April 19, 1955 T. R. SMITH 2,706,346

WATER SPRAY CONDENSER FOR CLOTHES DRIERS

Filed Feb. 23, 1952 3 Sheets-Sheet 1

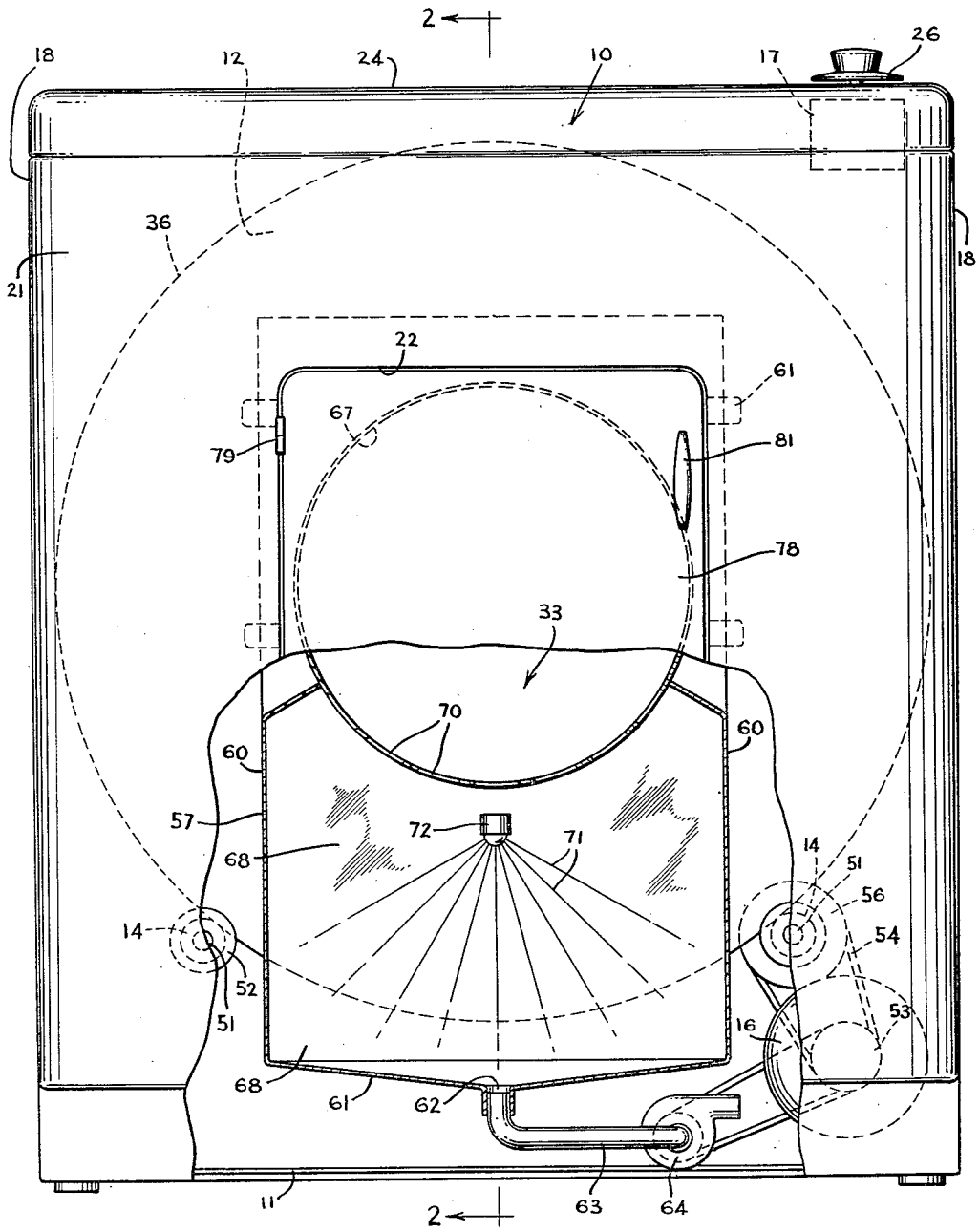

FIG. 1

