March 13, 1956 J A. ENGEL 2,737,729

DRYERS

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FIG. 1.

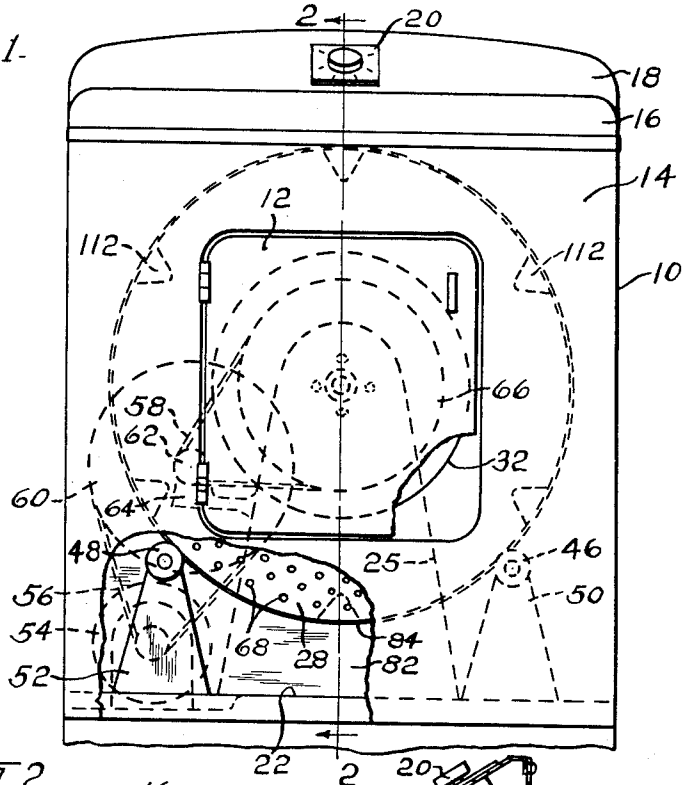


FIG. 2.

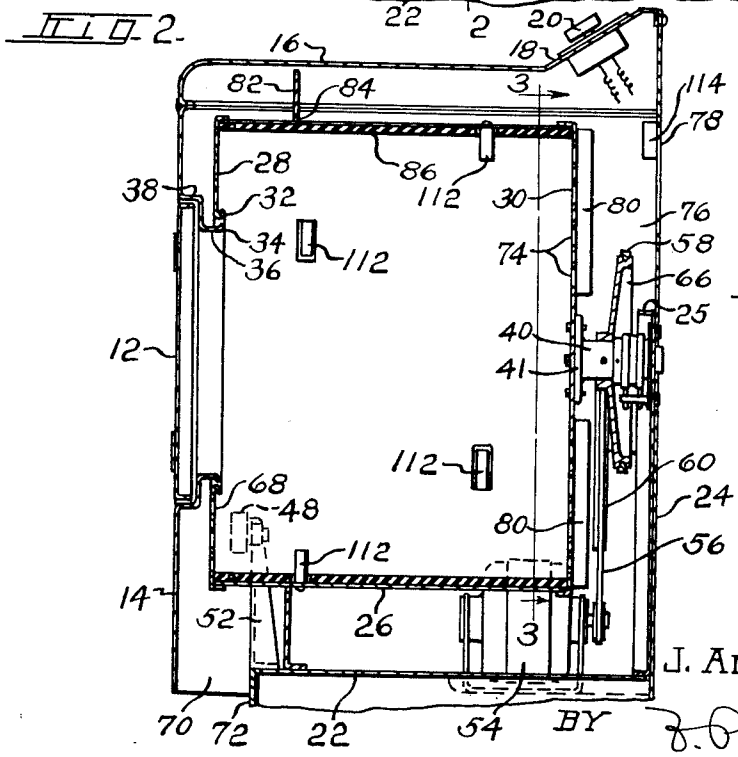
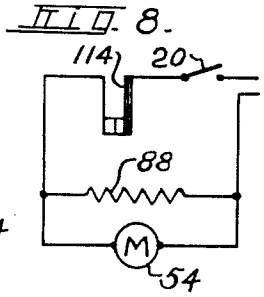


FIG. 8.



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FIG. 3.

