Aug. 28, 1962 J. M. PINDER 3,050,975

LAUNDRY MACHINE WITH SUCTION MEANS FOR REMOVING MOISTURE

Filed Oct. 14, 1959 4 Sheets-Sheet 1

FIG. 1

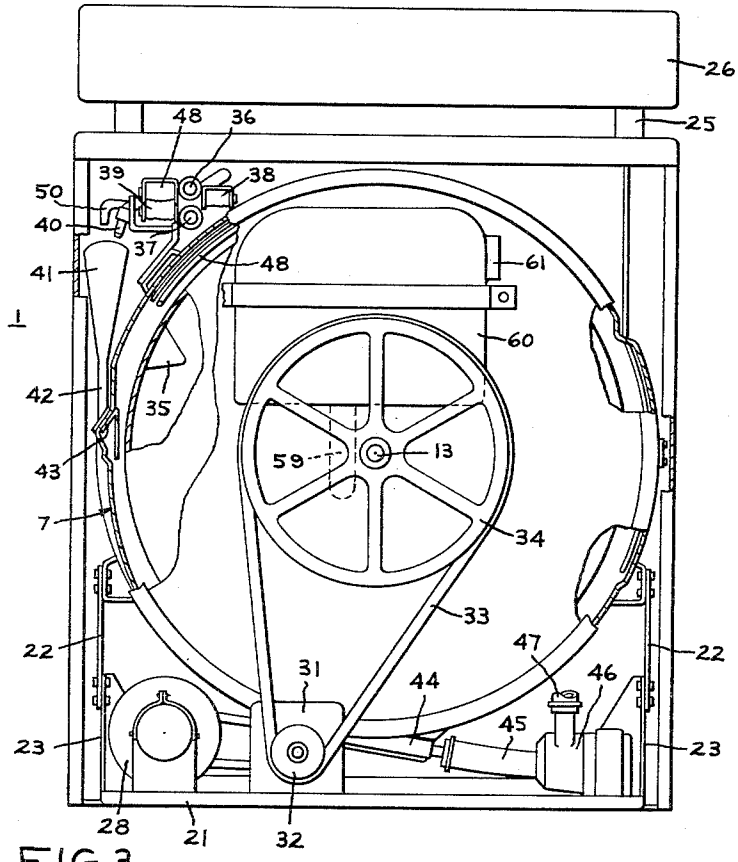
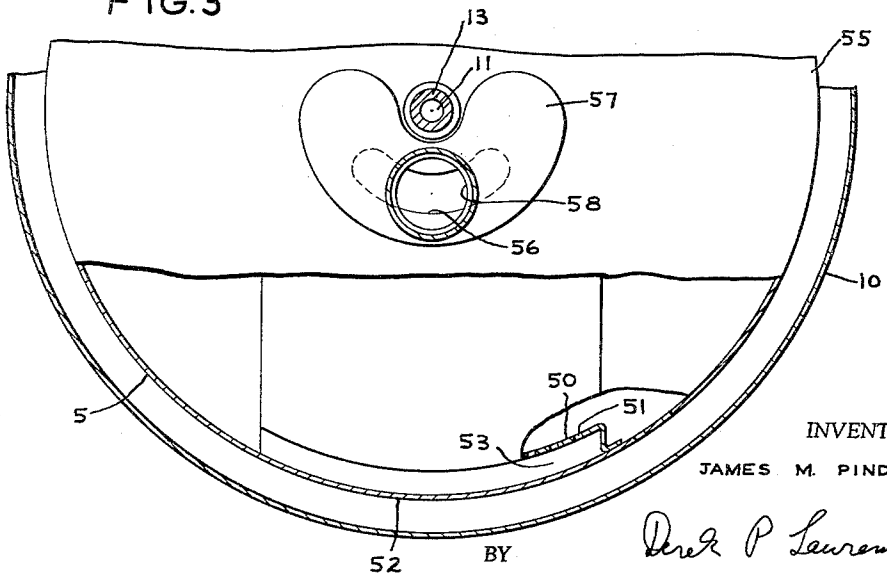