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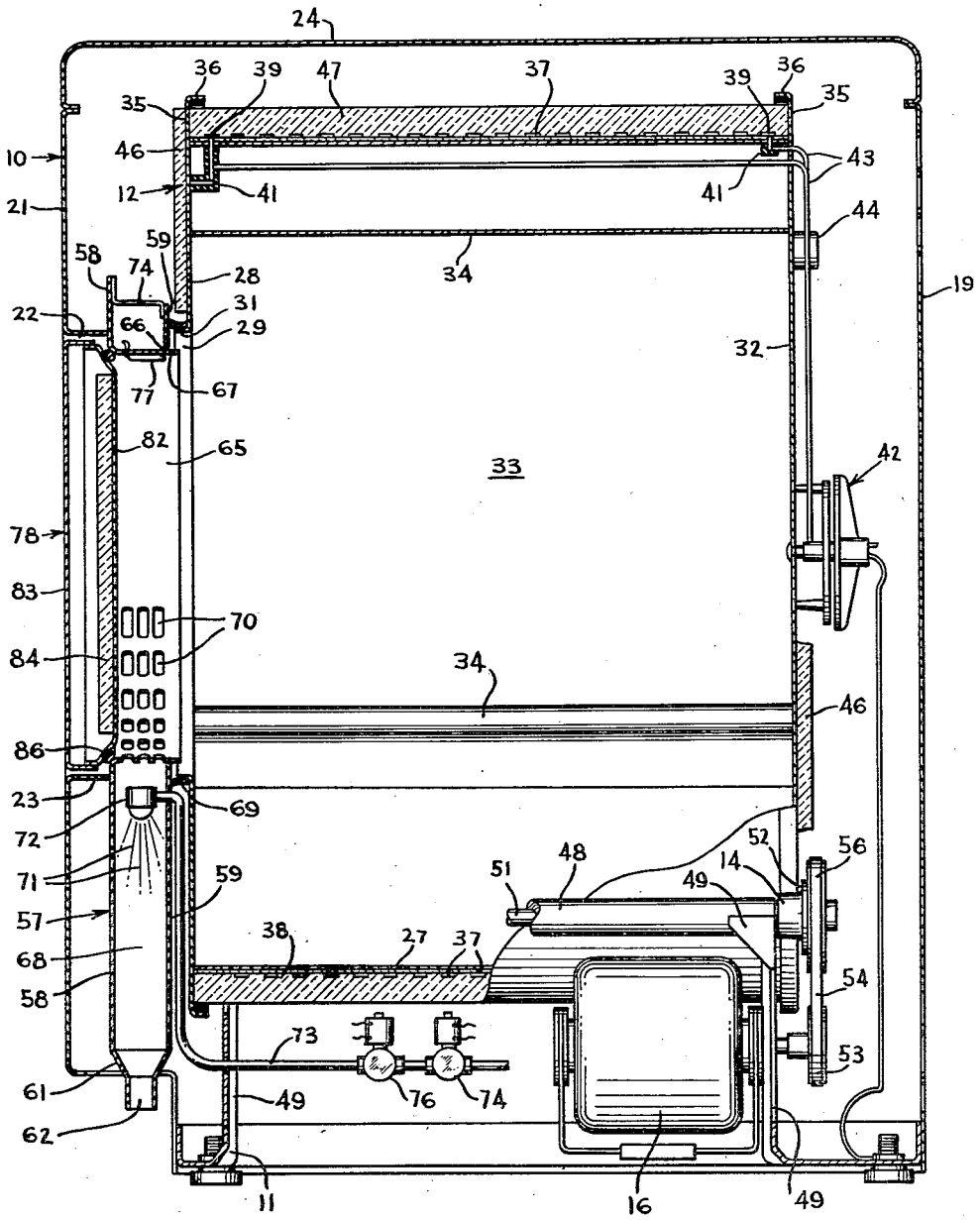

FIG. 2

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WATER SPRAY CONDENSER FOR CLOTHES DRIERS

