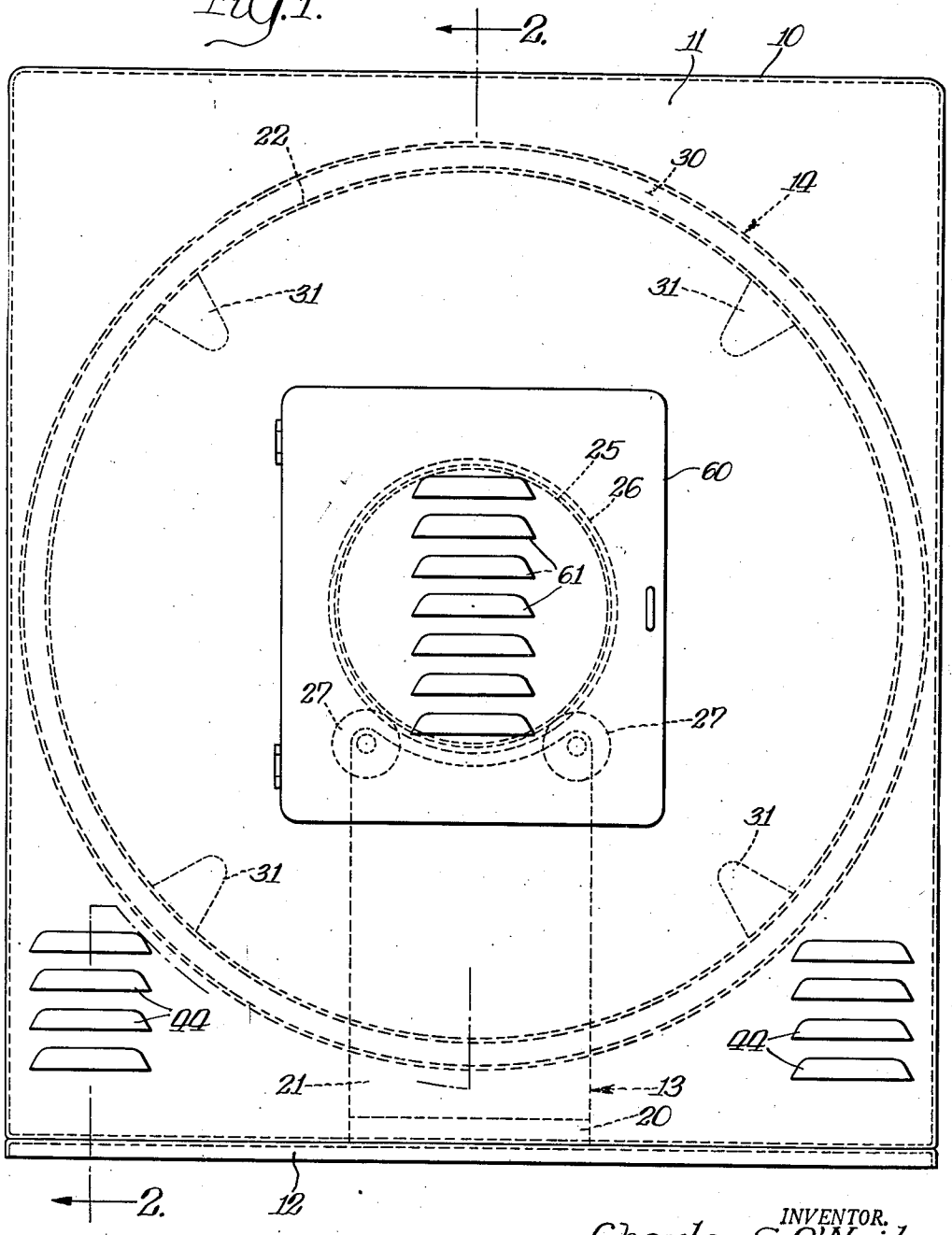
Sept. 2, 1952 C. S. O'NEIL 2,608,769

DRIER

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Fig. 1.