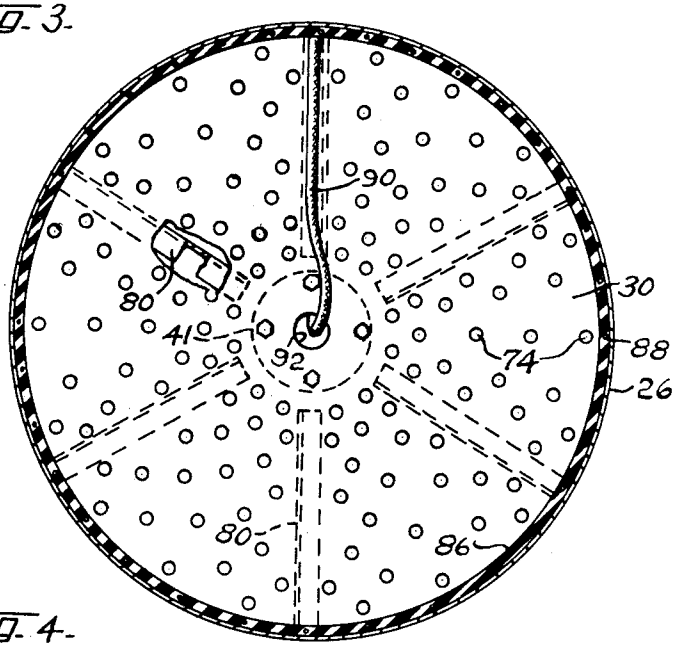


FIG. 4.

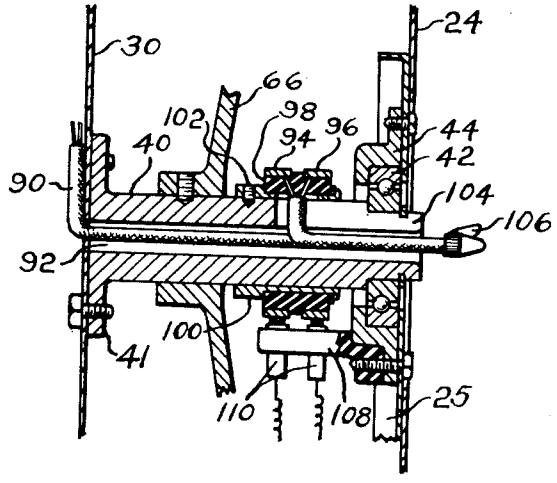


FIG. 5.

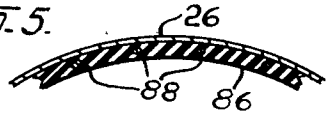


FIG. 7.



FIG. 6.



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2,737,729

DRYERS

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Application May 12, 1951, Serial No. 226,031

3 Claims. (Cl. 34—133)

This invention relates to laundry apparatus, and more particularly to dryers.

In commonly known dryers, there is generally provided a tumbling drum in the form of a perforate basket, and a relatively concentrated stationary source of heat radiation at an elevated temperature, together with power means for circulating heated air through the basket during tumbling of laundry contained within the drum. Such apparatus discharges into the atmosphere large amounts of humid air at an elevated temperature. The sources of radiant heat operate at temperatures sufficiently high to constitute a fire hazard, because of the presence of lint produced by the tumbling action. The discharge of considerable quantities of air at an elevated temperature represents a considerable loss of heat over and above that necessary to evaporate moisture from damp laundry contained in the basket, and necessarily creates a heated damp, humid atmosphere indoors where such apparatus is normally employed.

The present invention is directed to a laundry dryer in which substantially the entire drum is directly heated to a relatively low temperature, affording direct radiant heating as well as contact heating of laundry tumbled in the drum. The invention further contemplates the circulation of room temperature air through the dryer without the addition of heat thereto except as may be imparted to such air by its passage through tumbling clothes subjected to the low temperature radiation and contact drying referred to. Thus, the air discharged from such apparatus, while elevated in moisture content by reason of its passage through damp laundry heated by low temperature radiant heat, has a relatively slight temperature increase. The rate of circulating air through the tumbling laundry is relatively low, and may be dependent in large part by natural convection so that air does not circulate through the apparatus at such a rate as to result in an unnecessarily large heat loss.

It is accordingly an object of the present invention to provide a dryer wherein the source of heat is substantially the entire drum surface maintained at a relatively low temperature.