Filed Feb. 23, 1952 3 Sheets-Sheet 3

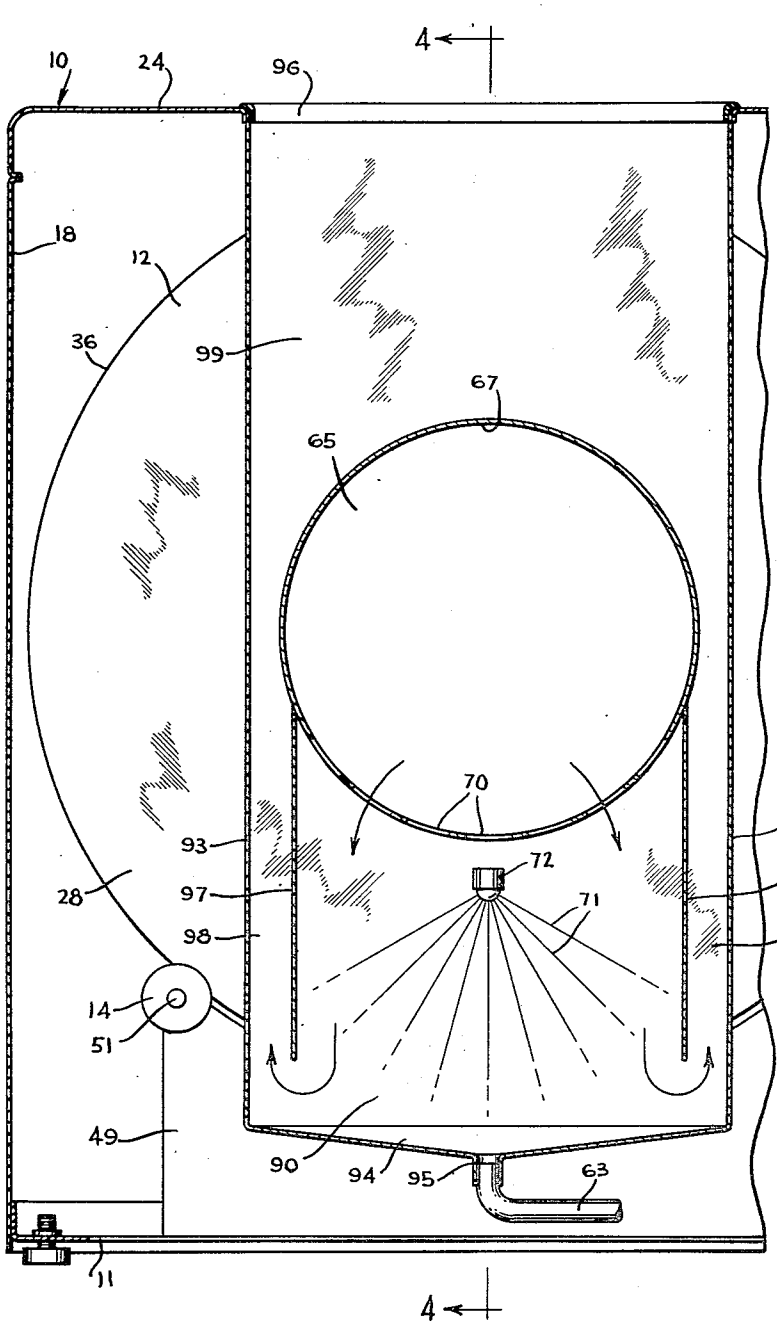

FIG. 3

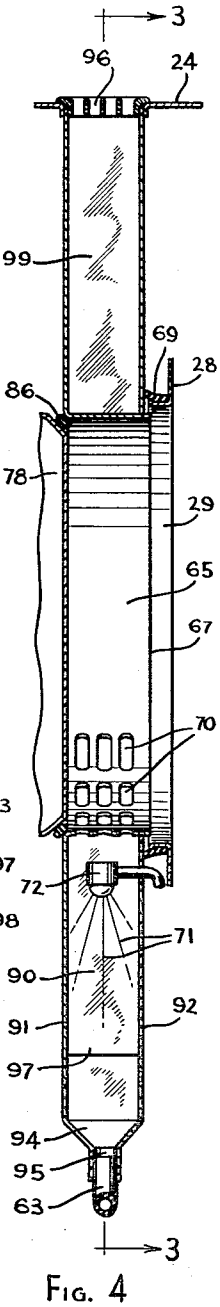

FIG. 4

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WATER SPRAY CONDENSER FOR CLOTHES DRIERS

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3 Claims. (Cl. 34—75)

The invention relates to clothes driers and more particularly to tumbler type clothes driers wherein the clothes to be dried are tumbled in a heated substantially imperforate, horizontally rotatable drum.

In the usual type clothes driers using perforate drums, spaced enclosures therefor, ducts for conducting the air and circulating fans, there is a tendency for lint to collect between the drum and enclosure and in the ducts which may eventually clog the same, and should lint collect near the heating element, a fire hazard is presented. If the lint is ignited, the fire could readily spread through the entire assembly and surrounding area.

In accordance with the invention, a substantially imperforate drum defining a drying chamber has a single access opening in alignment with a similar opening in a surrounding cabinet or casing through which the fabrics to be dried are inserted and removed and the heat for drying the fabrics is radiated into the drying chamber through an imperforate wall of the drum. During the drying operation the access opening in the casing is sealed by a closure or door and the outer periphery of the access opening in the drum is sealed against the ambient atmosphere; however, the drum is in direct communication with a vertically extending condensing chamber or duct. The vapor evaporated from the fabrics and the lint leaving the drying chamber passes into the condensing chamber wherein a water spray under any suitable control condenses the vapor and wets the lint by direct contact. The water, condensed vapor and lint then pass into or through any suitable conduit for discharge to drain. Since the water spray condenses the vapor, a general flow of vapor in the direction of the spray is created; therefore, any normal leakage around the seal about the access opening in the drum will tend to be inward. Thus, this not only tends to eliminate the problem of vapor escaping into the casing with the possibility of corrosion of the parts, but at the same time restricts the movement of the lint in this direction.

