiring diagram that may be used in the apparatus of Fig. 13;

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Fig. 16 is a vertical section of a still further modified apparatus according to the invention; and

Fig. 17 is a vertical section of a fully automatic washing machine embodying the invention.

Referring to the apparatus of Figs. 1 and 2, the washing machine there illustrated has a washing vessel compartment 5 bounded by two side walls 3, 4, a sloping bottom wall 2 and a curved deflector wall 1. At the junction of the deflector wall 1 and the bottom wall 2 a gap-like nozzle 6 is provided and connected by an air duct 7 to the outlet of centrifugal blower 8 driven by motor 9.

At one side of the washing compartment 5 is shown a float compartment 13 the bottom of which is connected by means of a duct 14 with the washing compartment 5. A water supply conduit 10 shown fed from a flexible hose 11 supplies water to the float compartment 13 under the control of a solenoid operative valve 12. A float 15 linked with a float switch 16 acts to open or close the electric circuit to the solenoid of the solenoid operative valve 12. The inlet of blower 8 is connected by side ducts 17 to the top portion of the washing compartment 5 above the top of the deflector wall 1 so that the air in the washing machine is recirculated by the blower.

A cover 19 hinged at 21 is provided with a handle 20 and an air check valve 22 biased by spring 18 to permit the passage of air into the interior of the washing machine.

A time switch 23 is provided and may be connected, as shown in Fig. 3, so as to open and close the electric circuit to the blower at predetermined intervals and for a predetermined number of times.

A discharge duct 24 is provided in the blower inlet to permit drainage of the water from the washing compartment 5. A perforated barrier, such as the screen 25, is arranged to be held across the gap 6 so as to keep articles being washed from clogging the gap 6 upon drainage of the water.

Between the blower outlet and inlet there is shown connected a by-passing duct 26 provided with a valve 27 adjustable by valve handle 27—1 for controlling the by-passing of air in the blower circuit and thereby controlling the washing action.

In the apparatus shown the time switch 23 includes a contact arm 23—1 operated by a clockwork mechanism and movable over extended contact surface 23—2 followed by three smaller contact surfaces 23—3. A stop pin 23—4 limits the rotation of the contact arm 23—1.

The above described apparatus may be operated by rotating the contact arm 23—1 in a clockwise direction from the "Off" position in

which it rests against the stop pin 23—4. The contact arm 23—1 is rotated to a position where it contacts the extended contact segment 23—2 to establish an electric circuit which causes the operation of blower motor 9. Water is fed through the inlet duct 10 until it reaches the approximate float operating level indicated by "L," the blowing of air through the gap 6 preventing the drainage of water through the air chamber 7. While the water is being introduced, articles to be washed may be placed in the washing compartment 5 together with an approximate amount of soap and any other necessary washing chemicals. The air escaping through gap 6 surges vigorously upward along the vertical portion of the deflector 1 and causes vigorous upward motion of the fluid contents of the washing compartment in the same region. At the upper curved end of deflector 1 the vigorous upward motion is suddenly changed to a horizontal motion, the air escaping above the liquid while the liquid is discharged into a retarding region bounded by walls shaped so as to impede rapid or streamlined rotation of the liquid contents of the wash vessel. Through the retarding region the liquid contents gradually move to be recirculated around to the portion of the compartment adjacent the air gap 6 where they are again suddenly and vigorously impelled through another cycle, as indicated by the arrows in the compartment 5 of Fig. 1. During this circulation the articles suspended in the water are subjected to a mechanical washing action by mechanical engagement with the walls of the washing compartment 5 and the rubbing of the articles being washed against each other to supplement the washing effected by the wash liquid per se. The sudden deflection from the upward motion to the horizontal motion and the discharge from the region of vigorous horizontal motion to the region of gentle circulation together with the mechanical engagement of the articles being washed with the walls of the washing compartment 5 as well as the rubbing of the articles being washed against each other, all contribute to produce a highly satisfactory washing action. A foraminous baffle 28 inserted in the recirculation path, as shown in Fig. 1, further increases the mechanical action on the articles being washed giving excellent washing results difficult to duplicate with conventional washing machines. The baffle 28 may be provided with corrugations to still further increase this mechanical action and provide a "washboard" effect.

Under the influence of the clockwork the contact arm 23—1 slowly rotates in a counterclockwise direction, and when the arm leaves the contact surface 23—2 the blower motor 9 is inactivated, blower 8 stops and the liquid contents of the washing compartment 5 drains through the air chamber 7, the blower outlet, the blower inlet and discharge duct 24. The articles being washed are retained in the retaining compartment 5 during the water drainage. After substantially all the fluid contents of the washing compartment are drained the contact arm 23—1 reaches a contact surface 23—3 starting the blower and thus preventing further drainage of water through the air gap 6. The inflow of water may be maintained during the drainage period and rapidly fills up the washing compartment when the blower is restarted. The flow of air through the washing compartment provides an agitating action which assists in rinsing of the articles being washed by the second filling of water. After another interval of time a contact arm 23—1 leaves a contact surface 22—3 again stopping the blower 8 and permitting drainage of the rinse water. The time switch 23, shown in Fig. 3, provides for a second and third rinsing operation which automatically repeat the operations of the first rinse. The degree of agitation during the washing as well as the rinsing is controlled by varying the amount of air blown through the air gap 6 into the washing compartment 5. The by-pass line 26 together with the valve 27 constitute one simple construction for varying this air stream; the by-passing of more air diminishes the intensity of the agitation produced in the washing compartment 5.