A further object of the invention is to provide a dryer wherein the source of heat is substantially the entire drum surface, and in which such surface is composed of wettable material having an affinity for drawing moisture from damp laundry contacting such surface.

Another object of the invention is to provide a dryer wherein the entire drum acts as a source of drying heat, and in which evaporated moisture within the drum is removed by slowly moving air streams passing through the drum.

Still another object of the invention is to provide a dryer in which all temperatures are maintained low, during evaporation, and in which the temperature rise in the air discharging therefrom due to reduced evaporation, is utilized to terminate the drying cycle.

A further object of the invention is the provision of drying apparatus in which the temperature of all parts

throughout the cycle is maintained at a relatively safe level by reason of the utilization of extended radiating and drying surfaces uniformly but moderately heated.

A still further object of the invention is the provision of a safe, simple, economical drying apparatus capable of effective drying without elevating the temperature of the surrounding atmosphere unduly.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description when taken in conjunction with the accompanying drawings. It is expressly understood that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein like reference characters indicate like parts:

Figure 1 is a front elevation of a dryer with cabinet portions broken away to illustrate the general arrangement of the parts;

Figure 2 is a vertical section taken substantially on the line 2—2 of Figure 1;

Figure 3 is a section taken substantially on the line 3—3 of Figure 2, through the drum;

Figure 4 is an enlarged fragmentary sectional detail of the bearing mount for the tumbling drum and the electrical connections associated therewith;

Figure 5 is an enlarged fragmentary sectional view of the drum showing one form of heat liner therefor;

Figure 6 is a similar enlarged fragmentary section of the drum showing the heating elements positioned exterior of the drum;

Figure 7 is an alternative fragmentary sectional view of a drum composed of plastic; and

Figure 8 is a control circuit diagram.

Referring to Figures 1 and 2 of the drawings, there is shown a cabinet 10 having an access door 12 in the front wall 14 thereof, a top deck 16, and control panel 18 having a manual control 20. Within the cabinet is an elevated deck 22 extending forwardly from the rear wall 24 to a point short of the front wall 14 of the cabinet. Mounted for rotation within the cabinet is a substantially cylindrical drum 26, the same having an annular front wall 28 and a rear wall 30. The front wall is provided with a circular opening 32 into which projects a stationary door frame flange 34 having a circular portion 36 and rectangular portion 38, the latter forming a flush recess for the door 12. The drum is supported for rotation rearwardly thereof upon a stub shaft 40 journaled in a bearing 42 affixed by an annular Z-section member 44 to the back panel 24 and flanged reinforcing brace 25. Such stub shaft is affixed to the rear wall of the drum by a flange 41. The forward end of the drum is supported on a pair of spaced rollers 46 and 48 rolling on the exterior of the drum 26, such rollers being supported on brackets 50 and 52 projecting upward from the forward edge of the floor or deck 22.

The drum is adapted to be rotated at a tumbling speed by a motor 54 mounted on the deck 22, such motor driving the drum through reduction belt drives 56 and 58. The belt drive 56 drives large and small idler pulleys 60 and 62, respectively, journaled on an idler shaft (not shown) supported from a bracket 64, and the belt drive 58 in turn drives a pulley 66 mounted on the stub shaft 40.

The forward annular wall 28 of the drum is provided with a multiplicity of ventilating apertures 68 adapted to permit air to enter the drum from the space 70 between the lower portion of the front wall 14 and the forward end 72 of the deck 22. The rear wall 30 of the drum is similarly provided with a multiplicity of apertures 74 adapted to permit outward flow of air from the drum into the space 76 therebehind, when such air may escape

through the back panel through any suitable large aperture such as 78. Radial angle irons 80 are applied to the back wall 30 of the drum and act as a modified fan gently assisting the flow of air from within the drum outwardly through the apertures 74 into the space 76 behind the drum.

The casing is divided fore and aft by a partition 82 having a large aperture 84 therein closely conforming to the exterior cylindrical surface of the drum 26. Such partition effectively prevents air from bypassing from the forward end of the casing to the rear thereof, so that air entering at the space 70 necessarily must flow through the drum, discharging at the rear thereof into the space 76, thence discharging through the back panel aperture 78. Air surrounding the drum and within the cabinet, by reason of such partition, constitutes a substantially dead air space, tending to minimize exterior heat losses from the drum.