A construction of this type not only eliminates the fire hazard by preventing contact of lint with the heating element, but at the same time it eliminates the use of air circulating fans, duct work therefor and lint traps that are both bothersome and awkward to handle. Also, the operator has a tendency to forget to clean the lint trap which, when clogged, tends to reduce the efficiency of the drier and increase the fire hazard.

Accordingly, it is an object of the invention to provide an improved clothes drier which eliminates the necessity of air circulating fans, special duct work therefor requored for inducing the circulation of heated air through the tumbling apparatus and lint trap, and to provide a single chamber with a vapor condensing liquid spray therein to dispose of the vapor normally discharged into the ambient atmosphere.

It is another object of the invention to provide a horizontally mounted tumbler type clothes drier with a single access opening which directs the lint leaving the opening into the condenser and it passes along with the water and condensed vapor to drain.

It is another object of the invention to provide a tumbler type clothes drier having a single access opening with a vented liquid contact vapor condenser which acts to aid in the control of the flow of the vapor from the drying chamber during its operation.

Other objects, features, capabilities and advantages are comprehended by the invention as will later appear and as are inherently possessed thereby.

Referring to the drawings:

Figure 1 is a diagrammatic front plan view with portions in section of a tumbler type clothes drier showing the improved condensing chamber applied thereto;

Figure 2 is a partial vertical longitudinal sectional view of the clothes drier taken along the line 2—2 of Figure 1 and showing the improved vapor condenser;

Figure 3 is a diagrammatic partial vertical transverse sectional view similar to Figure 1 but showing a modified form of vapor condenser with venting means therefor; and,

Figure 4 is a vertical longitudinal sectional view of the vapor condenser and vent taken on the line 4—4 of Figure 3.

Referring now more in detail to the drawings for one form of clothes drier embodying the features of the present invention, there is shown an outer cabinet **10** secured to a base or frame structure **11** for completely enclosing the operating parts of the clothes drier. The base **11** further provides a support for a hollow clothes receiving rotatable tumbler or drum **12** mounted for rotation about a horizontal axis within a cradle formed by four spaced hard rubber rollers **14**, and rotated by means of a pivotally mounted electric drive motor **16** in a manner to be hereinafter more fully described. Suitable control mechanism **17**, the details of which are not shown, may be included in the assembly for automatically controlling the operation of the drying cycle.

The cabinet **10** has its main body portion formed with side panels **18**, a louvered back panel **19** for permitting flow of cooling air about the drive motor **16**, a front panel **21**, having a substantially centrally located square access opening **22** therein with an inwardly directed flange or skirt portion **23** disposed about the horizontal axis of the drum **12** whereby the operator may gain access to the interior of the drum, and a top panel **24** to provide a substantially rectangular unitary structure. The top panel **24** is preferably formed with an opening adjacent one of the front corners through which an upwardly projecting control shaft having a control knob **26** thereon is adapted to be grasped by the operator for manipulation to effect automatic operation of the drier.

The horizontally mounted drum or tumbler **12** within the casing **10** includes an imperforate cylindrical wall **27** disposed between a vertical front wall or header **28**, having a single centrally located axis opening **29** with an outwardly directed cylindrical flange **31** facing the opening **22** in the front panel **21**, and a vertical imperforate rear wall or header **32** spaced in parallel relation to the front wall. All three elements are welded or secured together, in any suitable manner, to form a unitary rigid structure to define a drying chamber **33** therein. A plurality of parallel, horizontal and radially inwardly directed clothes lifting ribs or elevating vanes **34** are secured to the inner periphery of the cylindrical wall **27** in any suitable manner. Each wall has identical flange portions **35** extending radially outward beyond the outer periphery of the cylindrical wall **27** which are rolled or formed with flat horizontal cylindrical supporting surfaces or ribs **36**, adapted to rest on the rollers **14** to provide the sole supporting means for holding the drum in its horizontal position.