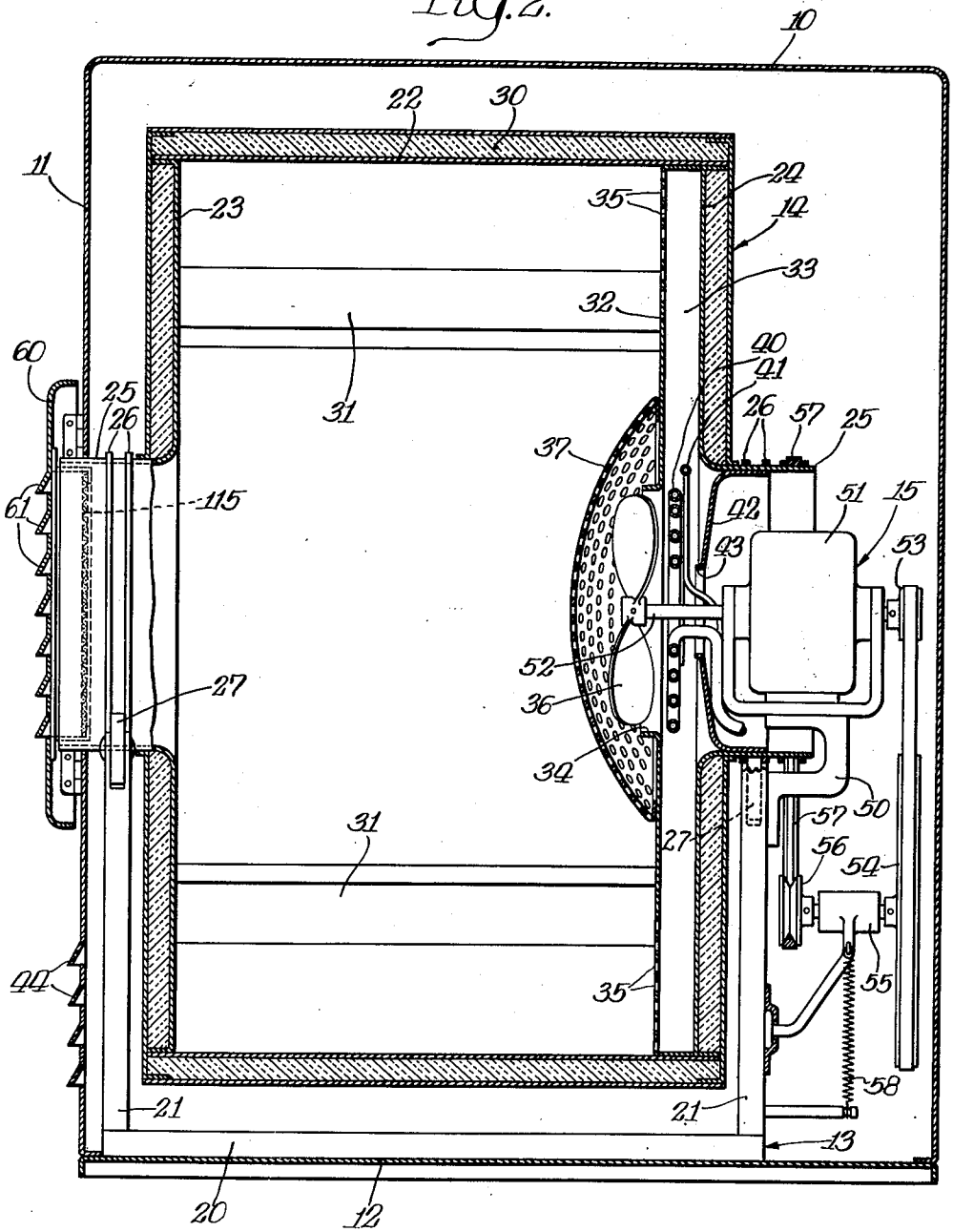
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DRIER

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Fig. 2.



