This invention relates to vertical axis laundry machines, and more particularly to such machines which have an operation suitable not only for the washing and centrifuging of clothes but also for the heat drying thereof.

While vertical axis washing machines are well known and commercially available, the heat drying of clothes has to date been effected by means of machines which have a container rotating on a non-vertical axis so that the rotation of the container causes a tumbeling movement of the clothes. While such machines have been found to be effective and useful, they present the disadvantage that a top loading opening—the most convenient for an operator—cannot be used in as simple a fashion as is possible with vertical axis washing machines. In addition, there is the factor that, where the usual approach is taken by a manufacturer of manufacturing top loading vertical axis washers and front loading dryers, the expense of manufacture of washers and dryers in the same factory becomes greater because there can be little standardization between the parts of the two machines.

A further point of importance is that, in those machines which do not have special additional structures provided for the adding of detergent, bleach, and the like (as is true on most less expensive models), a top loading machine is far superior to a front loading machine: in a top loading machine, it is merely necessary to raise the lid and introduce the treating agent. This can be done without interrupting the operation of the machine, whereas the opening of the door on a horizontal axis machine necessarily involves stopping the operation of the machine while the treating agent is being added. For reasons such as these, the foregoing is a major objective of my invention to provide a vertical axis washing machine of the type in which a washing operation and a heat drying operation may both be provided.

It is a further more specific object of my invention to provide a machine in which the tumbeling, flexing, and impacting of the clothes is effected by continually spinning them out of an inner container by centrifugal force and providing guide means to guide the clothes and washing fluid back into the inner container for a repetition of the cycle.

Another specific object of my invention is to provide a vertical axis washing machine in which the movement of the clothes during a drying operation is effected in substantially the same manner as that set forth above in connection with the washing operation.

Yet a further specific object of my invention is provision of a vertical axis washing and drying machine wherein the clothes container receptacle is so formed that the clothes are moved as an air moving impeller so that a separate impeller for this purpose is not necessary.

In one aspect of my invention I provide a vertical axis laundry machine in which the clothes containing basket is formed as an inverted cone open at its top. The basket is surrounded by a tub, and both are rotatably mounted. The tub extends axially inwardly over the basket so that, when the tub is stationary and the basket is rotating, the tub guides clothes and liquid flung from the basket inwardly back over the basket so that they fall therewith and go through the cycle again. In addition, means are provided for holding the tub stationary at suitable times during rotation of the basket. The tub has openings formed in it so that removal of liquid from the basket may be provided during rotation of the basket and tub together; in this connection, means are provided for receiving and draining the liquid passed through the tub openings during this common rotation of the basket and tub.

The tub holding means is suitably controlled throughout a sequence in the conventional manner so that it is operative or not operative and so that, consequently, the tub either rotates with the basket or remains stationary about the rotating basket. Because the clothes and washing liquid are flung back and over into the basket when the tub is stationary, the machine provides a washing operation during rotation of the basket alone. When the basket and tub rotate together a centrifugal extraction operation is provided by virtue of the centrifugal force acting on the liquid in the clothes to force that liquid through the openings so that it may be drained.

In addition to the washing and centrifuging action thus obtained I provide a forced air drying system by forming vanes on the outside wall of the basket so that they pump air up between the basket and the tub. The air thus comes up over the edge of the basket and passes into contact with the clothes being flung out of the rotating basket and guided back into it by the stationary tub. Of course, suitable means for heating the air may be provided, and this may be done either in an open air cycle where the air is merely brought in, heated, and then discharged, or in a closed air cycle where the air is dehumidified after contacting the clothes and is then reheated and passed through the clothes once again. In connection with the use of the machine for drying purposes, there is no need for the tub to be rotatable; thus, where drying is to be the exclusive function of a machine, the tub need not be rotatably mounted.

The novel features which are believed to be characteristic of my invention are set forth with particularity in the appended claims. My invention, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawing, FIGURE 1 is a side elevational view, partly in cross section, of my improved laundry machine; and

FIGURE 2 is a fragmentary view in perspective of a part of the machine of FIGURE 1.