In order to evaporate the moisture in the clothing within the drum, heat must be supplied thereto. One such means for heating the drum is shown in the form of an electrical heating element **37** formed by a single, flat, long, thin and relatively wide strip of stainless steel tightly wound in an open spiral over a thin layer of electrical insulation **38** to cover substantially the entire outer periphery of the imperforate cylindrical wall **27**, and the opposite or free ends **39** of the heating element are secured to suitable terminal posts **41** disposed in the recess provided in one of the vanes **34**. A heating element of this type uniformly heats the entire periphery of the drum, which, of course, heats the clothing in the drying chamber **33** to drive off the moisutre or a high percentage thereof, and the overall temperature of the entire heating element is reduced considerably.

The means for energizing the heating element includes a collector ring assembly **42**, having the usual brushes and slip rings, mounted on the rear wall **32** of the drum in any

suitable manner and it is connected to a source of electrical energy and to conductors **43** leading to the terminal ends of the heating element **37**. One of the conductors **43** may be connected in series with a temperature responsive thermostat or limit switch **44** secured to the rear wall **32** of the drum which acts to deenergize the heating element whenever the temperature within the drying chamber **33** reaches or tends to exceed a predetermined safe value.

To improve the efficiency of the drier, insulating pads **46** are attached to the outer surface of the front and rear walls **28** and **32**, and a layer of thermal insulation **47** of any suitable dielectric type is wrapped about the outer periphery of the heating element **37** to totally enclose the same. Therefore, any lint shaken off the clothing during the drying operation which may enter the interior of the casing **10** cannot accumulate on the heating element; thus an additional fire hazard is eliminated.

In order to support the rotatable drum in its horizontal position, a pair of parallel horizontally spaced tubular bridging members **48** are disposed parallel with the drum and rigidly secured to the upper outer ends of oppositely disposed webs **49** to provide a relatively simple rigid supporting structure, and each tubular member **48** journals a horizontal shaft **51** with outwardly projecting ends to which the supporting rollers **14** are secured in any suitable manner. In addition, each supporting roller **14** has its outermost end provided with a radial projecting flange **52** to constitute a thrust collar or surface extending inwardly adjacent the rims **36** on both of the end walls and are relatively closely spaced thereto in such manner as to limit axially shifting movement of the drum when it is rotated about its horizontal axis.

The drive motor **16** has a driving pulley **53** secured thereto and is flexibly mounted for rotation on an axis parallel to the drum axis, and is connected by means of a belt **54** to a driven pulley **56** rigidly secured to a projecting end of one of the horizontal supporting shafts **51** adjacent one of the rollers **14**. When the motor is energized, the driven pulley **56** rotates one of the shafts **51** and the friction between the engaging portions of the rollers **14** and rims **36** causes the drum **12** to rotate about its horizontal axis at a considerable speed reduction; i. e., 34 and 50 r. p. m., while the opposite shaft carrying its pair of rollers merely acts as a rolling support.

Referring now more particularly to Figure 2, it can be seen that the front header or wall **28** on the drum **12** is spaced from the front wall or panel **21** of the cabinet **10** to provide room for receiving a vertically extending substantially rectangular box-shaped duct or condenser construction **57**. This condenser construction comprises front and rear walls **58** and **59**, respectively, a pair of side walls **60** and a lower end wall **61** having a discharge opening **62** which is directly connected to a conduit **63** leading to a liquid pump **64** for conducting the liquid to any suitable drain opening. The condenser **57** may be secured to the casing by an upward extension of the front wall **58** through lateral bracket or wing means **61** formed on the inturned flange **23** about the access opening **22**. In addition, the upper portion of the condenser construction is formed with a relatively short horizontal cylindrical passage **65** of approximately the same size as the access opening **31** in the drum, and is in alignment therewith and the opening **22** in the front wall **21** of the cabinet.

The horizontal cylindrical passage **65** may be formed in any suitable manner, such as, for example, by cutting an opening **66** in an upwardly extending portion of the back or rear wall **59** of the condenser **57** and punching or pressing a similar opening in its front wall **58**, with a drawn cylindrical portion or collar **67** extending toward and overlapping a portion of the outwardly directed flange **31** about the access opening **29** in the front wall **28** of the rotatable drum. The lower sector of the cylindrical collar **67** provides the upper end wall of the condenser and the side walls **60** are directed inwardly below the axis of the drum to engage the outer periphery of the collar to define the enclosed condensing chamber **68**. It is to be understood, of course, that the above is given by way of example and any suitable condenser and collar construction may be incorporated at this point.