A switch 29 may be inserted in a line shunting the time switch 23 if it is desired to operate the washing machine non-automatically, as for example, when the washing mixture is to be used to wash two batches of articles consecutively without permitting intervening drainage.

The automatic washer embodying the invention may be adapted for operation by a vacuum cleaner, as shown in Fig. 4. A metallic stand 50 serves to support the automatic washer and also serves as the permanent storage place for the vacuum cleaner 51, which may be either of the upright type or the tank type as shown.

The blower outlet of the vacuum cleaner 51 is connected by the air hose 52 to the nozzle 53 fixedly mounted in a container 54 in which is also positioned a funnel shaped conduit 55 so disposed that the outer smaller orifice of the funnel member 55 can be attached to the circular inlet opening of air chamber 7, and the inner wider orifice faces the nozzle 53 so that all the air delivered by the vacuum cleaner 51 to the nozzle 53 is forced through the funnel 55 into the air chamber 7, substantially in accordance with the principles of an air injector pump.

The container 54 has an inlet opening 56 for the attachment of the duct 17. In the bottom portion of container 54 is the drain outlet 57 for the attachment of the discharge duct 24.

The electric circuit of the automatic washer when operated by a vacuum cleaner is essentially the same as that shown in Fig. 3, with the exception that the place of the motor 8 is taken by a socket 58 into which the plug 59 of the vacuum cleaner 51 is to be inserted, as indicated by dotted lines in Fig. 3.

The intensity of the washing action is regulated by the air valve 60 in air hose 52 and similar to valve 27.

When the time switch 23 breaks the main circuit and thus the air jet from the nozzle 53 ceases, the liquid contained in wash basin 5 descends by gravity through air gap 6, air chamber 7 and funnel 55, into container 54, and therefrom through drain outlet 57 and discharge duct 24 into a convenient drain.

The excellence of the washing action produced by the impingement of the circulating mass containing the articles being washed against a foraminous baffle makes the provision of a relatively quiescent liquid retarding zone unnecessary. In fact, the streamlining of the liquid recirculation bath, except for the presence of the baffle, increases the mechanical action of the baffle against the articles being washed, in that the liquid circulation and the intensity of impingement of the washed articles against the baffle is increased.

Fig. 4A shows such a generally streamlined construction in which the wash basin 30 is so

shaped that the liquid return path is bounded by wall 31, semi-circular in cross section, the remaining portion of the wash basin being essentially similar in shape to that shown in Fig. 1. A coarse mesh screen 32 is shown mounted on a generally L-shaped frame 33, the upper end of the screen 32 resting against the upper end of the deflecting wall, as indicated at 34. The frame 33 holding the screen 32 may be suitably arranged for insertion as by providing each of the said walls of the apparatus with an inwardly pressed shoulder having an upper supporting surface 37 curved to provide notches 38 for receiving the ends of cross bars 42, 43, which project from the sides of the frame. A generally upwardly directed frame extension 39 may be provided so that the closing or latching of the cover 40 pivoted at 41 will retain the screen 32 in place against the deflecting wall even though the movement of the basin contents tends to lift the screen 32. A filling compartment 35 is also shown connected to the wash basin 30 by means of the slot 36 provided in the curved wall 31. A water inlet pipe 10 and overflow conduit 36 are shown mounted in the filling compartment 35, water being merely permitted to flow in continually, any excess over-flowing through conduit 36. The liquid level L is maintained by the location of the opening of the overflow conduit 36 and may be thus maintained without the use of floats, switches or valves.

The operation of the apparatus of Fig. 4A is similar to that of Fig. 1. The empty machine is connected by means of the inlet pipe 10 to a water supply line, the screen-containing frame being withdrawn from the basin or pivoted around projections 42 to the extreme clockwise limit, where the screen and frame do not obstruct the opening of the basin 30. The timer switch may now be started and, under the influence of the air discharged through the gap 6, liquids are not permitted to leave the compartment 30, and accumulate as introduced through the inlet pipe 10. The article to be washed together with the necessary washing chemicals and soaps are added and the compartment 30 rapidly fills to the level L where it is maintained without appreciable dilution by the passage of excess water through the filling compartment 35.

The interruption of the air discharged through gap 6 permits the liquid contents of basin 30 to rapidly drain even though the inlet pipe 10 is continually admitting water. Articles may easily be added to or withdrawn from the basin when the screen-frame 33 is merely pivoted away from the obstructing position shown, but the frame 33 may be bodily withdrawn if desired. The lower extension of the frame may be omitted to permit simpler withdrawal, or pivoting around bar 43 for access to the inside of the washing compartment.

Excellent washing may be effected in the apparatus of Fig. 4A. The lower portion of the walls defining the liquid return path may also be streamlined to further improve the mechanical washing action of the screen 32.

Fig. 4B illustrates such a modified construction in which not only the wall portion 31 but the floor portion 45 is generally cylindrically shaped so as to more effectively guide the liquid stream around its rotational path. Two air discharge gaps 46 and 47 may be employed, as shown, for effectively impelling the liquid mass at a high rotational velocity, but either one may be omitted if desired. Additionally, the upwardly directed guiding wall 48 may also be shaped as part of the same or different cylindrical surfaces defined by the wall 31 and the floor 45 to further improve the mechanical washing action of the screen 32.