Referring now to FIGURE 1, I have shown therein a laundry machine 1 which is provided with an outer cabinet 2. Cabinet 2 gives a desirable appearance to the machine while at the same time providing a support (as will be further explained) for the operative parts of the machine. Cabinet 2 may, if desired, be secured on a base 3; in its top surface 4 the cabinet has an access opening 5 adapted to be closed by a lid 6 which may be opened by an operator in any suitable manner to gain access to the interior of the machine.

Secured to the sides of cabinet 2 within the cabinet is an annular steel member 7 having a central opening 8 about which are spaced a number of spring members 9 supporting a moving system, generally indicated at 10; the support is effected by engagement of the springs 9 with flange 11 of a member 12 forming part of the moving system. Member 12 forms a thrust and radial bearing for a hollow shaft member, generally indicated by the numeral 13. Shaft 13 has, at its upper end, an outwardly extending flange 14 rigidly secured to the bottom 15 of a tub member 16. Tub member 16 includes a side wall 17 which curves generally outwardly from its base to a point 18 somewhat above the top 19 of a clothes receptacle or basket generally indicated at 20. Basket 20 is formed generally in the shape of an inverted cone with a rounded bottom and an open top. In the present em-
3 bodiment, the basket 20 is substantially imperforate and is supported on a base 21 secured at the end of a shaft 22 rotatably mounted within the hollow shaft 13, both shafts being rotatable on the same generally vertical axis (excepting, of course, the conventional limited deviation from that axis permitted by springs 9).

Shaft 22 is supported on the tub bottom 15 in rotatable relation thereto by a shoulder portion 22a. The shaft 22 is driven through a transmission 24 by a motor 23. Transmission 24 may preferably be of the multispeed type, controlled by any suitable means such as a solenoid 24a so that a lower speed is provided when the solenoid is deenergized and a higher speed when the solenoid is energized. Such mechanisms are conventional and commercially available, and therefore it is not deemed necessary to show the detailed structure of transmission 24. The transmission and the motor may be supported by any suitable means such as a bracket 25 secured to and depending from member 12.

With this arrangement, operation of the motor 23 causes the basket 20 to be operated through shaft 22, the rotational speed of the shaft being determined by transmission 24. It will have been observed that, with the structure thus far described, the tub 16 is normally freely rotatable; means may be provided, as will be explained hereinafter, to couple the basket 20 and tub 16 together so that they rotate as a unit. There are, however, times when it is desired that the tub 16 remain stationary and for this purpose I provide a conventional brake structure, generally indicated by the numeral 26, which is controlled through a solenoid 27 so that when the solenoid is energized the brake is operated to prevent rotation of shaft 13 while when the solenoid is not energized shaft 13 may rotate freely.

Returning now to a description of the tub 16, it includes a number of spaced finger-shaped indentations 28 indented toward the basket 20, which extend from about the level of the top 19 of basket 20, or slightly below, to a point substantially above. The clearance between the top of the basket and the tub is made quite close wherever the indentations 28 occur, for a purpose to be herein-after described in connection with the operation of the machine. As previously stated, the side wall 17 of tub 16 extends outwardly and upwardly to point 18. From that point it extends directly upwardly as shown by portion 29, and then inwardly as shown at portion 30, a central opening 31 being left in portion 30 in alignment with opening 5 to permit access through opening 5 to the open top 19 of basket 20. Secured between the portions 29 and 30 are a number of vanes 32 which, as best seen in FIGURE 2, have faces 33 curving inwardly in the direction of rotation as shown by arrow A.

The basket 16 also has its wall 17 provided with a number of spaced openings 34 which are used, as will be further explained hereinafter, for removal of the water from the machine at the appropriate time. Water passing through openings 34 passes into an outer stationary receptacle 35 formed by the side walls of cabinet 2 and the member 7, and then into a pumping structure 36 driven by a reversible motor 37. In the direction of rotation of motor 37 which is provided during washing operations, the motor drives pump 36 in the appropriate direction to discharge liquid from the bottom of outer receptacle 35 into a conduit 38 which extends upwardly from pump 36 and terminates in a nozzle 39 positioned to direct liquid back into basket 20. When the direction of rotation of motor 37 is reversed, as is the case when the centrifugal extraction of liquid from the clothes is desired, it causes the pump 36 to rotate in the reverse direction to the previous rotation thereof; this in turn causes the pump to discharge into a conduit 40 adapted for discharge to a stationary tub or drain line (not shown) so that the pump is then effective to drain the outer receptacle 35. While any suitable pump may be used for these purposes, a suitable and typical pump for

the purpose described in detail and is claimed in Patent 2,883,843 issued to me on April 28, 1959, and assigned to General Electric Company, assigns of the present invention.