The collar **67** defining the horizontal cylindrical passage **65** prevents articles of clothing from falling into the condensing chamber when they are being inserted or removed from the drying chamber **33**, and when the clothing is being tumbled during the drying operation. Also, the upper imperforate sector of the collar **67** prevents the escape of vapor and lint upwardly into the interior of the casing **10**. An annular ring of sealing material **69** is preferably clamped about the outer periphery of the outwardly projecting flange **31** with a forwardly projecting edge for engaging the rear wall **59** of the condenser **57** to provide a rotating seal to restrict the flow of vapor and lint into the interior of the cabinet **10**.

The lower portion or sector of the cylindrical collar **67** has a series of relatively large perforations or openings **70** which provide the means for permitting direct communication between the drying chamber **33** and the condensing chamber **68**. As the vapor and lint discharged from the drum pass through these perforations and enter the condensing chamber, they encounter a liquid contact spray **71**, whereat the vapor is condensed and the lint saturated by direct contact, to thus eliminate the possibility of having the vapor and lint discharged into the room or interior of the casing.

The liquid spray is provided by any suitable liquid atomizing means, and in the modification shown a nozzle **72** is located at the upper portion of the duct below the collar **67** and it preferably fans or spreads a constant volume of atomized water to cover the entire horizontal cross-sectional area of the condensing chamber **68** in a generally downwardly direction. In this manner, the possibility of having a portion of the spray splash into the drum **12** through the perforations **70** is eliminated. This downward direction of the spray **71** along with the condensing of the vapor tends to create a slight pressure drop in the condensing chamber with respect to the drying chamber, thus the circulation of the vapor discharged from the drum will be in the direction of the condensing chamber **68**. The nozzle **72** is supplied with water by means of a suitable conduit **73** connected to the usual cold water supply and the water flowing to the spray nozzle may be under the control of a solenoid controlled valve **74** which is responsive to the actuation of the control knob **26**. Suitable safety means (not shown) may be incorporated to shut off the supply of condensing liquid should the drive motor **16** fail and the pump **64** become inoperative for any reason.

With an arrangement of this type, the flow of water to the condensing chamber **68** will not occur until the drying operation is initiated and the solenoid valve **74** is energized to permit a constant flow of water to the nozzle **72** and the supply of water will continue as long as the drying operation lasts or the drum is rotated. As an additional feature, if desired, and in order to conserve the amount of water sprayed through the nozzle **72** during the warming-up period of the drum, when the heating element **37** is first energized, a thermostatically controlled valve **76**, under the control of a temperature responsive bulb **77** mounted in the passage **65**, may be placed in the conduit **73** to interrupt flow of liquid to the nozzle until the temperature of the interior of the drum reaches some predetermined high value equivalent to that where vaporization of the liquid in the clothing begins to take place. When this occurs the bulb **77** causes the thermostat to act to open the valve **76** to spray liquid into the condensing chamber and condense the vapor generated. As long as the temperature remains relatively high, the thermostat will hold the valve **76** open, and after the drying cycle is completed and the drum cools down, the thermostat will act to cut off the supply of liquid, even though the drum is still being rotated during the cooling down period. It is to be understood that either or both of the valves may be utilized.

In order to insure the proper direction of flow of the vapor and lint discharged from the drum, and to prevent the tumbling clothing from being thrown out of the aligned openings, the access opening **22** in the front panel **21** has mounted therein an imperforate closure or door **78**. This door is generally square in front plan and hinged at **79** to pivot about a vertical axis and is provided with the usual handle or grip device **81** to permit the operator to grasp the same to open or close the door at will. The door **78** is preferably constructed with inner and outer panels **82** and **83**, respectively, having their major portions separated to provide an insulating space and to enclose insulating material **84** on the inner portion of the inner panel **81**, and a rubber or other suitable gasket **86** is disposed adjacent the outer periphery of the inner panel **82** to contact the front wall **58** about the cylindrical passage **65**. In this manner, the inner

panel 82 will heat up at a relatively rapid rate and any vapor initially condensing thereon is restrained from flowing out of the front access opening 22 by means of the gasket 86. At the same time, the front or outer panel 83 is shielded from direct contact with the heated vapor and is therefore maintained at a much lower temperature, thus the danger of injury or annoyance to the operator is reduced considerably.

The operation of a tumbler type clothes drier of the type hereinabove described incorporating liquid spraying, vapor condensing and lint disposing features made in accordance with the present invention is as follows:

The operator opens the door 78 and inserts the damp clothing to be dried into the drying chamber 33 defined by the imperforate drum 12 and the door is closed. Next, the operator manipulates the control knob 26 to the setting corresponding to the desired condition of dryness. This manipulation energizes the drive motor 16 to rotate the drum 12 about its horiozntal axis and energizes the heating element 37 until the major portion of the moisture is removed from the clothing. At the same time, in the modification shown, the solenoid valve 74 is energized to condition the spray nozzle 72 for operation.