FIG. 3



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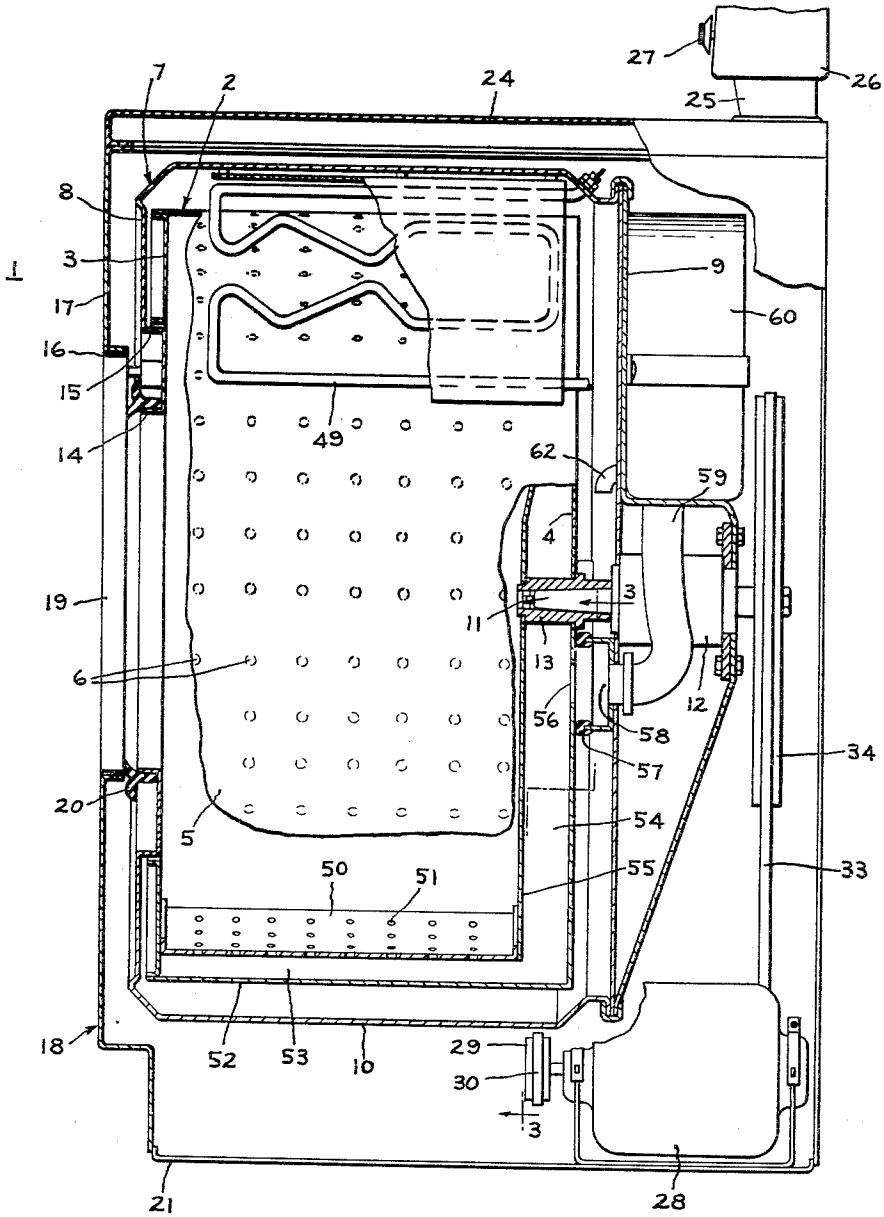


FIG.2

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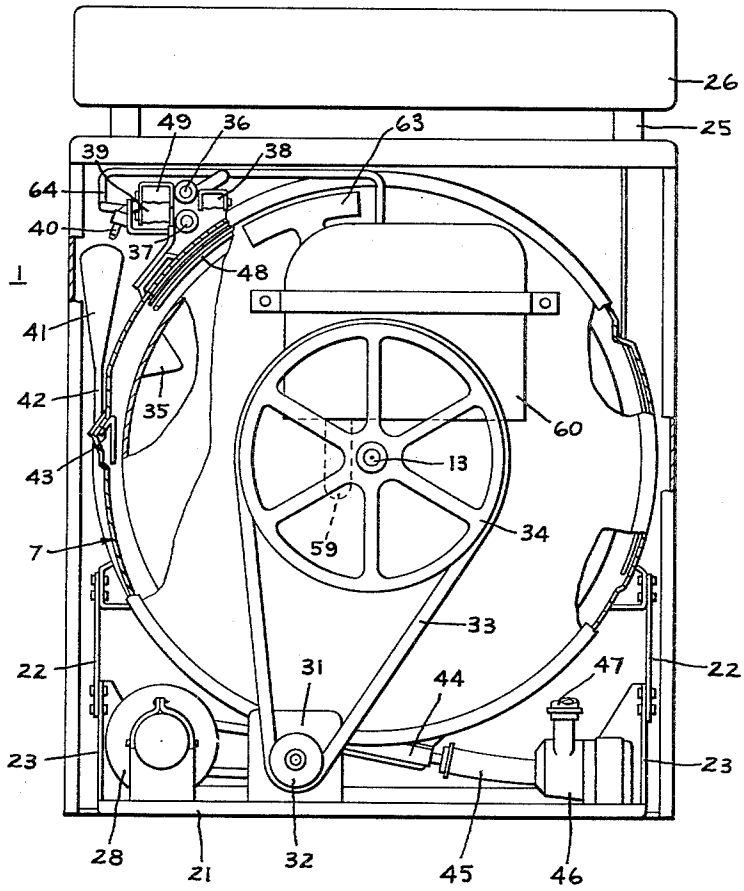
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LAUNDRY MACHINE WITH SUCTION MEANS FOR REMOVING MOISTURE