The supply of air to the washing machine may be arranged as shown in Fig. 5. The air passes from duct 52 through a flow check valve 70 into air chamber 7 and therefrom through air gap 6 into wash basin 5. When the time switch 23 breaks the circuit, the supply of air ceases and any liquid contained in wash basin 5 descends by gravity into the air chamber 7. The liquid being prevented by flow check valve 70 from entering duct 52, all liquid flowing through air chamber 7 will pass through the solenoid valve 71 into duct 17 and therefrom into discharge duct 24.

The solenoid valve 71 is arranged to be in the open position when de-energized and to be in the closed position when energized and may be electrically controlled in the manner shown by the wiring diagram of Fig. 6. As shown in Fig. 5, the lower portion of duct 17 is arranged to have two discharge openings for optional attachment of the discharge duct 24 to either discharge opening, while the other discharge opening is closed by a cap or plug.

The selective channelling of air from duct 52 into air chamber 7 and of liquid from air chamber 7 into duct 17 can be accomplished in various other ways, as for instance by the automatic sleeve valve in Fig. 7.

A sleeve member 80 moves in a housing 84 having two permanently attached seating members 81 and 83 respectively. The sleeve 80 includes a cap 85 separated from the remainder of the sleeve at one portion by opening 86. When air under pressure is supplied from duct 52, the sleeve member 80 will be pushed forward and pressed against seating member 81, permitting the air to pass from duct 52 into air chamber 7 and closing the passage for air or liquid from the interior of housing 84 to duct 17. When the supply of air from duct 52 ceases the spring 82 retracts the sleeve member 80 into and against seating member 83, thus closing the passage for air or liquid from air chamber 7 to duct 52 and opening the passage from air chamber 7 to duct 17 and discharge duct 24.

More specifically, the operation of the sleeve valve shown in Fig. 7 is as follows: The normal inoperative position of the hollow movable sleeve member 80 is when the cap 85 is in sealing engagement with the fixed sleeve member 83 providing a passageway from air chamber 7 into duct 17. The movable sleeve member 80 is maintained in this position by the biasing action of the spring member 82. Upon operation of the washing machine, the first surge of air under pressure from the blower 51 which is conveyed along duct 52 coming into engagement with the cap 85 slides the movable sleeve member 80 to the left until it comes into sealing engagement with the fixed sleeve member 81 (Fig. 7), against which it is maintained by the pressure of the accelerated air, despite the oppositely directed biasing forces exerted by the extended spring member 82. In this position, the cap 85 blocks the entrance to the duct 17 permitting the air to flow upwardly through duct 7 into the washing compartment 5. Upon cessation of the compressed air due to the stopping of the blower 51, the biased spring member 82 pulls the cap

85 back to its normal position in sealing engagement with the fixed sleeve member 83, thereby permitting the water and air in duct 7 to flow outwardly through duct 17.

The float switch 16 and float 15 may be omitted from the apparatus shown in Figs. 1, 2, 4 and 5, in which case the water inflow may be adjusted so that when air is blown through the air gap 6 the water will rapidly fill the washing compartment 5 to the level "L," an overflow being provided in the chamber 13 for surplus water flowing in. The inlet conduit 10 may merely be equipped with a simple "on-off" valve for actuation when the washing sequence is to begin. The "on-off" valve may be electrically operated by the closing of the time contacts of the time switch 23. The "on-off" valve may be manually operated, if desired.

The use of air as the impelling medium in a washing machine offers among others, the following important advantages:

The driving mechanism and other mechanical requirements for agitating the wash water are reduced to extreme simplicity.

The washing action can be varied in intensity within wide limits by varying the amount of air introduced into the wash basin.

There being no moving mechanical parts required in the wash basin, the air washer is in conjunction with the above mentioned variability of the washing action, universally adaptable for the washing of very delicate and fragile items as well as for the washing of very dirty and sturdy items.

It is a generally recognized fact that stale hot water as it comes from any hot water tanks is, as a washing medium, inferior to well aerated hot water.

Furthermore, among the important advantages inherent to air washers it should also be noted that while all other types of washers, which have movable tubs, baskets or impellers, require a generally cylindrical or square shape resulting in a relatively deep washer unit, thus practically excluding the possibility of their use in almost every bathroom of conventional design which is usually relatively narrow, the overall dimensions of an air washer can be kept similar to those of the average clothes hamper with a relatively small depth, for which there is a space provided in the layout of practically all bathrooms.

Against these advantages stand the following difficulties due to which the practical application of air as the impelling medium in washing machines has met so far only with very limited success:

First, the introduction of air into the wash water required a very careful apportionment of the amount of soap added to the wash water with regard to the quantity, degree of softness or hardness, and temperature of the specific wash water used. If the amount of soap was insufficient the resulting washing action was insufficient. If the amount of soap added was somewhat more than required the bubbling air in the water caused an excessive suds formation which rapidly transformed into suds practically all of the liquid contents of the wash basin. In short, if this critical requirement of proper dosage of soap was not carefully observed the washing took place in the air washer either with plenty of water but not enough soap, or with plenty of soap but not enough wash water—as most of the latter combined with the air and extra soap to form excess suds.