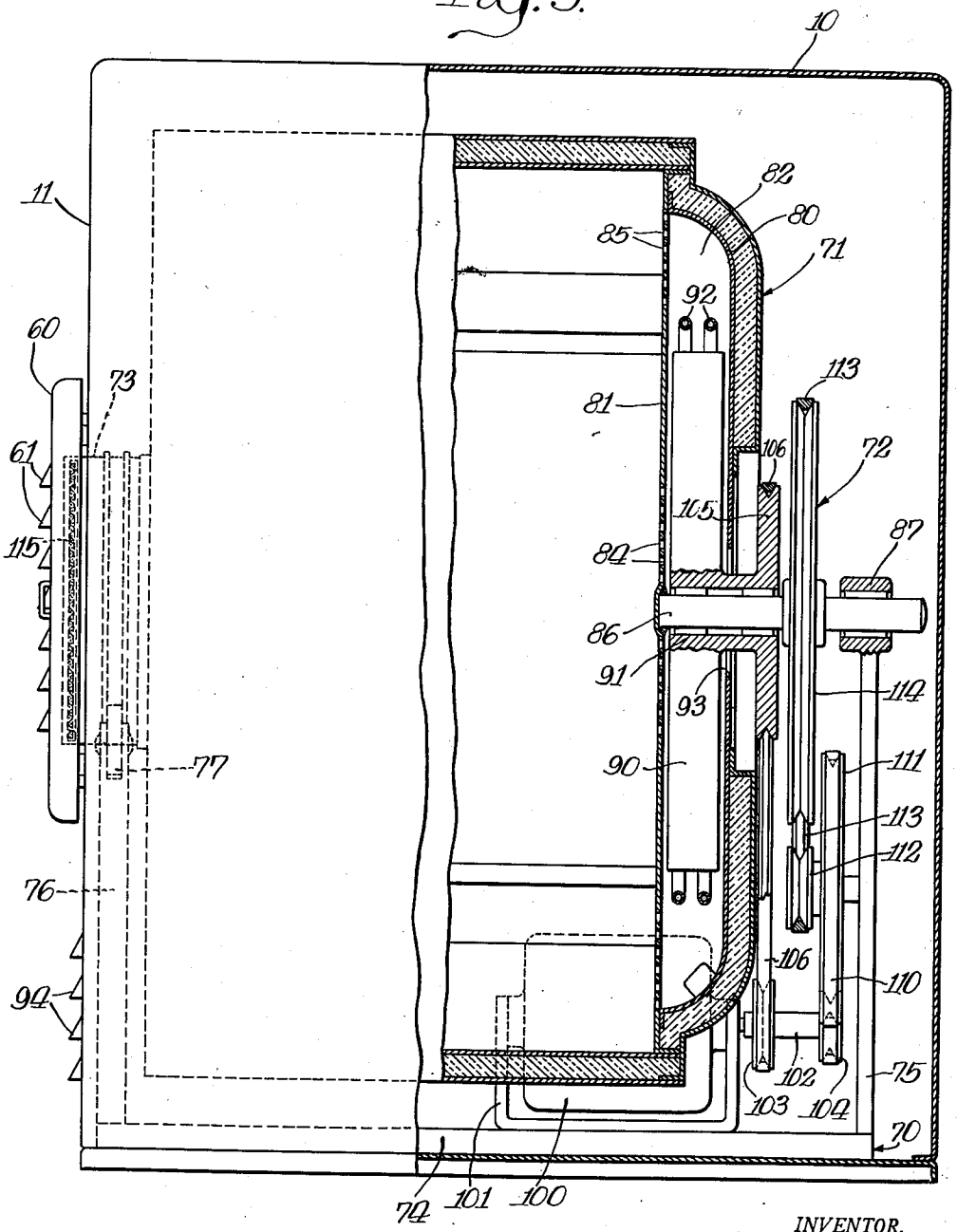
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Fig. 3.



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DRIER

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Fig. 4.