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FIG. 4



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LAUNDRY MACHINE WITH SUCTION MEANS FOR REMOVING MOISTURE

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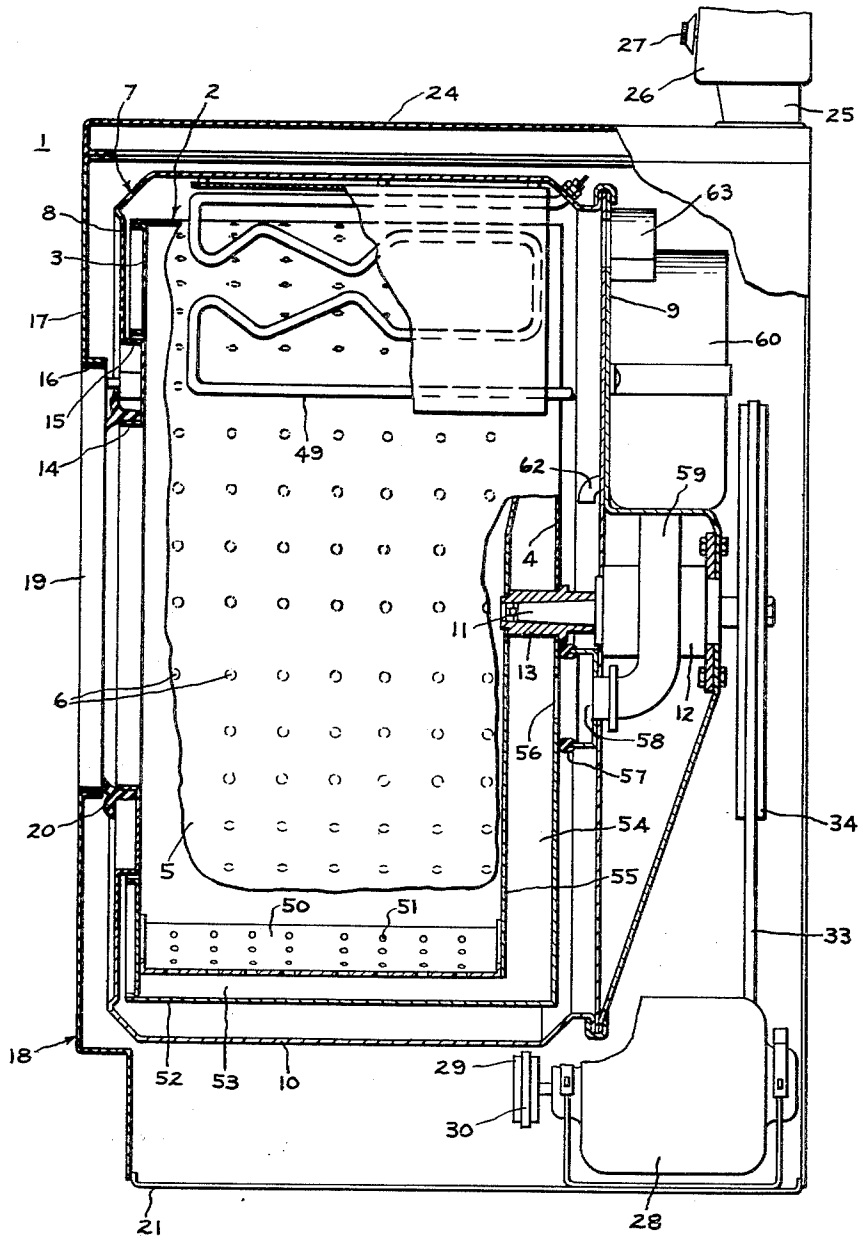