While the water level in outer receptacle 35 will generally remain substantially below the level of portion 41 of member 7, there will inevitably be some splashing of water up over portion 41. In order to prevent any such splashed water from entering into contact with the electrical components of the machine, more particularly the motor 23 and solenoids 24a and 27, I provide a boot member 42 which is secured at its lower end to portion 43 of member 7 and is secured at its upper end to the outer surface of bearing member 12. The provision of this boot, in the conventional manner, 50

also prevents movement between the moving system 10 and the member 7 on which it is supported without any possibility of leakage of water where it should not be allowed. As has already been mentioned, the machine 1 also includes components suitable to cause it to provide a drying operation as well as the washing and centrifuging operations of a washing machine. The basket 20 is provided on its outer surface with impellers or vanes 44 which have an air moving effect when the basket rotates, causing air to be pulled up through openings 45 in member 15 and openings 46 in member 14, thereby to pass through the electric heating unit 47 which may be supported in any suitable manner (not shown). Thus, when the basket rotates, air is pulled up over the heater 47 and through openings 46 and 45, thereby to pass up between the basket and the tub. In order to insure this path for the circulating air, the end 48 of member 14 may be formed as a trough with a flange 49 of basket 26 projecting down thereinto thereby to form a trap through which air will not pass but through which water will drain. The air, after it has been forced up past the top of basket 20, passes through the space between the top of the basket and the tub, and through the opening 51. The air then passes through a channel 49a formed between the cabinet top 4 and the top 30 of basket 16, down through a channel 50 formed between the side 29 of basket 16 and the sides of the cabinet, and then over suitable air dehumidification means generally shown at 51 as consisting of cold water sprays which condense the moisture out of the air.

In the conventional manner, the dehumidifying means may be in the form of valves and conduits providing a small flow of water in the form of a spray so as to condense the moisture out of the air passing through channel 50. It will thus be seen that the air, when it passes out of channel 50, must pass through the spray of water from valves 51 so as to be cooled sufficiently for moisture to condense out of it, and then will pass down and over the heating element 47 once again so as to be heated. Thus, warm, dry air is continually provided to contact clothes at the outer edge of basket 20 in the closed recirculation system, as will be fully discussed when the operation of the machine is described hereinafter.

It will be understood that machine 1 is provided with the conventional sequence control mechanism which may be housed in a raised section 52 provided at the back of the machine. The sequence control mechanism is, in this case, indicated by the part shown in phantom outline by the numeral 53, it being understood that any conventional sequence control mechanism capable of opening and closing switches in the predetermined sequence, and of being preset by a manual member 54, may be used, and that such items are commonly available in a variety of forms.

Having described the various components of my improved machine 1, the operation thereof effective to provide washing, centrifuging, and drying, will now be explained. When a washing operation is to be provided, the sequence control mechanism causes motor 23 to be

the
energized to cause rotation of basket 20, solenoid 27 to be energized to cause tub 16 to be prevented from rotation, and motor 37 to be energized to circulate through conduit 38. In addition, suitable solenoids may be energized for a suitable period so as to permit water to be introduced into basket 20 through an inlet 55, it being understood that the hydraulic inlet system of the machine may be of the conventionally provided type and is therefore not further described. It is to be understood that the energization of the inlet valves is provided until a suitable amount of water of the desired temperature has entered the basket 20. Also, of course, at this time any desired treating agents such as detergent may be inserted through opening 5 into basket 20.