As the interior or drying chamber 33 in the drum is heated by means of the heating element 37, a portion of the moisture in the clothing is evaporated and, due to the rotation of the drum, the clothing is agitated or tumbled by the elevating vanes 34 in such manner as to uniformly heat the same.

When the temperature of the heated air and vapor reaches a predetermined high value, the thermostatically controlled valve 76 is energized to permit the flow of cold water under pressure to the nozzle 72. The nozzle discharges the water downwardly in a finely divided spray and covers the entire interior of the lower portion of the condensing chamber 68. As the vapor leaves the drum it passes through the access opening 29 into the passage 65 through the perforations 70 and enters the condensing chamber 68, comes in direct contact with the finely divided spray 71 and is condensed. This condensing of the vapor creates a slight pressure drop at this point and because the drying chamber 33 is imperforate elsewhere, the vapor must flow toward the spray. Since this action is continuous and the water spray condenses all of the vapor generated, there is little tendency for the vapor to escape around the seal 69 about the access opening 29 and if the condensing of the vapor is efficient the chamber 33 should be under a very slight subatmospheric pressure so that any tendency for leakage around the seal would be from the exterior to the interior of the drum.

The vapor passing through the perforations 70 carries with it a major portion of the light and fine airborne lint which is immediately saturated with water and falls to the bottom of the condenser while the heavier lint is thrown out of the access opening by the clothing onto the cylindrical collar 67. During the tumbling operation, from time to time, articles of clothing are momentarily partially thrown out of the access opening 29 and contact the collar 67 and this movement creates a wiping action which tends to work the heavier lint through the perforations.

It can be seen that any vapor contacting the inner panel 82 of the door 78 and condensing thereon will eventually pass or flow into the condensing chamber through the perforations because of the gasket seal 86 around the passage 65.

The water from the spray nozzle 72, the condensed vapor and the now water saturated lint all flow through the outlet 62 in the bottom of the condensing chamber 68 to the conduit 63 leading to the inlet of the pump 64 for discharge to a suitable drain opening.

When the major portion of the vapor is evaporated from the clothing, the temperature of the interior of the drum begins to rise and when it approaches a predetermined high value, the thermostat 44 in the drum is actuated to deenergize the heating element 37; however, the rotation of the drum is preferably continued for a predetermined length of time in order to reduce the temperature of the drum and the fabrics being dried. During this interval the liquid spray 71 is continued to condense any residual vapor and to aid in the cooling of the drum, and when the temperature of the drum reaches a predetermined low value, the thermostatically controlled valve 76 is actuated to cut off the supply of cold water to the nozzle 72. After the drying operation has been completed, rotation of the drum is stopped and the operator need but open the door 78 and remove the dried articles from the chamber 33. If the temperature in the drum has not been reduced to a sufficiently low value, the stopping of the drier or the opening of the door will automatically cut off the supply of water to the nozzle.

Referring now to Figures 3 and 4, there is shown a tumbler type clothes drier substantially identical in construction and operation to the previously described drier, with the exception that the condensing chamber 68 has been modified to provide a vapor vent. Since like parts are given like reference characters, detailed description of the general drier construction is not deemed necessary.

In this construction the access opening 29 in the front wall or header 28 of the drum encompasses the horizontal passage 65 with the enlarged perforations 70 in the lower portion thereof, and the double walled closure or door 78 carrying its gasket 86 seals about the outer end of the horizontal passage 65 in the usual manner. The perforations in the collar 67 provide for direct communication from the drying chamber 33 to a condensing chamber 90. This condensing chamber 90 comprises a vertical duct construction generally rectangular in horizontal cross section and includes vertical front and rear walls 91 and 92, respectively, end walls 93, a bottom wall 94, having a liquid discharge opening 95 therein, and an open top 96 in direct communication with the ambient atmosphere. The spray nozzle 72 is disposed in the condensing chamber below the perforated portion of the collar 65 to direct the atomized condensing water downwardly in the usual manner. Vertical members or baffles 97 are mounted in the condensing chamber adjacent each end wall 93 which extends across the width of the chamber and they have their upper ends joined to the outer periphery of the cylindrical collar 67 to provide a pair of relatively narrow open ended passages 98. The lower open ends of the passages 98 defined by the baffles 97 are disposed adjacent the lower end of the condensing chamber below the normal spray pattern and within the angle of spray to insure that the liquid spray covers the entire horizontal cross sectional area of the duct. The upper portion of the vertical passages 98 terminates in a common passage 99 at the upper portion of the duct which in turn is open to the ambient atmosphere at the opening 96.