In order to subject tumbling clothes within the drum to radiant heat effective to evaporate moisture therefrom, the entire internal surface of the drum is covered with a heat blanket which may be of plastic, rubber, or rubber-like material. Such blanket has imbedded therein resistance heating conductors which will be effective to maintain such blanket at a temperature preferably not exceeding 200° to 250° F. Such blanket is shown in Figure 2 at 86, and in Figure 5, the imbedded resistance conductors are shown as at 88. Electrical connections are made to such resistance conductors through a lead cable 90 extending into an axial bore 92 in the stub shaft 40, such conductors being connected to spaced slip rings 94 and 96 mounted upon an annular resistance block 98 secured to the shaft 40 by a supporting sleeve 100 and set screw 102. To facilitate the making of connections and the assembly of the parts, the shaft 40 may be provided with a slot 104 extending to the rearward end thereof and the leads brought out rearwardly of the end of the shaft to facilitate connections as at 106. A stationary brush holding block 108 is provided mounted upon the annular bearing support ring 44 and suitable brushes 110, contacting the slip rings 94 and 96, are provided. The electrical connections are preferably such that the resistance conductors and drive motor 54 will be energized simultaneously and are controlled by the control 20 which may have a timing mechanism for establishing a maximum drying period, as modified by a thermostatic control 114 as will hereinafter be referred to.

The heating effect of the resistance conductors will be such as to at no time create a temperature in the blanket sufficiently high to damage laundry contained within the drum, and by providing for heating only at such times as the motor is operating, a satisfactory margin of safety is provided. The drum may be provided with a plurality of rounded triangular vanes 112 arranged in staggered relation to facilitate tumbling and to assure the lifting of garments and clothing to a relatively high point within the drum whereby maximum drying effect may be had throughout the entire load while being tumbled.

The tumbling speed will be below that which would cause laundry contained within the drum to adhere to the drum as by centrifugal force, and it will be seen that but a relatively small amount of power will be required to drive the drum. In practice, while the blanket has been shown in Figures 2 and 5 as positioned internally of the drum shell 26, it will be appreciated that the blanket may be positioned exteriorly of the drum as shown in Figure 6, or the entire drum may be formed of a plastic with resistance conductors imbedded therein as is shown in Figure 7. The exterior surface of the drum, for example, in the arrangement shown in Figures 2 and 5, will preferably be polished so as to minimize radiation losses exteriorly of the drum, and the internal surface of the blanket will be such as to afford maximum internal radiation from such blanket. If desired, the drum may be merely an imperforate metal shell, heated by an extended arcuate low temperature stationary blanket type heater arranged externally of and closely adjacent to the drum, whereby to efficiently transfer heat to the drum surface.

From the foregoing description, the operation of the apparatus will be readily understood. Laundry tumbled within the drum will be subjected to heat radiation from the cylindrical drum wall whereby moisture will be caused to evaporate from such laundry. Also, as the damp clothes are tumbled against the blanket or internal wall, moisture will be transferred to the wall and evaporated by the heat. Where the blanket is of rubber or rubber-like composition, or other material having a surface affinity for water, so as to be wetted by contact of damp clothes, such water as is thus transferred will be promptly evaporated into the atmosphere. At the same time, air is allowed to enter into the space 70 inside the front panel wall and pass through the drum, entering through the apertures 68 in the forward wall 28 and escaping through the apertures 74 in the rear wall 30. The air, in passing through the drum, will pick up moisture from the evaporation effected within the drum, and will become slightly heated by contact with the tumbling laundry and by the radiant effect of the blanket. Convection will provide a natural flow from front to rear into the rear cabinet space 76, exhausting through the aperture 78 in the back panel. Moderate flow is assisted by the angle vanes 80 disposed upon the rear wall 30 of the drum. By the arrangement thus provided, the flow of air through the drum will be at a relatively low rate, and the rate will to some extent depend upon the degree to which air within the drum becomes heated by contact with the tumbling laundry, heated vapor, and the radiant heat. Thus, the rate of flow will tend to balance itself, increasing as the temperature rises and decreasing as the temperature lowers. The flow, however, will constantly remove air which has picked up moisture from the drying clothes. The arrangement is such that a high degree of efficiency results, since little radiant heat is lost exteriorly of the drum and radiation internally thereof directly concentrates upon the laundry contained within the drum. The drying effect is in part the result of the low temperature radiation referred to, as well as by tumbling and wiping contact of the damp laundry with the drum shell. The heat losses from the apparatus are limited to such exterior radiation and such temperature increase as may be present in air exhausting from the apparatus, but since the quantity of air passing through the apparatus is held to a minimum, the over-all efficiency of the apparatus is high. Thus, the heating current required to maintain the drum surface at a proper temperature will be considerably lower than in such machines wherein stationary heating units are used for radiation acting indirectly upon laundry tumbled in the perforate drum, and in which such heating units are utilized to pre-heat air driven through the drum for drying purposes in large quantities.