FIG. 5

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3,050,975

LAUNDRY MACHINE WITH SUCTION MEANS FOR REMOVING MOISTURE

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Filed Oct. 14, 1959, Ser. No. 846,436
11 Claims. (Cl. 68—20)

This invention relates to domestic laundry machines, and more particularly to such machines which include improved means for effecting removal of moisture from wet clothes.

In automatic laundry machines for domestic use, it is imperative to provide some appropriate means of removing a substantial part of the liquid content from the clothes after they have been washed. In the past, this means has generally taken two forms: either the liquid has been squeezed out of the clothes, or else a high speed rotation of the clothes container has been provided to cause a centrifugal liquid extraction phenomenon to occur. Of these two systems, the centrifuging, or spin, operation has proven to be the most practical; yet even this preferred one of the two approaches to removing moisture has had the inherent disadvantage that, while effective liquid removal occurred, the entire machine had to be constructed to withstand the very substantial forces involved in high speed rotation of a substantial but not necessarily balanced mass, as well as special speed transmission means being required to provide different speeds for washing and for spinning. The squeezing operation when provided requires the use of flexible means and special squeezing mechanisms, and has likewise resulted in a substantial additional expanse. Thus, while the known means of removing liquid from clothes are effective, the additional expense involved in their use makes it highly desirable to provide a structure which will avoid the expense and structural difficulties both of the squeezing system and of the high speed system, yet which will perform as effectively as these two systems.

It is therefore an object of my invention to provide a laundry machine including novel means for effecting removal of liquid from clothes in a container.

A more specific object of the invention is to effect the removal of liquid by drawing a substantial amount of air through the clothes as they lie against a perforated member. Liquid is removed for two basic reasons: first, the high speed of the air movement through the clothes causes a substantial amount of liquid removal; and second, the lower pressure on the downstream side of the clothes exerts a hydrostatic tension on the liquid in the capillaries of the fabric of the clothes to pull additional liquid out of the clothes.

In carrying out my invention, I provide a laundry machine with suitable means for tumbling clothes, the means including a perforated member which has one surface arranged to contact the clothes at least intermittently. On the other side of the perforated member, I provide suction means which exercises, at least part of the time, a strong suction through the perforations so as to cause air passing at high speed through the clothes to remove a substantial amount of water from the clothes. Preferably, I also provide means which insure the positioning of the clothes against the member during at least part of the time the suction means operates, so that the structure insures that the air will pass completely through the clothes, that is, that passage through the clothes will be the only means of egress from the clothes receptacle for the air.

The features of my invention which are believed to be novel are set forth with particularity in the appended claims. My invention itself, 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 drawings, FIGURE 1 is a rear elevational view of a laundry machine, specifically a combination clothes washer-dryer, embodying my invention in one preferred embodiment thereof, the view being partially broken away and partially in section in order to illustrate details of the invention;

FIGURE 2 is a side elevational view of the machine of FIGURE 1 with the side panel removed, with certain surfaces broken away, and with certain surfaces in section to illustrate details;

FIGURE 3 is a view along lines 3—3 in FIGURE 2;

FIGURE 4 is a rear elevational view of a second embodiment of my invention; and

FIGURE 5 is a side elevtional view of the machine of FIGURE 4.

Referring now to the drawings, I have shown therein a domestic laundry machine 1 in the form of a combination washer-dryer. Machine 1 is of the horizontal axis type, that is, it includes a clothes basket 2 which is rotatable about a non-vertical axis, in this case the axis specifically being horizontal. Basket 2 includes front and rear walls 3 and 4 and a connecting outer wall 5 provided with a plurality of perforations 6 as shown. Wall 5 is preferably cylindrical in shape with the perforations being distributed substantially over the entire surface thereof. Cylindrical basket 2 is mounted within an imperforate tub structure 7 which encloses it on all sides. Tub 7 includes a front wall 8, a rear wall 9, and a connecting side or outer wall 10. In the embodiment shown, the wall 10 is generally cylindrical in shape in much the same way as the wall 5 of basket 2.