Second, the introduction of air into the wash basin frequently caused the "ballooning" of articles, especially of more tightly woven fabrics, thereby driving these articles to the surface of the wash liquid causing portions thereof to even emerge above the surface of the wash liquid and thus to be held practically stagnant in this position. These ballooned articles, or at least portions thereof, were thus not only prevented from being subjected to an efficient washing action but due to their almost motionless position also created obstacles in the paths of other articles and thus tended to cause.

Third, a certain bundling and tangling among the articles washed, thus further reducing the efficiency of the washing action.

In short, the practical difficulties with using air as the impelling medium in a washing machine were—excessive suds formation, ballooning, and bundling. These three factors integrally combined to reduce the overall efficiency of the washing action and to thus counter- or even overbalance the above mentioned important advantages obtainable with air washers.

The objectives of the invention are to eliminate the aforementioned practical difficulties encountered in air washers, as known heretofore, by preserving and further accentuating the important advantages obtainable with the use of air as the impelling medium in washing machines through the following new and useful arrangements:

I. The invention eliminates the critical aspect of the addition of the right amount of soap with regard to kind, quantity and temperature of the wash water used, in the following way: (*a*) The suds formation is confined and permitted to take place in only a portion of the total surface of the wash liquid, with a continuous stream of air and water directed against it. This stream of air and water while causing a certain additional suds formation causes the breakdown and reconversion into free air and soap water of large portions of suds formed. (*b*) Provision of escape passages through which excess suds are channelled to depart into the drain outlet of the washer. (*c*) Provision of constant maintenance of the wash water at the proper washing level, through admission of additional hot water into the wash basin, in continuous and immediate replacement of all soap water leaving the wash basin in the form of excess suds.

In other words, the tendency towards excess suds formation in case of a too high soap concentration in the wash water is reduced by provision (*a*), and if the added amount of soap was highly excessive the transformation of most of the soap water into suds is prevented by maintaining the quantity of liquid in the wash basin at the proper operating level through addition of fresh water so that the required proper soap concentration in the wash water is reached rapidly and automatically without any interruption or other interference in the continued and smooth progress of the washing action.

The introduction of additional hot water into the wash basin can be accomplished by any of a number of well known arrangements for maintaining a liquid in a container at a predetermined level, such as for instance a float valve, or a float switch controlling a solenoid operated inlet valve, or more simply by the continuous admission of hot water into an inlet compartment having a connection to the interior of the wash basin and having an overflow arrangement to insure that as long as the level of liquid in the wash

basin is below the predetermined operating or washing level the hot water continuously flowing into the inlet compartment will flow therefrom into the wash basin; and when the level of liquid in the wash basin has reached the washing level all additional hot water flowing into the inlet compartment will depart through the overflow arrangement into the drain outlet of the washer without passing through the wash basin.

II. The apparatus of the invention greatly reduces the tendency for the ballooning and bundling of the articles washed, and further improves the efficiency of the resulting washing action.

The impingement of the articles being washed against the foraminous baffle causes any entrapped air in the articles to be pounded out. The buffeting action of additional liquid impinging against the articles also helps to squeeze out entrapped air by direct pounding action.

The dragging of the articles along the sloping baffle also substantially eliminates bundling of the articles washed and keeps the baffle from becoming clogged with impinging articles.

Even in the absence of the baffle, the novel arrangement in the shape of the wash basin providing a liquid accelerating region, a separation region, and a liquid retarding region, also is highly effective for preventing ballooning and bundling. The air, liquid and articles to be washed are compelled by the shape of the wash basin to move within and between these regions in such a way that the general direction of the motion when leaving the accelerating region is substantially horizontal. This permits the air to escape upwardly while the liquid and air change to a downwardly direction plunging thereby into the retarding region of the wash basin. This arrangement whereby the air, liquid and articles washed are compelled to enter the separation region in a generally horizontal direction, which changes to upwardly for the air and downwardly for the liquid and articles washed, eliminates to a large extent the possibilities for any balloon formation. Moreover, any air that may have remained trapped in any of the articles when plunging into the retarding region is quickly pounded out of its entrapment by the articles and the liquid plunging subsequently into the retarding region. Consequently, this arrangement eliminates completely the ballooning factor from any interference with the efficiency of the washing action.

Further important features of the invention are the simplicity of the driving and control mechanism. The former requiring only a motor and blower which in certain modifications of the invention may be replaced by attachment of the washer to a household vacuum cleaner. On the other hand, the control mechanism of the automatic washer in its simplest form is reduced to a simple time switch arranged to alternately open or close the circuit of the motor in predetermined intervals. The need of a solenoid operated outlet valve and automatic control arrangement therefor is eliminated by utilizing the impelling medium, namely the air, to block the departure of liquid from the wash basin as long as the blower is operated by the motor, and by permitting the liquid contents of the wash basin to empty through the blower housing into the drain outlet of the washer when the motor is de-energized by the time switch. The need of an inlet valve and automatic control arangements are eliminated in certain modifications of the invention by letting the water run continuously into the inlet compartment.

The washer has no moving mechanical parts within the wash basin; no valves, except the simplest air valve for regulating the intensity of the washing action; no complicated automatic controls, except a simple time switch; and, in certain modifications of the invention it does not even need its own motor and blower, but may be operated by any ordinary household vacuum cleaner.