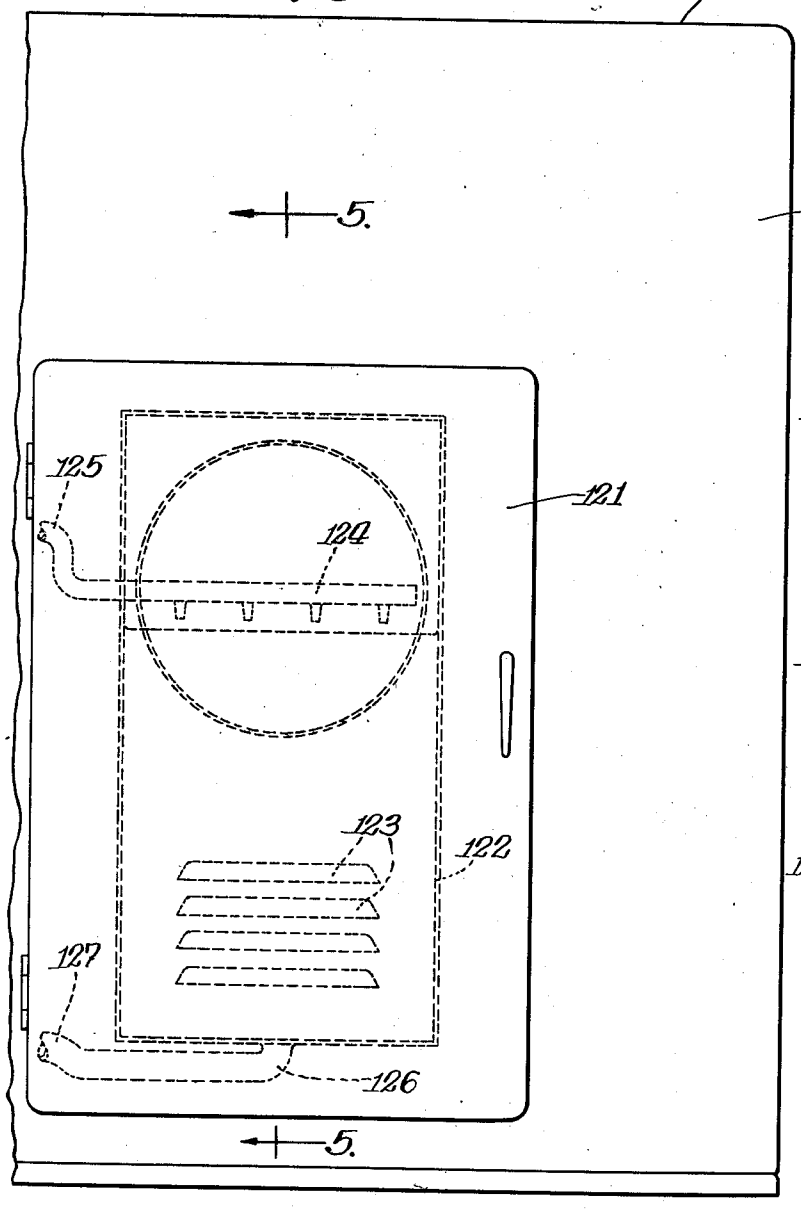
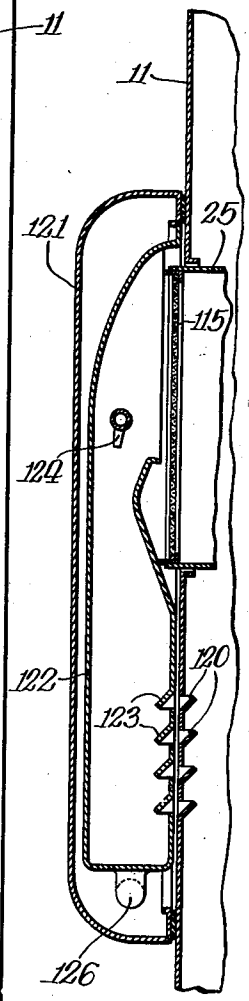


Fig. 5.



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UNITED STATES PATENT OFFICE

2,608,769

DRIER

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Application July 19, 1946, Serial No. 684,939

7 Claims. (Cl. 34—131)

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The invention relates generally to dryers and more particularly to a dryer for laundry, suitable for use in the home, and of the type in which the laundry is tumbled in the presence of heat to evaporate moisture therefrom.

The general object of the invention is to provide a novel dryer of the foregoing type, which is capable of drying laundry in a relatively short period of time and at a relatively low operating cost, and which may be produced inexpensively on a production basis.

Another object is to provide a dryer of the foregoing type, in which heated air is circulated within the drying chamber to effect the drying action, with only a small quantity of such air flowing from the machine so as to maintain the heat loss at a minimum.

A further object is to provide a dryer of the foregoing type, in which air from the drying chamber is withdrawn therefrom and is reheated and recirculated so as to absorb a maximum quantity of moisture before being discharged from the machine.

Still another object is to provide a dryer of the foregoing type, in which a large quantity of heated air is circulated through the drying chamber but only a relatively small quantity is discharged from the machine so that the air discharged will approach its saturation point and thus effect a maximum conservation of heat.

A further object is to provide a dryer of the foregoing type, having a drying chamber in the form of a rotating drum mounted within a casing, the drying being effected by recirculation of heated air through the drum with a small quantity of air from outside the drum added to the recirculating stream and a similar quantity discharged therefrom, with the air approaching its saturation point, the added air being taken from the space between the drum and casing and being preheated by heat radiated from the drum.

It is also an important object of the invention to provide a dryer of the foregoing character, comprising a rotating drum mounted within a casing, the drum together with its supporting structure and drive mechanism being constructed as a unit to facilitate assembly thereof to render it adaptable to any desired form of casing.

Another object is to provide a dryer of the foregoing type, in which air is recirculated through the drying chamber with only a small discharge from the machine so that such discharged air is close to its saturation point, and which is provided with a condenser for the discharged air to remove moisture therefrom and return the relatively dry air to the machine for further circulation therethrough.

