My invention relates to clothes dryers and, more particularly, to such machines wherein a stream of heated air is circulated through the clothes to extract moisture from them during the drying operation and the air is scrubbed by a curtain of cold water upon leaving the basket.

While this invention is applicable to a clothes dryer alone, it is illustrated and described below in detail as applied to a combination washer-dryer machine of the general type disclosed in Patent 2,800,008, issued July 23, 1957 to Walter J. Raczyński, owned by General Electric Company, the assignee of the present application. It is sufficient to state here that the machine disclosed in said patent is of the horizontal axis tumble action type well known in the art, having means for establishing a closed circulation of drying air through the machine during its use as a dryer, the moisture in the drying air being condensed by contact with cold surfaces of the washing tub. However, rather than using a cold surface to condense the moisture, as in this patent, the invention contemplates the utilization of a cold water spray for this purpose. This invention also contemplates the provision of a cold water spray curtain arrangement for condensing the moisture from the drying air by means which distributes the curtain properly with respect to a part of circulating the air, and also prevents back-siphoning from the tub thereby to prevent expulsion of suds from the washing tub back into the spray source.

It is an object of my invention to provide a new and improved spray condenser for clothes dryers wherein back-siphoning into the spray inlet is positively prevented upon cessation of flow of cooling water from that inlet.

Another object is to provide such a spray condenser in which the communication between the tub structure and spray inlet is mechanically closed upon cessation of water flow from that inlet.

A further object is to provide such a spray condenser in which the communication between the tub structure and spray inlet is hydrostatically closed upon cessation of water flow from that inlet.

In carrying out my invention, I provide a laundry drying machine which is provided with a clothes container, a blower connected to an inlet of the container, and a duct connecting an outlet formed in the container back to the blower. These three items form a closed air system during the drying cycle of the machine. The system also includes heating means outside the container for heating the air which is to be blown through the container. In order to precipitate moisture and lint from the air coming from the container, means are provided for supplying condensing water into the conduit intermediate the heating means and the container. These means include an open-end tube extending into the conduit, a nozzle outside the tube spaced by an air gap therefrom, and water spreading means inside the conduit adjacent the end of the tube. Water supply means are provided to cause water to pass from the nozzle into the tube against the spreading means, which in turn are responsive to cessation of water flow to close the end of the tube, thus preventing any flow of moist air or of suds back through the tube.

The features of my invention which I believe to be novel are pointed out with particularity in the appended claims. My invention itself, however, may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a rear elevational view of a combination washer-dryer embodying my invention in one form thereof, certain surfaces of the view being broken away to illustrate details of the machine;

Fig. 2 is a detail view in section of the condenser portion of an air conduit and with one form of spray inlet used in my invention, this figure being drawn to a larger scale than is Fig. 1;

Fig. 3 is a view similar to that of Fig. 2 and showing a second form of spray inlet arranged in accordance with this invention; and

Fig. 4 is a view similar to that of Fig. 2 and showing still a third form of spray inlet arranged in accordance with this invention.

Referring now to the drawings, I have shown therein a domestic laundry machine 1, of the general type disclosed in said Raczyński patent, and comprising a combination washer and dryer. The machine 1 is of the horizontal axis type, that is, it includes a clothes basket 2 which is rotatable about a generally horizontal axis. The basket includes front and rear walls (not shown) and a connecting side or outer wall, the outer wall being cylindrical in shape and provided with a plurality of perforations, or holes, as is well known in the art.

The cylindrical perforated basket is mounted within an imperforate tube structure 3 which encloses it on all sides, having a front wall (not shown), a rear wall and a connecting side or outer wall. In effect, the basket and tub form together a container for clothes. In my preferred embodiment, the outer wall of the tub structure is generally cylindrical in shape and has the same center as the cylindrical wall of the basket. The basket is rotatably supported from the tub structure by a horizontally extending shaft 4 mounted in an elongated bearing (not shown) fixed from the rear wall 5 of the tub structure. The shaft 4, as well as supporting the basket, also serves as a means for turning it during the operation of the machine. The tub and basket are, of course, provided with openings in the front wall thereof, aligned with a door opening in the front wall (not shown) of the appearance cabinet 6 which surrounds the tub.