The rotation of basket 20 by motor 37 causes clothes and liquid in basket 20 to be moved by centrifugal force up the sloping walls of the basket, the clothes finally sliding up over the top of the basket against the wall 17 of tub 16 in the vicinity of finger projections 28. As the clothes slide up over the top of the basket 20, they are impacted upon the vanes 32 forming the tub 16, in a given centrifugal action. The impact, which is beneficial in effecting a desirable mechanical washing action, the surface 33 of each vane 32 is formed that it tends to direct the clothes inwardly toward the center of the basket 20. Due to the fact that the tub 16 is stationary, the clothes are then directed by the vanes inwardly so that they then fall down within the basket 20 and receive a further impact. The mechanical washing action, then, consists essentially of causing the washing liquid and the clothes to be flung into impact with the vanes 32 and then to be guided by the vanes 32 back down into the basket 20 for a further impact therein.

It will be understood that, because of the direction of movement of the clothes, there is very little tendency for any of the clothes to wedge themselves or fall between the basket and the wall 17 of tub 16. However, in order to further insure this result, fingers 29 have been found most beneficial. Fingers 29 tend to pick up the clothes as they pass over the top edge of basket 20, helping to guide them upwardly into impact with the vanes 32. A further item acting to prevent any wedging of the clothes is the upward flow of air around the outside of basket 20 created by impellers or vanes 44 during rotation of the basket 20. This air moves upwardly around the bucket 20, tending to push out any clothes which might try to move down into a wedged position between the basket and the tub.

The washing action described continues for any desired period of time which may, for instance, be on the order of 10 minutes. During this period of time the pump 36 is, as stated, operated in the direction to cause liquid washing into receptacle 35 to be guided into conduit 38 back into basket 20. This is desirable since a certain amount of liquid will be lost, both by passing out through openings 34 and by dripping down wall 17 of tub 16 and out through openings 45, through the trough 48, and down to the bottom of receptacle 35. By permitting this water back into basket 20, the fact that a certain amount of water will escape from the tub and basket system becomes immaterial.

It is conventional, at the end of the washing operation, to cause the liquid in the clothes to be centrifugally extracted from the clothes in order to make the rinsing operation more effective. In order to effect this centrifuging operation, at least two changes from the previous washing operation, and preferably three, are provided. First, the brake 26 is released by deenergization of solenoid 27; and second, the direction of rotation of motor 37 is reversed so that pump 36, instead of pumping liquid from the bottom of receptacle 35 up through conduit 38, will pump it out through conduit 40 to drain. The release of brake 26 means that there is no longer

any force except very minor frictional forces stopping the tub 16 from rotating. As a result of this, the continual impact of clothes on the vanes 32 as they are flung up out of the rotating basket 20 will cause the tub 16 to start to rotate with the basket 20.

In this manner, the tub will gradually come up to the same speed as the basket 20, with the clothes eventually being plastered about the upper and outer edge of basket 20; it being contemplated that the clothes will overlap the edge of the basket 20 so that they will effectively couple the basket and tub together for joint rotation. As a result of this rotation centrifugal force acts on the liquid in the clothes causing it to pass out through openings 34 into receptacle 35 where the pump 36 removes the liquid to drain.

The third change mentioned above as desirable for the centrifuging operation is the energization of solenoid 24a to cause transmission 24 to provide a higher speed. While acceptable results may be obtained with a single speed transmission, it is preferred to provide, generally, a higher speed for centrifuging than for washing. In addition, the type of washing action may be varied between heavy and light by means of a multi-speed transmission, the impact becoming greater (and therefore the washing action heavier) as the speed is increased.

The centrifuging action continues for an appropriate period of time which may, for instance, be on the order of 5 minutes. At the end of this operation a rinse step is provided in substantially the same manner as the washing step, that is, by reversing the direction of rotation of pump 36 so that recirculation is again provided and by causing braking of the tub 16 by energization of solenoid 27. After the rinsing, a suitable centrifuging operation is again provided in the same manner as before. At the end of this last centrifuging operation the brake is again applied to stop the rotation of the tub 16.