With a construction of this type, it can be seen that the condensing chamber is vented to atmosphere at all times. Thus, during the drying operation, if for any reason the water spray is incapable of condensing all of the vapor being generated in the drying chamber, the excess vapor will enter at the lower ends of the passages 98, pass upwardly through the duct and be discharged directly into the ambient atmosphere. This arrangement obviates the possibility of having the vapor pressure increase to a value where it forces vapor past the rotating seal 69 into the interior of the cabinet wherein it will condense and may eventually corrode and damage portions of the drier. This vent is particularly important under conditions should the water supply fail or should there be times when it is necessary to operate the drier without the condensing water. While under the latter condition, the length of time required to dry the clothing may be increased somewhat, the vapor pressure generated will force the vapor out of the vent without endangering the interior of the cabinet.

With the exception of venting the condensing chamber, the operation and function of the vapor condensing clothes drier in this modification is identical to the previously described construction in all phases; therefore, a further description is not deemed necessary. While both modifications contemplate a water pump to dispose of the water, it is to be understood that if a suitable floor drain is available, the pump may be dispensed with and the outlet in the condenser may be directly connected to it.

From the foregoing it can be seen that a tumbler type clothes drier has been provided which provides a relatively simple means for disposing of the lint and condensing the vapor discharged from the drying chamber, and that with a construction of this type the possibility of having large lint accumulations about the drying chamber and the duct work is substantially eliminated,

along with the necessity of air motivating fans and the like.

While I have herein described and upon the drawings shown illustrative embodiments of the invention, it is to be understood that the invention is not limited thereto but may comprehend other constructions, arrangements of parts, details and features without departing from the spirit of the invention.

It is claimed:

1. In a drier for moist clothing the combination of a substantially imperforate drum for receiving the moist clothing, said drum being mounted for rotation about its horizontal axis and having a single access opening therein about said axis, means for rotating said drum, means for heating said drum to evaporate the moisture in said clothing, a condensing chamber below said access opening and in direct communication therewith for receiving the vapor and lint discharged from said drum through said opening, a liquid contact spray mounted in said chamber to condense the vapor and saturate the lint discharged from said drum by direct contact, means for conducting the liquid, condensed vapor and lint to drain, and an upwardly directed duct providing a vent for said condensing chamber, said duct having a lower inlet in communication with a lower portion of said condensing chamber and an upper externally opening outlet in direct communication with the ambient atmosphere to permit the escape of non-condensed media from the lower portion of said condensing chamber after said media passes through the liquid spray out of contact with the remainder of the drying apparatus.

2. In a drier for moist fabrics, the combination of a horizontally mounted rotatable drum having a single access opening therein and being imperforate elsewhere, means for rotating said drum, means for supplying heat to said drum to evaporate the moisture in said fabrics, a casing surrounding said drum and having an access opening in alignment with the access opening in said drum, a closure for the access opening in said casing, a horizontal passage between said access openings and in alignment therewith, said passage having an imperforate upper sector and a perforate lower sector, means for sealing the access opening in said drum about said passage, a condensing chamber disposed below said passage and in direct communication with the interior of said drum through said perforate sector, a nozzle for spraying liquid in the interior of said condensing chamber to condense the vapor and saturate the lint discharged from said drum into said condensing chamber by direct contact, and vent means including an upwardly extending duct encompasing said horizontal passage for connecting a lower portion of said condensing chamber to the ambient atmosphere to permit the escape of uncondensed vapor after it passes through the liquid spray from said nozzle.

3. In a dryer for moist fabrics, the combination of a rotatable drum for receiving the fabrics and having a single access opening therein and being imperforate elsewhere, means for rotating said drum, means for heating the fabrics to evaporate the moisture therefrom, a casing surrounding said drum and having an access opening in alignment with the access opening in said drum, a closure for the access opening in said casing, a horizontal passage between said access openings and in alignment therewith, said passage having a perforate sector, means for sealing the access opening in said drum about said passage, a condensing chamber disposed below said passage and in direct communication with the interior of said drum through the perforate sector in said passage, a nozzle for spraying liquid in the interior of said condensing chamber to condense the vapor and saturate the lint discharged from said drum into said condensing chamber by direct contact, and an upwardly directed duct disposed between said casing and drum providing a vent for said condensing chamber, said duct having a lower inlet end disposed at a lower portion of said condensing chamber and an upper outlet end communicating with the ambient atmosphere through an opening in said casing to permit the escape of uncondensed media after it passes through the liquid spray from said nozzle out of contact with the remainder of the drying apparatus.

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