Figs. 8 through 12 illustrate a modified form of the invention having a washing compartment 1—1 formed by the two side walls 1—2, 1—3, the bottom wall 1—4, the rear wall 1—5 and the front wall 1—6. The bottom wall 1—4 is tightly secured to the rear and front walls 1—5 and 1—6, respectively, but does not reach fully to the side walls 1—2 and 1—3, respectively, thus forming the air gap slits 1—7 and 1—8, extending above the upper ends of two flared air chambers or pockets 1—9, 1—10, respectively, provided on the underside of the bottom wall 1—4.

The flared air chambers 1—9 and 1—10 are connected by ducts 1—11 and 1—12 to the solenoid operated distributor valve 1—13 having an air inlet duct 1—14 connected to the blower 1—15 driven by motor 1—16.

The lateral cover plates 1—17 and 1—18 are sealed to the rear and front walls 1—5, 1—6. The bottom plate 1—19 is sealed on all four edges to the corresponding vertical walls and is slanted toward the discharge opening 1—20 away from the opening 1—21 which is connected by duct 1—22 to the inlet 1—23 of blower 1—15.

The distributor valve 1—13 is arranged to be actuated to position A when one coil 1—24A of the double solenoid 1—24 is energized; to be actuated to position C when the other coil 1—24C of solenoid 1—24 is energized; and to be actuated by the spring 1—25 to the discharge position B when neither coil of the double solenoid 1—24 is energized.

When the double solenoid 1—24 is energized to actuate the distributor valve 1—13 to position A, the air coming from blower 1—15 through duct 1—14 is directed by valve 1—13 into duct 1—12 to pass into air chamber 1—10 and through air gap 1—8 into the wash basin 1—1 generating therein a washing action with all acting forces pointing in a substantially counterclockwise direction. When the double solenoid 1—24 is energized to actuate the distributor valve 1—13 to position C, the air coming from blower 1—15 through duct 1—14 is directed by valve 1—13 into duct 1—11, to pass into air chamber 1—9 and through air gap 1—7 into the wash basin 1—1 generating therein a washing action with all acting forces pointing substantially in a clockwise direction.

When the double solenoid 1—24 is de-energized so that the distributor valve 1—13 is actuated by the spring 1—25 to the discharge position B, the air coming from blower 1—15 through duct 1—14 is channelled into the lower deck of valve 1—13, as shown in Fig. 11, and therefrom into the outlet 1—26, with injector nozzle 1—27 discharging into the Venturi pipe 1—28 with discharge opening 1—20; while the liquid contents of wash basin 1—1 discharging through both air gaps 1—7 and 1—8, air chambers 1—9 and 1—10 and ducts 1—11, 1—12 are directed by the distributor valve 1—13 to the outlet 1—29 to discharge against the bottom plate 1—19 and thus to be channelled by the slanting of bottom plate

1—19 towards the Venturi pipe 1—28 with discharge opening 1—20.

The injector pump arrangement with nozzle 1—27 and Venturi pipe 1—28, by the use of air pressure, serves to permit the lifting of the discharging liquid for several feet from the bottom of the washer so that the emptying of the washer of its liquid contents is not confined or limited to a discharge by gravity into a sewer outlet lower than the discharge outlet 1—20.

The protective screens 1—32, 1—33 prevent the articles being washed from possible obstructing the free passage of liquid through air gaps 1—7 and 1—8 during the discharge periods.

The wash basin 1—1 is filled with wash liquid through the inlet compartment 1—34 having a pipe connection 1—35 to the interior of wash basin 1—1. The wash liquid is admitted to the inlet compartment 1—34 through a suitable duct connection 1—36 and valve 1—37. The valve 1—37 may be a float valve governed by float 1—38 or a solenoid operated valve actuated by the opening or closing of a float switch 1—39 which is actuated by the float 1—38.

This form of the washer includes a centrifugal extractor 1—40, operated by the motor 16 through a belt and pulley drive 1—41. The extractor 1—40 is housed in the extractor compartment 1—42 having in its bottom portion a plurality of lateral openings 1—43 through which all extracted liquid discharges to the slanted bottom plate 1—19.

Access to the wash basin 1—1 is obtained through the opening 1—44 which is closed during the operation of the washer by cover 1—45 that may be locked between lugs 1—46 on one side and lugs 1—63 on the other side by a suitable handle and lock arrangement 1—47. The gasket 1—48 insures the tight closing of the cover while the vent valve 1—49 in cover 1—45 serves to permit the entrance of air into the washer during the discharge periods. Perforated baffles, such as screens 1—64, may be interposed in the liquid flow path in those portions where the flow is very vigorous. The screens 1—64 may be mounted on frames readily supported by the cover 1—45, as shown.

The screens 1—64 operate in a manner similar to the baffle 28 in the construction of Fig. 1, by increasing the retarding action of the retarding zone of liquid. Decreasing the distance between the mechanical baffle of the region where liquid is impelled at high speed further increases the retarding action in that the liquid is retarded from a higher speed. Articles being washed are practically stopped by the baffle, liquid being permitted to pass to some extent. The sloping of the baffle permits motion of the liquid to help in the removal of the washed articles trapped by the baffles. If desired, a single baffle may be used in the construction of Fig. 8 to help retard liquid impelled from either direction in place of the two baffles shown.