However, the rotation of pump 36 is continued in the direction effective for draining and, in addition, for the first time heating element 47 is energized and valves 51 are turned on to provide a spray condensing effect. The continued rotation of basket 20 causes the clothes to continue their movement outwardly and upwardly into contact with vanes 32 and then back into the center of the basket 20. This continued rotation also continues to cause the movement of air previously mentioned so that the air passes in sequence through the heater 47 and then through openings 46 and 45, up between basket 20 and the imperforate part of wall 17 between openings 34 and 45, and then through the clothes as they are being flung outwardly from the basket, this contact of the heated air with the clothes serving to vaporize moisture from the clothes and thereby dry them.

After thus contacting the clothes, the air passes up through opening 31 and then through channels 49a and 50 and back downwardly and past the sprays emanating from condenser valves 51, a small portion of the air possibly taking the shorter path through openings 34. As the moist heated air passes through the spray it is cooled below its saturation point to cause condensation of moisture out of the air. The air then passes back over heater 47, and so forth to repeat the cycle and continue the drying action. Because of the configuration of trough 48 and flange 49, a water seal is provided at that point to prevent any bypassing of the heating element by the air so that all the air continually passes over the heating element to obtain maximum effectiveness.

This heating operation may continue, either for a preset time or until the clothes are dry depending upon whether a conventional timed sequence or an automatic timed sequence is desired (both being well known and provided on commercially available machines). Thus, in the vertical machine 1, a complete washing, centrifuging and drying action is provided for the clothes inserted therein. It is to be noted that while the motion of the clothes is essentially the same during washing and drying,
two entirely different purposes are served by this same motion. In washing, the object is to impact the clothes on the fixed vanes 32 and then impact them by causing them to fall into the basket 20, the impacts having the result of flexing them and providing a mechanical washing action. However, insofar as drying is concerned the object is to tumble the clothes and then utilise the same basket structure to facilitate the movement of air through the clothes and the basket. Thus, the apparatus is suitable both for washing and for drying.

Two entirely different purposes are served by this same motion. In washing, the object is to impact the clothes on the fixed vanes 32 and then impact them by causing them to fall into the basket 20, the impacts having the result of flexing them and providing a mechanical washing action. However, insofar as drying is concerned the object is to tumble the clothes and then utilise the same basket structure to facilitate the movement of air through the clothes and the basket. Thus, the apparatus is suitable both for washing and for drying.
10. A vertical axis laundry machine comprising: a substantially imperforate basket formed as an inverted cone open at its top; a tub surrounding said basket and extending above and inwardly over said basket, said tub including an imperforate section extending around said basket and forming a channel therewith; means for rotating said basket and tub together at a speed sufficient to fling clothes and liquid outwardly over the edge of said basket; means for holding said tub stationary during rotation of said basket; said tub including means for guiding clothes and liquid spun up out of said basket inwardly over said basket when said tub is stationary and said basket is rotating; said tub having openings formed therein adjacent its bottom and adjacent the top of said basket for removal of liquid; a stationary outer receptacle surrounding said tub in liquid-receiving relation thereto; means for recirculating liquid from said receptacle back into said basket; drain means connected to said receptacle; and means controlling said tub holding means; said basket having air impelling vanes formed on its outer surface in said channel so as to cause air to pass upwardly through said channel during rotation of said basket thereby to tend to blow clothes away from a position where they might be wedged between said basket and said tub.

11. A vertical axis laundry machine comprising: a substantially imperforate basket formed as an inverted cone open at its top; a tub surrounding said basket and extending above and inwardly over said basket; means for rotating said tub and basket together at a speed sufficient to fling clothes and liquid outwardly over the edge of said basket; means for holding said tub stationary during rotation of said basket; said tub including vanes for guiding clothes and liquid flung up out of said basket inwardly over said basket when said tub is stationary and said basket is rotating; said tub having openings formed therein adjacent its bottom, and having a substantially imperforate section extending around said basket in spaced relation thereto and forming a channel with said basket, said basket having air moving vanes formed on its outer surfaces and arranged to move air upwardly through said openings and said channel during rotation of said basket; an outer cabinet surrounding the sides and top of said tub in spaced relation thereto and forming with the top and sides of said tub outer channel means through which air may pass from the top of said tub back to the bottom thereof, means for condensing moisture out of the air positioned intermediate said outer channel means and said openings; means downstream of said condensing means for heating the air after it has been dehumidified by said condensing means; and drain means for removing condensed moisture.

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