The basket is rotatably supported from the tub structure by a horizontally extending shaft 11 which is mounted in an elongated bearing 12 hung from the rear wall 9 of the tub structure. Shaft 11 supports the basket by means of a hub 13 secured centrally to the basket rear wall 4. Shaft 11, as well as supporting the basket, also serves as the means for turning it during the operation of the machine. The tub and the basket are provided respectively with openings 14 and 15 in the front walls thereof, these openings being aligned with a door opening 16 in the front wall 17 of the appearance cabinet 18 which surrounds the tub. A hinged door 19 mounted on the appearance cabinet seals against a suitable gasket 20 formed around the tub opening 14 so as to close off the tub during operation of the machine.

The tub structure 7 and the appearance cabinet 18 are both mounted on a suitable base structure 21 provided at the bottom of the machine. The tub specifically is mounted thereon, as shown, by means of a plurality of brackets or arms 22 which are mounted on upstanding plates 23 fixedly attached to the base. The appearance cabinet may be welded to the base or otherwise secured thereto in any appropriate manner. The top of the appearance cabinet may, as shown be formed by a separate member 24 which supports on posts 25 a control panel 26 having the conventional appropriate control apparatus, generally indicated at 27.

In addition to the tub and the appearance cabinet the base 21 also mounts basket drive means. The drive means comprises a motor 28 which is connected through a pulley 29 and a belt 30 to a suitable speed reduction device 31. Device 31 has an output pulley 32 connected by a belt 33 to a pulley 34 mounted on the end of shaft 13, so that when pulley 34 is rotated it causes—through rotation of shaft 11—rotation of the basket. The parts are so proportioned that the basket 2 is rotated at a speed appropriate to effect tumbling of the clothes, with the clothes being carried up in the basket, this action being assisted by

the provision of conventional means such as vanes 35, for instance, and then falling across the basket. For instance, an appropriate speed for effecting this action in a cylindrical basket having a 26 inch diameter is in the vicinity of 47 r.p.m.

Machine 1 is provided with suitable water supply means whereby either hot water, cold water, or a mixture of hot and cold water may be admitted to tub 7 for washing and rinsing purposes. The water supply means includes connections 36 and 37 through which hot and cold water are supplied respectively. A valve controlled by a solenoid 38 admits hot water to the machine and a valve controlled by an opposed solenoid 39 admits cold water to the machine. The hot and cold water valves under the control of solenoids 38 and 39 discharge through a common outlet conduit 40. The water then passes through a suitable air gap into a funnel 41 which leads to a line 42 connecting with an opening 43 in the side of the tub wall 10. The air gap provided by funnel 41 makes it impossible for water to be syphoned from the machine and thus contaminate the incoming water supply line.

In order to permit removal of water from the machine after it has been used for either washing or rinsing, the clothes tub 7 communicates at the bottom thereof with a sump 44 which, through a conduit 45, connects with a drain pump 46 having an outlet 47 connected to an appropriate drain (not shown). The pump 46 is energized at suitable times to drain the used wash and rinse water from the machine.

In order to heat the air in the basket for drying purposes during the drying portion of the machine operation, I provide a heater assembly 48 mounted in the upper portion of tub 7 between the inner surface of the tub wall 10 and the outer surface of the perforated cylindrical wall 5 of the basket. The machine illustrated in FIGURE 1 is of the type which uses a cold wall condenser during the drying cycle for condensing the moisture extracted from the wet clothes. The lower left quadrant of the cylindrical wall 10 of tub 7 comprises this condenser, the wall being cooled by flowing cold water over it. The condenser water is admitted to the machine through an additional solenoid actuated valve controlled by a solenoid 49. Solenoid 49 is energized during the drying operation so that the valve controlled by it passes water at a slow rate sufficient to condense the moisture extracted from the clothes. The condenser water valve discharges through a separate conduit 50 into funnel 41, whence, as before, the water flows through conduit 41 and opening 43; then because of the slow flow of the water, it flows in a thin sheet down the lower left quadrant of tub wall 10. This water, of course, flows into the sump and is disposed of, in the same manner as the wash and rinse water, by operation of the drain pump 46.