Access to the centrifugal extractor 1—40 is obtained through the cover 1—50, suitably hinged at 1—51 and having a suitable handle and locking arrangement 1—52.

The automatic operation of the washer is controlled by the time switch 1—53 which may be operated by a spring and clockwork arrangement of the conventional design or by a timer motor 1—54 to rotate the contact arm 1—55. The corresponding contact strips of the various circuits are arranged so that the contact arm 1—55 rotated counterclockwise by the timer motor 1—54 keeps the circuit of motor 1—16 and timer motor 1—54 continuously closed for the entire period of the washing cycle, while the circuits of the two coils of the double solenoid 1—24 are alternately opened and closed in predetermined intervals of time during the wash and rinse periods to cause the distributor valve 1—13 to be actuated back and forth between the positions A and C and to cause both coils of the double solenoid 1—24 to remain de-energized during the discharge periods to cause the valve 13 to be actuated by the spring 1—25 to the discharge position B.

A duct 1—56 with valve 1—57 establishes a direct connection between the outlet and inlet of blower 1—15. When the valve 1—57 is closed all the air delivered by the blower 1—15 can reach the blower inlet 1—23 only after having passed through wash basin 1—1 and having generated therein the obtainable most vigorous washing action. If the valve 1—57 is partially opened a portion of the air delivered by the blower 1—15 will be by-passed through the duct 1—56 directly back to the blower inlet 1—23, and thus the intensity of the washing action in wash basin 1—1 will be correspondingly less. The washing action of the washer can thus be varied between gentle and very vigorous by the proper setting of valve 1—57.

Fig. 13 is a simplified version of the washer, exemplifying the invention, wherein a household vacuum cleaner 2—70 serves as the source of supply for the air to generate a washing action in wash basin 2—1. The air passes from the vacuum cleaner 2—70 through duct 2—71 and pipe 2—14 into the duplex valve 2—72. When the solenoid 2—73 is energized the valve 2—72 is actuated to permit a free passage between the pipe 2—14 and pipe 2—74 to the duplex valve 2—75. When the solenoid 2—76 is energized the air passes from valve 2—75 into duct 2—12 air chamber 2—10 and through air gap 2—8 into wash basin 2—1; when the solenoid 2—76 is de-energized the air passes from valve 2—75 into duct 2—11, air chamber 2—9 and through air gap 2—7 into wash basin 2—1. When the solenoid 2—73 is de-energized the spring 2—77 actuates the valve 2—72 to close the passage for air or liquid between pipe 2—14 and pipe 2—74 and to open the passage between pipe 2—74 and the discharge pipe 2—78, thus opening a free path for the discharge by gravity of the liquid contents in wash basin 2—1 into discharge pipe 2—78 for disposal of the used wash water into a convenient drain outlet connected to the sewage system of the house.

The wash basin 2—1 is filled with water through the inlet compartment 2—34, having a pipe connection 2—35 to the interior of wash basin 2—1. The water is admitted to the inlet compartment 2—34 through a suitable duct connection 2—36 and permitted to run continuously during the entire washing operation. After the wash basin 2—1 has been filled to the proper washing level all additional water entering the inlet compartment 2—34 from duct 2—36 is drained off through the overflow pipe 2—37 to discharge into the bottom portion of the washer upon the slanted bottom plate 2—19 having in its lowest point a drain outlet and pipe 2—38 connected to the discharge pipe 2—78.

The used air after having passed through wash basin 2—1 travels around the baffle plates 2—79 and 2—80 to escape through a plurality of vent openings 2—81.

The automatic operation of the washer is con-

trolled by the time switch 2—82. By the setting of the time switch 2—82 for the desired number of minutes for the washing period proper, the contact arm 2—83 closes the circuit of the timer motor 2—84 to rotate the contact arm 2—83 in a counterclockwise direction until it reaches after a predetermined period of time the "off" position, at which all circuits are opened and the entire cycle of the washing operation consisting of a washing phase of variable length followed by alternating discharge and rinsing phases is terminated. The timer motor 2—84 is connected to the outer contact strip 2—90. The second circle of contact strips 2—91 opens and closes the circuits of the solenoid 2—73 and of the electric outlet socket 2—84 for the plug 2—86 on cord 2—87 of the vacuum cleaner 2—70. The third circle of contact strips 2—93 opens and closes in short predetermined intervals of time the circuit of solenoid 2—76 which actuates the valve 2—75 to alternately open and close the passage between pipe 2—74 and pipes 2—11 or 2—12, thus varying in short intervals the admittance of air to the wash basin 2—1 through air gap 2—7 or 2—8. The intensity of the washing action in wash basin 2—1 is regulated by the proper setting of the air valve 2—88 in duct 2—14.

The washer is supported on a standard 2—89 which serves as the permanent storage place for the vacuum cleaner and the various attachments thereto. The standard 2—89 has a safety plate or arm 2—90 the size and shape of which varies in accordance with the type and shape of the vacuum cleaner used. The function of the safety plate 2—90 is to insure that only the blower outlet of the vacuum cleaner can be attached to the duct 2—71.