The tub structure 3 and the appearance cabinet 6 are both mounted on a suitable base structure 7 at the base of the machine. The tub specifically is supported therefrom by means of a plurality of arms or brackets 8 which are mounted on upstanding plates 9 fixedly attached to the base. The appearance cabinet may be welded to the base or otherwise suitably attached thereto. In addition to the tub and the appearance cabinet, the base 7 also mounts the basket drive means. The drive means comprises a motor 10 and a multi-speed transmission assembly 11. The motor drive and transmission assembly by means of a belt 12 and the transmission assembly in turn drives the basket through a belt 13. The belt 13 specifically drives a basket drive pulley 14 which is mounted on the outer end of the basket drive shaft 4. The transmission assembly is shiftable between two different gear ratios so that the basket may be driven at one speed for tumbling clothes and at a second speed for centrifugally extracting water from the clothes. Any suitable means whereby the transmission is shifted.
between the lower and higher speeds may be used, as is well known in the art.

The machine, as thus described, comprises a combination washer and dryer. That is, it proceeds through a cycle of operations first washing, rinsing and damp drying the clothes and then, if desired, completely or fluff-drying the clothes. The clothes basket is driven at its lower speed both for washing the clothes and for tumbling them during the drying operation. It is driven at its higher speed for extracting both wash and rinse water from them by centrifugal extraction. The machine, during its sequence of operations, is under the control of a suitable timer operated sequence control which energizes and de-energizes the various electrical components of the machine in predetermined sequence. Since the sequence control forms no part of the present invention, it will not be described herein. However, a sequence control and circuit suitable for use in the illustrated machine are described and claimed in the co-pending application of Walter E. Gray, Serial No. 512,612, filed June 2, 1955, and assigned to the General Electric Company, the assignee of the present application.

The machine 1 is provided with suitable water supply means whereby either hot water or a mixture of hot and cold water may be supplied to the tub 3 for washing and rinsing purposes. The water supply means includes connections or lines 20 and 21 through which hot and cold water are supplied respectively. A valve controlled by a solenoid 22 admits hot water to the machine and a valve controlled by an opposed solenoid 23 admits cold water to the machine. The hot and cold water valves under the control of solenoids 22 and 23 discharge into a common outlet conduit 24. From the conduit 24 the water passes through a suitable air gap to a funnel 25. The funnel discharges into a fill water line 26 which leads to a sump 27 which is mounted at the bottom of the tub and communicates with the interior of the tub. The break or air gap provided by funnel 25 makes it impossible for water to be siphoned from the machine to contaminate the incoming water supply.

By means of a conventional pressure actuated or hydrostatic sensing device, not shown, the water solenoids 22 and 24 may be controlled to produce the proper water level in the machine during the washing operation. Such a sensing device may be connected to the interior of the tub and it will be understood that any suitable device of this type may be utilized. Further, it will be understood that the sensing device controls the water solenoids only when suitable circuits are closed by the timer operated sequence control. The water level in the tub during the washing operation is such that the lower portion of perforated basket 2 is covered, whereby the basket dips continuously into the water as it rotates.

As best shown in Fig. 1, a blower housing 40 is mounted upon the rear wall 5 of the tub structure and communicates on its outlet or downstream side with an elongated open bottom conduit (not shown) extending longitudinally within tub 3 at an upper portion of the tub between the front and rear walls of that tub. Mounted within this housing is a centrifugal type blower 41 driven by an electric motor 42. The blower housing includes a suitable hollow partition 43 directing air into the center of the blower and this partition in turn is connected with a tubular conduit 44, preferably mounted in a generally vertical position upon the rear wall 5 of the tub structure as by means of suitable clamps 45 and 46. Conduit 44, which is mounted upstream of blower 41 and which serves as a spray condenser housing, is hermetically sealed at its lower end to sump 27 as by means of a hollow projection 47 of that sump extending upwardly therefrom. Mounted in an appropriate location outside the container, such as the blower housing, are one or more spaced heating elements 48 serving to heat the air moved theretofrom by blower 41. The heating elements preferably are of the sheathed type in which a resistance wire is maintained at a spaced relationship within an outer sheath by a highly compressed compound such as magnesium oxide. If desired, a suitable heat reflector, not shown, may be positioned between the heating elements and the blower housing to prevent direct radiation of heat to that housing and to utilize the heat from said elements more effectively upon the air removed by the blower. When the heating elements are energized during the drying cycles, the heat transferred to the air is then carried through a closed circuit into the tub, thence into the perforated basket, over the clothes to cause vapor migration out of those clothes and through the sump 27 back to conduit 44. During the drying cycle, the heater elements 48 are under the control of a thermostat 50 which is mounted in the rear side of backsplash 51 of the appearance cabinet and which has a manually adjustable control knob 52 mounted on the front side of that backplash whereby the response of the thermostat may be varied. Preferably, the thermostat not only controls the energization of the heater, but is also so connected with the sequence control that it is effective to control the duration of the drying cycle itself. A suitable circuit for accomplishing such control is shown in the aforesaid Gray application, Serial No. 512,612. The thermostat may be of any suitable type, in the present case, it is of the expansible bellows type, by means of a temperature sensing element 53 which is positioned within the tub 3 adjacent the basket 2. The sensing element is connected to the thermostat by means of a suitable hydraulic line 54.