A member 50 provided with perforations 51 is arranged as shown in FIGURES 2 and 3 so that it extends from the front to the back of the basket and covers about a 45 degree section of the inner cylindrical surface of the basket. Beneath the member 50 the basket wall 5 is provided with an imperforate section 52 so that the space 53 between section 52 of wall 5 and member 50 is in effect accessible only through the perforations 51 of member 50. At this point, it is important to note that the term perforation," as used herein when referring to openings 51, is intended to designate openings of a size small enough to prevent passage of an article of clothing, or part thereof, yet large enough (as opposed to a porous structure) to permit fluid to be sucked therethrough at a relatively high velocity. For instance, while these figures are not to be taken as absolute limitations, circular openings having a diameter of 1/16 inch to 1/4 inch have been found effective.

Space 52 communicates with the space 54 formed at the back of the basket between the back wall 4 and an additional wall member 55. Space 54 in turn communicates with an arcuate opening 56 (best seen in FIGURE 3) in back wall 4. Abutting against the back wall 4 is a stationary sealing gasket member 57 which provides a running seal by its engagement with the back of wall 4 of the basket. It will be noted from FIGURE 3 that the gasket member 57 is formed so that it encloses the opening 56 whenever that opening is in communication with an opening 58 formed at the end of a stationary conduit 59 leading to a pump and water separator assembly 60. The assembly 60 includes a relatively powerful pump (which may be of any conventional design and is therefore not illustrated in detail) for exercising suction through conduit 59, spaces 54 and 53, and perforations 51, on clothes in the basket.

In the embodiment shown in FIGURE 1 it is intended that the air pulled from the basket through conduit 50 into assembly 60 be exhausted through a suitable opening to atmosphere such as that shown at 61. It will further be understood that the water separation function performed by assembly 60 is also of a conventional nature which may be provided in the conventional fashion by a series of baffles (not shown) which catch the water while permitting the air to continue on through outlet 61. The separated water passes out by the force of gravity through opening 62 and then drips down the back wall of the tub 7 to the sump 44 to be drained.

It will readily be observed that, due to the position of the stationary opening 58, suction will be exerted through the perforations 51 of member 50 only when opening 56 is reasonably well aligned with stationary opening 58. This occurs only over a predetermined arcuate degree of travel, so that there is an intermittent suction exerted, the suction being exerted for a predetermined period during each basket rotation when member 50 has rotated approximately to the bottom position as shown in FIGURES 2 and 3.

As mentioned above, machine 1 is a combination washer and dryer, that is, it proceeds through a cycle of operations, first washing and damp drying the clothes and then, if desired, completely heat drying the clothes. Throughout all the operations of washing, damp drying, and drying, the clothes basket is driven at the same single tumbling speed by motor 28. In order to obtain the proper sequence of operation of the various components a conventional sequence control mechanism (not shown) may be provided in the usual manner to cause the components to proceed through a predetermined sequence of steps to effect the three operations of washing, damp drying and drying. First, the inlet water valve solenoids are energized to cause either hot or warm water to flow into the tub 7 until it reaches a suitable level, after which the water ceases to flow in and the clothes are tumbled in the water. The operator normally adds a suitable amount of detergent or other cleansing substance to effect a cleansing of the clothes. After an appropriate period of washing in this manner, the drain pump 46 is energized to remove the used wash water from tub 7.

After the wash water has been drained out of the machine, rinse water is introduced by re-energization of the inlet water valve solenoids, either the hot water valve solenoid 38 alone, the cold water valve solenoid 39 alone, or both solenoids together being energized to provide hot, cold or warm water. After the rinsing operation the water is again drained by energization of the drain pump 46. Customarily several rinses are provided with the water being drained out after each one.

After the water has been drained subsequent to the last rinse step, the washing operation is complete and the damp drying operation is then provided. According to my invention, the assembly 60 is put into operation at this time to cause a substantial amount of suction to be exercised through conduit 59. This suction is operative through perforations 51 on the interior of basket 2 whenever opening 56 is in alignment with opening 58. It

will, of course, be understood that as the clothes tumble they rise; assuming the rotation of the basket to be clockwise as viewed in FIGURE 1, they rise up past the heaters and at a point at or shortly before the top of the basket is reached they fall to the bottom of the basket. Inasmuch as suction is exercised through perforations **51** only when member **50** is in the vicinity of the bottom of the basket it will be seen that whenever suction is exercised through perforations **51** there will be clothes directly in contact with the member **50** since the clothes fall to the bottom of the basket during the tumbling action. As a result, air is pulled at high speed through the perforations **51** of member **50**, out through spaces **53** and **54** and conduit **59**, and into assembly **60** where the air is exhausted from opening **61** and the water, preferably, is separated and ejected through opening **62**. It has been found that this action, continued for an appropriate length of time, removes the same amount of liquid from the clothes as does a centrifugal extraction operation when conducted in the speed range generally provided in the combination washer dryer field.