In a wash basin having two air gaps, with the supply of air switched alternatingly from one air gap to the other in relatively short intervals of time, any residual tendency for bundling between the articles being washed and rinsed is effectively prevented. If the air is supplied to the wash basin continually through only one air gap and the washer is loaded to capacity with articles of unequal size and quality, a tendency may develop for certain articles to become wrapped around certain other articles thus forming a bundle and preventing the articles or portions thereof which became located in the inner portions of the bundle from undergoing an efficient washing action. By alternating the admission of air in frequent intervals through two oppositely located air gaps, thus causing a frequent and complete reversal in direction of all forces causing motion and agitation in the wash basin, any tendency for tangling and bundling which may have started to develop during one short interval during which the air was introduced through one air gap becomes immediately reversed and undone as the air supply is switched to the other air gap, thus insuring a better, more even and more efficient washing action.

Obviously these advantages can also be obtained with more than two air gaps, as for instance four air gaps, in a rectangular or square shaped wash basin, or in a circular shaped washer with any desired number of air gaps.

According to another embodiment of the invention, the wash vessel may be formed without a separate inner guide structure for the liquid retarding region.

Fig. 17 shows such a construction in which the side wall 4—61 of wash vessel 4—63 is also used to bound the liquid retarding region, the liquid impelling guide surface being provided by a suitably shaped insert 4—64. The air gap 4—68 may merely be a narrow space below the insert 4—64, an air inlet 4—69 being provided for the enclosed space between the insert 4—64 and the nearby wall of the wash vessel.

The practical application of the invention is not confined to washing machines of the type designed to perform only the washing and/or rinsing phase proper of the washing cycle, but may also be applied to good advantage in washing machines designed to perform a complete cycle of the washing operation consisting in the washing, dousing, rinsing, and damp drying; the sequence thereof being initiated manually, or by automatic controls. Such a fully automatic embodiment of the invention is shown in Fig. 18 wherein the wash tank 121 is housed and suitably supported in a metallic housing 120. Within the wash tank 121 is the wash basket 122. The side walls of wash basket 122 are perforated. The axle 123 is rigidly attached to the center of the bottom of wash basket 122. The axle 123 extends in a substantially vertical upward direction and is suitably shaped to seat on its upper end a complete roller thrust bearing 124 on which the hub 125 of wash basket 122 is seated so that the wash basket 122 may be rotated freely around the axle 123, but cannot be moved in any other direction or way. The hub is shaped in its upper portion to form a circular guide surface, as indicated at 126, extending downwardly in a cylindrical shape to near the bottom of wash tank 122.

The side and bottom portion of wash basket 122 is rigidly and permanently attached to the cylindrical portion of hub 125 by means of connecting ribs, indicated by dotted lines 127, in such a fashion to produce the circular shaped air gap 128. The vanes 129 are rigidly attached to the bottom of wash basket 122 and so shaped that when air is introduced into the wash tank 121 through one or several inlets 130, the currents of air deflected by the vanes 129 and escaping upwardly through air gap 128 will set the wash basket 122 to a high speed rotation around its vertical axis whenever there is no water in the wash tank 121.

However, when the wash tank 121 is properly filled with water the air entering the wash basket 122 through air gap 128 and passing along the guide surface 126 to escape upwardly, as approximately indicated by the single head arrows, will force the water and all articles to be washed and contained therein into a turbulent circulatory motion, as approximately indicated by the double head arrows, while at the same time and due to the inertia of the turbulent mass of water contained in wash tank 121 the rotation of the wash basket 122 around its vertical axis will remain at a relatively very low speed. The air is supplied to the air inlets 130 by a motor-blower-unit 132 which is suitably seated and firmly secured in the lower portion of the housing 120. A foot valve 133 is inserted into the conduit connecting the air outlet of the motor-blower-unit 132 with the air inlets 130 to prevent the entrance of any liquids from the wash tank 121 into the motor-blower-unit 132. By inserting an airflow regulator, for instance as indicated at 134, the intensity of the washing action as well as the speed of rotation of the wash basket during the drying process may be regulated and pre-set between very wide limits.

An electric heating element 135 may be attached to the lower side of the bottom portion of the wash tank 121 for the purpose of maintaining the temperature of the water during the washing and rinsing operations and aiding in the drying of the articles washed during the centrifuging process.

The washing machine, as shown in Fig. 18, may be equipped to perform the complete washing operation of washing, dousing, several rinses, and drying by centrifugal extraction of liquid from the articles washed in an automatically controlled sequence by means of the solenoid operated inlet valve 136, the solenoid outlet valve 137, and the timer 138. The design and methods of operation of these automatic control elements is well known to all those versed in the art, and thus need not be described here in detail.

The washing machine described above is distinguished by the following features:

The wash vessel itself, or a guide structure rotatably or generally movably supported within the vessel is provided with inwardly facing guide surfaces for guiding impelled liquid in cooperation with the gas flow means including gas discharge means having a discharge outlet for discharging gas into the liquid held within the vessel in such manner that portions of the liquid are agitated and impelled by the gas so that articles placed within the liquid are subjected to agitation and a washing action.

More specifically, the guide surfaces of the guide structure and the gas discharge outlet are so shaped and positioned that the gas discharged into the liquid causes portions of the liquid to be lifted along a lifting region or discharge region of the guide surfaces to a higher level and impelled toward a retarding region of the guide structure along which the articles carried by the lifted liquid are retarded while being traversed by the impelled liquid and subjected thereby to a vigorous washing action.