In practice, a thermostat 114 located adjacent the rear discharge opening 78 and in circuit with the time control 20, heating unit and motor will, act to cut the power off when the temperature commences to rise above a limit, which may be set at 200° or thereabouts. As the drying commences, the temperature within the drum rises to 150° to 180°, but is held against any rapid rise by the evaporating moisture. As the clothes approach a dry condition, due to a sharp decrease in evaporation, the temperature rapidly rises, serving to indicate through the thermostat completion of the drying cycle. When such a temperature is reached, the thermostat opens the circuit.

While the tumbling drum has been disclosed as having perforate forward and rear walls, for the free flow of air through the drum, it will be seen that the drying principle may be applied to any solid cylinder type washing machine as a final drying step, following centrifuging. In such an arrangement, the cylinder will be heated in the manner disclosed, but the forward and rear walls will be substantially imperforate; and the air with-

in the drum will be changed at a gradual rate, by passing air into and out of the drum through the same passages as wash water is introduced and drained from the drum, a blower being used to overcome impedance to flow resulting from constricted passages. In particular, the drying principle may be applied to solid cylinder washers of the general type disclosed in applications Serial No. 54,956, filed October 16, 1948, now Patent No. 2,575,335, Serial No. 787,445, filed November 21, 1947, now Patent No. 2,586,794, and Serial No. 775,237, filed September 20, 1947, now Patent 2,637,189.

While a single form of the invention, with suggested variations, has been illustrated and described, it is to be understood that the invention is not limited thereto. As various changes in the construction and arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A laundry dryer comprising, in combination, a rotatable drum, said drum having a substantially cylindrical imperforate outer wall, a perforate back wall, and an annular perforate front wall defining a circular access opening, means mounting said drum for rotation on a substantially horizontal axis including means for rotating said drum at a tumbling speed, plastic means applied to substantially the entire internal area of said cylindrical imperforate wall, electrical means imbedded therein for uniformly heating said plastic means to a temperature in the range of 150–200° F., and means rotatable with the drum for inducing substantially axial flow of air therethrough.

2. A laundry dryer comprising, in combination, a rotatable drum, said drum having a substantially cylindrical imperforate outer wall, a perforate back wall, and an annular perforate front wall defining a circular access opening, a cabinet for said drum having a door communicating with said access opening, means within said cabinet mounting said drum for rotation on a substantially horizontal axis including means for rotating said drum at a tumbling speed, substantially uniformly thick plastic means applied to substantially the entire internal area of

said cylindrical imperforate wall, electrical means embedded in said plastic means for uniformly heating substantially the entire area of said cylindrical imperforate internal wall to a temperature in the range of 150° to 200° F., and means rotatable with the drum at drum speed for inducing substantially axial flow of air therethrough, and an air inlet at the front of said cabinet, and an air outlet at the rear of said cabinet, elevated with respect to said inlet.

3. A laundry dryer comprising, in combination, a rotatable drum, said drum having a substantially cylindrical imperforate outer wall, a perforate back wall, and an annular perforate front wall defining a circular access opening, means mounting said drum for rotation on a substantially horizontal axis including means for rotating said drum at a tumbling speed, and inwardly projecting rounded axially thin triangular members mounted in spaced and staggered relation on said cylindrical wall, substantially uniformly thick plastic means applied to substantially the entire internal area of said cylindrical imperforate wall means for uniformly heating substantially the entire area of said cylindrical imperforate internal wall, and means rotatable with the drum at drum speed for inducing substantially axial flow of air therethrough.

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