Thus, once for each rotation of the basket a substantial amount of suction is exerted through the perforations **51** during a period when the member **50** is in the area adjacent the bottom of the basket, and therefore covered with clothes. As a result, the air pulled through the perforations **51** must pass directly through the clothes, carrying with it a substantial amount of moisture out of the clothes.

After the moisture content of the clothes has been brought down by this procedure to that conventional for damp dry clothes, the regular heat drying operation may, if so desired, be provided. This consists of energizing the heater assembly **48** and energizing the condenser water valve solenoid **49** so that condenser water flows in a thin sheet down the lower left quadrant of tub **7**. The clothes continue to tumble and the air in the system is circulated by this tumbling action first up past the de-humidifying sheet of water flowing down the side of the tub and then past the heater assembly **48**. The circulation of the clothes in the basket thus causes the air to continually pass through a cycle in which it is dehumidified, then heated, then circulated over the clothes to pick up moisture therefrom. This part of the procedure may be controlled in a suitable manner, either by straight timing or by some type of automatic drying control so that when the clothes are substantially bone-dry the drying operation will cease and the machine will shut off completely, with the clothes being clean and dry.

It will readily be seen from the structure described that the damp drying operation, which is essential if the heat drying is to be kept within reasonable bounds as to time and cost, is performed without the necessity for providing either a multi-speed transmission or a squeezing structure. The combination of the liquid blown out of the clothes by the air moving at high speed, and of the liquid pulled out of the fabric capillaries by hydrostatic tension, gives a result comparable to those achieved by centrifuging operations.

Referring now to FIGURES 4 and 5 of the drawings, there will be described a second embodiment of the invention, with like parts to those of the embodiment of FIGURES 1 to 3 being shown by the same numerals. It will be observed that the assembly **60** for exercising the suction on the clothes, instead of having an opening **61** exhausting outside the tub **7** as in FIGURE 1, is provided with an outlet **63** which exhausts the air from the assembly **60**, after the moisture and water has been removed from the air, directly over the heater assembly **49**. The other major difference is that instead of the condenser water being supplied through a conduit **50** into the funnel **41** as in FIGURE 1, it is instead supplied through a conduit **64** to the assembly **60** where it effects a de-humidifying function in one of the conventional manners either by contacting the air in a thin film as it does in the embodiment of FIGURE 1 or else by being sprayed through the air and then caught by baffles. Such structures are completely conventional and since a variety of them may be used in connection with my invention it is not deemed of importance to show any one particular type of such structure.

With the structure of FIGURES 4 and 5, the operation of the machine is the same as before through the washing operation. When the damp drying operation starts, the suction is exerted, as before, intermittently through perforations **51** of member **50**. However, instead of this air being ejected from assembly **60** through opening **61** with the water being returned through outlet **62** to drain, the water is separated and removed through conduit **62** as before, but the air is blown through conduit **63** over the heaters. In other words, instead of the open cycle shown in the embodiment of FIGURE 1 a closed air cycle is provided. In this second embodiment, the operation of assembly **60** is continued during the heat drying cycle, assembly **60** continuing to exercise suction through perforations **51** when assembly **48** is energized (although, of course, such a procedure is also possible with an open-cycle type machine such as shown in FIGURE 1). In this manner, the dry air being blown out through conduit **63** is then heated by passing it over the heater assembly before being pulled at high speed through the clothes covering perforations **51**. With the stated operation of the structure of FIGURES 4 and 5, the beneficial effect of causing air to pass at high velocity through the clothes is obtained not only for the damp drying operation but also for the heat drying operation. It has been found that this helps considerably in the heat drying operation, causing the clothes to be completely dried substantially faster.

It will readily be understood that the advantages of the invention may be obtained regardless of whether the air cycle is an open one or a closed one, and regardless of whether the heaters are utilized all the time, part of the time, or not at all; in other words, the arrangement is highly advantageous both for the damp drying operation in replacing the conventional centrifuging operation, and in speeding up the heat drying operation.