The return guide structure 122 of Fig. 18 is provided with perforations arranged so that when liquid is removed from the wash vessel and gas admitted thereto, the revolvably supported guide structure will be rotated by the impelling action imparted thereto by the discharged gas so that as a result of the rotary motion imparted to the guide structure wash liquid retained in the articles previously washed within the interior of the guide structure will be extricated by centrifugal force.

More specifically, the border region of the lifting region adjoining the retarding region is so shaped as to cause articles carried by the liquid to be retarded while liquid discharged into the retarding region traverses the retarded articles at a substantial velocity, and subjects them to a vigorous washing action.

The lifting region and the retarding region of the guide structure are solocated and arranged relatively to each other within said vessel as to cause articles carried by the liquid into the retarding region to drift or to be carried and returned toward the lifting or discharge region of the guide structure. A portion of the guide structure into which liquid impelled along the discharge region of the guide structure is arranged to form an opening accessible for insertion or removal of articles to be washed into the space confined by the guide surface structure.

More specifically, the portion of the upper side of the retarding region into which the liquid impelled along the discharge region is discharged forms an opening accessible for insertion or removal of articles to be washed into the space confined by the guide structure.

In order to make the retarding region of the guide structure highly effective in retarding articles carried by the liquid impelled into the retarding region, mechanical baffle elements (not shown), similar to the baffle 28 shown in Fig. 1, which are pervious to liquid may be located along the path of the articles discharged into the retarding region for intercepting them and subjecting them to the action of the liquid impelled at a relatively higher velocity through a portion of said retarding region into which the articles are carried. The desired retarding action for retarding the articles carried by the liquid discharged into the retarding region may be obtained by making the vessel structure of the retarding region of sufficient size so that the stream of liquid impelled at a relatively substantial velocity into the retarding region tends to retard the motion of the liquid while assuring that the liquid discharged into the retarding region moves therethrough at a higher velocity than the articles carried by the so-discharged liquid into the retarding region.

The portion of the vessel guide structure through which liquid discharged from the discharge region thereof enters the retarding region is shaped and arranged so as to permit escape of gas or air from the moving liquid while tending to obstruct escape of liquid or suds from the vessel.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same. It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific exemplifications of the invention described herein.

I claim:

1. In a washing apparatus: a wash vessel for holding wash liquid and articles to be washed; said vessel having inwardly facing guide structure elements having guide surfaces for guiding impelled liquid; and gas flow means including gas discharge means having a gap-like gas discharge outlet bounded by wall surface portions smoothly merging into portions of said guide surfaces for discharging gas into the wash vessel; said guide surfaces having an upwardly extending guide surface region merging into a downwardly facing, laterally extending guide surface region for causing gas discharged into the liquid to impel said liquid in upward direction and then in lateral direction along said upward and lateral guide surface regions whereby said impelled liquid tends to raise and then deflect the articles carried thereby for subjecting said articles to a washing action; said gas flow means including a rotary gas impeller structure having a housing provided with a gas outlet connected to said gas discharge outlet, and a gas inlet through which gas enters said impeller structure located below the lowest level of liquid in said vessel; and a liquid drain structure connected to said gas inlet and having a drain opening which remains open during the operation of said impeller structure for causing the liquid contents of said vessel to drain when the operation of said impeller structure is stopped.

2. In a washing apparatus as claimed in claim 1 in which the guide structure and gas discharge

means comprise two portions, each portion disposed to impel the liquid in opposing paths.

3. In a washing apparatus: a wash vessel for holding wash liquid and articles to be washed; said vessel having inwardly facing guide structure elements having guide surfaces for guiding impelled liquid; and gas flow means including gas discharge means having a discharge outlet for discharging gas into the wash vessel along an impelling zone of said guide structure; said guide surfaces having an upwardly extending guide surface region merging into a downwardly facing, laterally extending guide surface region for causing gas discharged into the liquid to impel said liquid in upward direction and then in lateral direction along said upward and lateral guide surface regions whereby said impelled liquid tends to raise and then deflect the articles carried thereby for subjecting said articles to a washing action; said guide structure having a retarding region arranged to receive liquid impelled along said discharge region; said retarding region having liquid pervious interceptor elements arranged along the path of liquid impelled into it for intercepting and retarding articles carried by the impelled liquid and causing the retarded articles to be traversed by said impelled liquid.

4. In a washing apparatus as claimed in claim 1 in which at least a portion of said laterally extending guide surface region is located above the static level of liquid in said vessel along which the impelled liquid is discharged into the retarding region.

5. In a washing apparatus as claimed in claim 3 in which at least a portion of said laterally extending guide surface region is located above the static level of liquid in said vessel along which the impelled liquid is discharged into the retarding region.

6. In a washing apparatus as claimed in claim 1 in which a portion of the guide structure through which the liquid is impelled in said lateral direction forms part of a boundary to an opening accessible for insertion or removal of articles from said vessel.

7. In a washing apparatus as claimed in claim 3 in which a portion of the guide structure through which the liquid is impelled in said lateral direction forms part of a boundary to an opening accessible for insertion or removal of articles from said vessel.

HERMANN SCHEIBLER.

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