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A further object is to provide a dryer of the foregoing type, in which air is circulated through the drying chamber and at least a portion of said air is discharged through the opening for the insertion and withdrawal of laundry, a door being provided for such opening and carrying a condenser for reducing the moisture content of the air discharged.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a front elevation view of a dryer embodying the features of the invention.

Fig. 2 is a vertical sectional view taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view similar to Fig. 2 but showing a modified form of dryer.

Fig. 4 is a fragmentary front elevational view of another modified form of dryer.

Fig. 5 is a fragmentary vertical sectional view taken on the line 5—5 of Fig. 4.

As heretofore mentioned, the present invention relates to a dryer for drying laundry adapted for domestic use. For that reason, the dryer preferably is adapted to dry a batch of laundry of a size substantially that of a batch which is washed in an ordinary household washing machine. The dryer is arranged to receive the laundry after it has been passed through a wringer or a centrifugal dryer to remove the major portion of the water, and the dryer then acts on the laundry to reduce the moisture content thereof to that which is suitable for ironing or to a bone-dry condition, as desired.

The present dryer comprises generally a casing provided with a drum into which the damp laundry is placed. The drum is rotated to tumble the laundry during the drying operation to subject all parts thereof to the air within the drum for evaporating the moisture content. In the form of dryer shown herein, the air within the drum is adapted to be recirculated and heated during such recirculation to increase the drying capacity of the air. During such recirculation, a relatively small quantity of air, preferably taken from the space between the drum and the casing, is introduced into the drum, and a corresponding quantity of air is forced from the drum. Air from outside of the machine is admitted to the space between the drum and the casing so as to absorb any heat radiated from the drum and thus become preheated before entering the drum.

By such arrangement, the air within the drum is sufficiently recirculated to approach its saturation point before being discharged from the

machine, and loss of heat due to the discharge of heated air from the machine is thereby held to a minimum. A blower, either in the form of an impeller or a fan, is mounted within the drum to effect such recirculation and to cause the air from the interior of the casing to be drawn into the drum and the air discharged from the drum, and a heating element is so mounted within the drum as to heat both the recirculated air as well as the air admitted through the intake.

Particular attention has been paid to designing the dryer so that it may be manufactured inexpensively, in quantities. To this end, the operating portion of the dryer is built as a unit. Thus, a frame structure having a pair of spaced uprights is provided with the drum supported by and between such uprights. The drive means for rotating the drum and operating the blower is also carried by the frame structure. Thus, a unit is provided which comprises all of the operating parts of the machine, and such unit may be mounted in a casing of any desired form.

Another feature of the invention lies in the provision of a novel form of condenser to be utilized with and as a part of the machine whereby the substantially saturated air discharged from the drying chamber of the drum passes through the condenser to have a major portion of the moisture removed therefrom, and such air is thereupon returned to the space between the drum and the casing for repassage through the machine. The condenser is preferably mounted in and made a part of a swinging door utilized for closing and opening into the drum through which the laundry may be inserted and withdrawn. While the condenser herein shown is of a form which is particularly advantageous when used with a machine in which the air within the drying chamber is recirculated before being discharged, such condenser may, of course, be used in any generally similar machine, whether or not the recirculation feature is employed.

The preferred embodiment of the invention is shown in Figs. 1 and 2 and comprises a casing **10** which may be of any desired form but is here shown as having a generally rectilinear form comprising a front wall **11**, a bottom or floor **12**, as well as top, side and rear walls. Mounted within the casing **10** are the operating parts of the machine, which are constructed as a unit, as mentioned above, to facilitate manufacture thereof, such unit being carried on the bottom **12** of the casing. It will thus be apparent that the casing **10** may have any desired form, of course within limits, so long as it is sufficiently large to enclose the operating unit. It thus may be of sheet metal construction.

The operating unit comprises generally a frame structure, indicated at **13**, a rotatably driven drum, indicated generally at **14**, and drive means, indicated generally at **15**. The frame structure **13** preferably comprises a base **20** mounted on the floor **12** of the casing and extending from front to rear of the machine. At each end of the base **20** is an upright **21** preferably of channel-like form and having substantial width. The drum **14** is of generally cylindrical form having a peripheral wall **22**, a front wall **23** and a rear wall **24**, the drum being mounted with its axis horizontal. The drum **14** is mounted between and supported by the uprights **21**. For this purpose, the front and rear walls **23** and **24** are preferably of substantially the same construction, to reduce production costs, and are provided with coaxial, annular flanges **25** extending outwardly therefrom. Each flange **25** is provided with a pair of spaced guide ribs **26** to receive a pair of rollers **27** rotatably mounted on the upper end of the adjacent upright, the drum thereby resting upon and being rotatably supported by the rollers **27**. The peripheral wall **22** as well as the end walls **23** and **24** are preferably insulated, as shown at **30**.