In addition, it will be obvious that additional members **50** may be provided around the basket to cause suction on the clothes two or more times for each basket revolution, rather than just once as in the embodiment described. Where such additional members **50** are provided, the design must, of course, undergo minor modifications so that suction is exerted through each member for an appropriate period without suction simultaneously occurring through another of the members. In this connection, it has been found that initiating the suction through a member **50** at the moment of impact of clothes thereon gives good results because at that moment the clothes are somewhat compressed from the impact; this increases the air velocity and the hydrostatic tension by decreasing the air passage area.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention and I therefore aim in the appended claims to cover all such equivalent variations as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a laundry machine, means for tumbling clothes including a perforated member having one surface arranged to contact the clothes at least intermittently, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes, and suction means on the other side of said surface exercising a

strong intermittent suction only through the perforations of said surface substantially concurrently with the intermittent contacting of clothes with said surface.

2. In a laundry machine, means for tumbling clothes in a predetermined pattern including a perforated member having one surface arranged to contact the clothes at their lowest position in the pattern at least intermittently, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes, suction means communicating with the other side of said perforated member adjacent said lowest position in said predetermined pattern and exercising a strong intermittent suction only through the perforations.

3. In a laundry machine, a clothes container rotatable on a non-vertical axis, means for rotating said container at a speed appropriate for tumbling clothes therein, a perforated member forming part of the inner surface of said container, and stationary suction means communicating with the other side of said perforated member during a predetermined portion of each rotation of said basket so as to exercise a strong intermittent suction only through the perforations, said suction means entering into communication with the other side of said perforated member during the part of each rotation when said perforated member forms the lower part of said container and is therefore in contact with clothes tumbling within said container, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes.

4. In a laundry machine, a clothes basket having end walls and a substantially cylindrical wall joining said end walls, said basket being rotatable on a non-vertical axis, means for rotating said basket at a speed for tumbling clothes therein, a perforated member having a surface forming a portion of the inner surface of said cylindrical wall, conduit means communicating with the other surface of said perforated member and extending through one of said end walls of said basket, a stationary conduit member having an end arranged in sealing engagement with said one end wall and positioned to be in communication with said conduit means for a portion of each basket rotation starting during the period when said basket has rotated to a position where said perforated member is in the vicinity of the bottom of said basket, a suction assembly communicating with said stationary conduit, said assembly being formed also to remove water from air sucked through said conduit, drain means in said laundry machine positioned to receive water from said assembly, and conduit means guiding water separated from the air in said assembly to said drain means.

5. In a laundry machine, means for tumbling clothes in a predetermined pattern including a perforated member having one surface arranged to contact the clothes at their lowest position in the pattern at least intermittently, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes, water supply means for providing water with which to wash and rinse the clothes, drain means for removing the water after it has been used to wash and rinse the clothes, and means for damp drying the clothes after a washing operation including suction means communicating with the other side of said perforated member adjacent said lowest position in said predetermined pattern and exercising a strong intermittent suction only through the perforations.

6. In a clothes drying machine, means for tumbling clothes in a predetermined pattern, means for heating the clothes as they tumble in order to cause removal of vapor from the clothes, said tumbling means including a perforated member having one surface arranged to contact the clothes at least intermittently at their lowest position in the pattern, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes, means for increasing the speed of vapor removal from the clothes comprising suction means communicating with the other side of said perforated member adjacent said lowest position in said predetermined pattern and exercising a strong intermittent suction only through the perforations.

7. In a laundry machine, means for tumbling clothes including a perforated member having one surface arranged to contact the clothes when said surface is in a predetermined position, said perforated member being formed so that during the contacting of the clothes a substantial majority of its perforations are covered by the clothes, and suction means on the other side of said surface exercising a strong suction only through the perforations of said surface at least part of the time that said surface is in said predetermined position.

8. The apparatus defined in claim 3 wherein said stationary suction means includes an outlet to atmosphere.

9. The apparatus defined in claim 4 wherein said suction assembly includes an air outlet communicating back to said basket.

10. The apparatus defined in claim 4 wherein heating means are positioned to heat air in said basket and wherein said suction assembly includes an air outlet communicating back to said basket in the vicinity of said heating means.

11. In a laundry machine, a substantially cylindrical clothes container rotatable on a non-vertical axis, means for rotating said container at a speed appropriate for tumbling clothes therein, a perforated member forming part of the inner surface of said container, said perforated member extending substantially from end to end within said container and covering approximately 45 degrees therewithin, and stationary suction means communicating with the other side of said perforated member during a predetermined portion of each rotation of said container when said perforated member is in the vicinity of the bottom of said container so as to exercise a strong intermittent suction only through said perforated member.

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