The wash and rinse water used during the washing portion of the operation and the water from the condenser spray together with condensed moisture extracted from the clothes and lint entrapped therewith, are collected in and discharged from sump 27, which connects with tub outlet 88, as shown. A discharge hose 55 leads from sump 27 to a pump 56 which is connected to the household drain by a flexible conduit 57. The pump 56 is energized at suitable times to drain the dirty wash and rinse water from the machine and is continuously energized during the drying cycle.

It will be noted that the discharge hose 55 is connected to sump 27 at a higher level than the wash water inlet or fill line 26. Specifically, the wash water line 26 is connected to the sump adjacent its bottom and the discharge hose 55 is connected thereto above fill line 26, but below the outlet of the tub into the sump. Thus, throughout the entire operation of the machine, even when the drain pump is running, as during the drain periods of the wash cycle and during the drying cycle, a liquid pool or seal is maintained over the end of fill line 26. This prevents the blowing out of suds through the line 26 and the funnel 25 if an over-suds condition occurs during the washing operation and also prevents the escape of steam through line 26 during the drying operation. Further, if the door should be briefly opened during the drying operation so that cool air enters the machine, the pool in the sump will prevent the escape of air through the fill line 26 if it expands. This avoids the introduction of a relatively large quantity of moist air to the interior of the cabinet. As will be further noted, when the pump 56 is operating during the drying operation, it has a discharge capacity sufficient to maintain the water level in the sump at the edge of tube 55 and thus, no complete water drain from the bottom of the tub and air may readily pass from the tub into the lower end of condenser conduit 44. Upon stopping the operation of pump 56 during the drying cycle, however, water immediately seals the outlet of the tub and rises into the lower end of conduit 44, as hereinafter explained. Any air trapped under this condition, then bleeds outwards through trap element 31.

With the foregoing in mind, reference now is made to
Fig. 2 showing one form of condenser spray means for use in the invention. Mounted in the side of condenser conduit 44 and preferably axially inclined with respect thereto i.e., at an acute angle thereto, is an open ended tube 68 axially aligned with respect to a nozzle 61. This nozzle may conveniently be held in a bracket 62 on the side of the conduit 55 generally spaced from the open end of the tube to provide an air gap 63. At its lower end the tube is normally closed; this is effected in this instance by a spreader plate 64 having rods 65 attached thereto and extending through brackets 66 disposed on the interior of the tube. Compression springs 67 are mounted between the ends of those rods and the brackets and serve to bias the spreader plate toward closed position.

As seen in Fig. 1, nozzle 61 is connected to suitable water supply means, such as the end of a condensing, or second, water line 68 which is under control of a valve actuated by a solenoid 69. This solenoid, in turn, is energized by the sequence control during the drying operation so that the valve controlled by it passes water at a slow rate sufficient to form a spray curtain within the condenser conduit 44 for condensing the moisture extracted from the clothes and being carried toward blower 41 by the moving stream of hot air.

The condensing water line 68 is connected at its upper end to the cold water line of the machine for flow whenever solenoid 69 is actuated to opening position. Upon opening of the valve controlled by solenoid 69, condensing water under line pressure is supplied to nozzle 61, passes through air gap 63 and strikes spreader plate 64 which is such that it may open that plate against the action of springs 67 and to disperse itself as a curtain of cold water across the entire cross section of conduit 44. Upon striking the walls of that conduit, it, of course, then runs downward as a sheet of water and is collected in sump 27 and withdrawn by pump 56 when that pump is operating. Since this action occurs only during the drying operation, moist, hot air is meanwhile being drawn from the clothes in the rotating basket, passing through the bottom of tub 3 into sump 27 and thence through the curtain of cold water spray back into blower 41 and thence over the heaters and back into the basket. During its passage through the curtain the moisture in this air is condensed and that condensate, together with bits of lint carried from the clothes, are precipitated and fall back into the tub 3. Immediately upon cessation of flow of the condensing water from nozzle 61, or upon the building up of a substantial superatmospheric pressure in tub 3 and conduit 44, the plate 64 closes, thus preventing passage of moist air into the interior of the appearance cabinet through air gap 63. Moreover, should an over-suds condition have existed in the tub prior to start of operation of blower 43, such suds are unable to escape through air gap 63.

A second form of mechanically operable spray means is shown in Fig. 3 and comprises an open ended tube 71 spaced from the nozzle 61 by the air gap 63. In this form, a flat spreader plate 72 pivotally mounted upon a bracket 73 supported by tube 71 is suitably positioned and biased into closing position by gravity. The end of tube 71 also is cut upon a slant to provide a closed seat for the plate when in closed position. Upon passage of condensing water from nozzle 61 the plate 72 swings into open position and serves to spread the incoming cold water as a curtain S across the conduit 44.

Fig. 4 represents a third form of spray means having no movable parts and depending upon a water seal to close off communication through the air gap 63. This form of spray means comprises an open ended tube 80, the lower end of which terminates adjacent a stationary spreader plate 81 which forms a pocket affixed to the wall of conduit 44 with a small open space 82 between the end of the tube and the plate. Water upon striking plate 82 is splashed as a spray S across the entire section of the conduit 44. When the water is shut off from nozzle 61, the water draining down the wall of conduit 44 toward sump 27 fills the pocket formed by plate 81 to the level 83, thus forming a water seal preventing escape of any moist air from the tub outwardly of air gap 63. When water is again supplied from nozzle 61, it strikes with enough force to break the water seal and thus spray across conduit 44 again.

From the above it will be seen that I have provided a simple and effective spray condenser which may be used upon a laundry machine, either of the type comprising solely a clothes dryer, or of the type comprising both a washer and a dryer. The condensing spray apparatus is self-protecting, being designed to respond to cessation of flow to preclude moist air or suds from backing up through it.

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 therein without departing from my invention, and I, therefore, aim, in the appended claims, to cover all such changes and modifications as fall within the true spirit and scope of my invention. What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a laundry machine having a drying cycle, a clothes container, a blower having its outlet communicating with said container, said container having an outlet, a generally vertically extending conduit connecting said container outlet and said blower, said container, said blower and said conduit connected to form a closed air system during the drying cycle of said machine, heating means in said system outside said container for heating the air in said system; and means for supplying condensing water into said conduit intermediate said heating means and said container outlet comprising an open end tube extending into said conduit, a nozzle outside said conduit substantially aligned with said tube and spaced by an air gap therefrom, and water spreading means inside said conduit adjacent the end of said tube, said water spreading means forming a pocket with said conduit, the top of said pocket being at least as elevated as the top of the open end of said tube, and means for causing water to pass from said nozzle into said tube against said water spreading means whereby said water is spread into a spray curtain in said conduit, said water dripping down the walls of said conduit into said pocket after cessation of water flow from said water supply means so as to cover the open end of said tube.

2. The apparatus defined in claim 1 wherein said open end tube extends into said conduit downwardly at an acute angle thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Applicant</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,864,175</td>
<td>Weitzl</td>
<td>July 21, 1931</td>
</tr>
<tr>
<td>2,607,209</td>
<td>Constantine</td>
<td>Aug. 19, 1951</td>
</tr>
<tr>
<td>2,628,866</td>
<td>Mitchell</td>
<td>Feb. 17, 1953</td>
</tr>
<tr>
<td>2,714,531</td>
<td>Kromer</td>
<td>Aug. 2, 1955</td>
</tr>
</tbody>
</table>