The interior of the drum **14** provides a drying chamber in which the laundry is placed and is adapted to be tumbled during the drying process by rotation of the drum. To effect the desired tumbling action, the drum may be provided with a plurality (four in the present instance) of inwardly directed vanes **31** which tend to lift the laundry toward the upper part of the drying chamber and cause it to fall across the chamber and thereby spread out so that all portions thereof are exposed to the heated air within the chamber.

One of the principal features of the present dryer lies in the fact that the air within the drying chamber is recirculated and heated during such recirculation so that it becomes substantially saturated with moisture before being discharged from the machine. To this end, I provide a transverse partition **32** within the drum, dividing the interior thereof into a drying chamber, which constitutes the major portion thereof, and an air passage **33** preferably adjacent and formed in part by the rear wall **24** of the drum. Air from the drying chamber portion is removed therefrom, passed through the air passage **33**, being reheated while so passing, and returned to the drying chamber portion. To permit such recirculation, the partition **32** is apertured both at its center and adjacent its periphery, the air being withdrawn from the drying chamber at one of these points and returned thereto at the other of these points. In the present embodiment, the partition **32** is provided with a flanged central aperture **34** and a plurality of perforations **35** adjacent its periphery.

To effect the recirculation, a blower is provided which, in the present instance, is in the form of a fan **36** positioned substantially within the central aperture **34** of the partition **32** for rotation coaxially with the drum **14**. To protect the fan, a bulged, perforated guard **37** is placed over the fan **36** to prevent laundry from contacting the latter during the tumbling action. The fan **36** is arranged to draw air from the air passage **33**, such air being withdrawn from the drying chamber through the aperture **35** adjacent the periphery of the partition **32**. The fan discharges such air axially into the drying chamber through a perforated guard **37**. To heat the recirculated air as it moves through the air passage **33**, an electrical heating element **40**, preferably of coiled form concentrically arranged in the drum, is positioned within the air chamber closely adjacent the fan **36**. Thus, the air drawn from the air passage **33** by the fan is drawn through the heating element **40** before being discharged into the drying chamber. To prevent overheating of the air, a thermostat **41** may be mounted in the air passage **33** adjacent the heating element **40** to control the flow of current to the heating element.

As heretofore mentioned, while the air from the drying chamber is recirculated, additional air from the space between the drum and the casing **10** is drawn into the drum by the fan **36**. In the present instance, the adjacent annular flange **25** of the drum forms an air intake through which such air is drawn to the fan.

Preferably, the intake is restricted by means of a shield 42 positioned within the annular flange 25 and provided with a reduced central opening 43. Thus, while some air outside of the drum is drawn in by the fan, the major portion of the air impelled by the fan is recirculated air drawn from the air passage 33.

Since, during the operation of the dryer, air is being added to the interior of the drum from the exterior thereof through the central aperture 43, an equivalent amount of air must be discharged from the drum. Preferably, such air is discharged through the opening provided for the insertion and withdrawal of the laundry. In the present instance, the annular flange 25 on the front wall 23 of the drum projects through the front wall 11 of the casing and provides an opening through which the laundry may be inserted and withdrawn. Such opening likewise provides an outlet for air from the drying chamber.

The air entering the drum through the central aperture or intake 43 is drawn from the space between the drum and the casing and consequently will be somewhat pre-heated by heat radiated from the drum. In order to cause such air to follow a circuitous path through the casing 10 and particularly a path around the exterior of the drum to absorb radiated heat therefrom, vents 44 are provided in the casing preferably in the lower portion of the front wall 11. As shown in Fig. 1, two sets of vents 44 are provided at opposite sides of the front wall.

The drive mechanism 15 of the operating unit also involves novel features. Thus, the drive mechanism includes a bracket 50 secured to the rear upright 21 of the frame structure and extending outwardly beyond the rear edge of the annular flange 25 of the drum to support a drive motor 51 within the annular flange 25 in concentric relation to the drum, the drive motor 51 has its drive shaft 52 extending forwardly through the intake 43 with the fan 36 mounted on the inner end of the drive shaft 52. Air drawn into the drum through the intake 43 thus passes around the motor to prevent it from overheating, the heat thus withdrawn from the motor further serving to preheat the air drawn in through the intake 43. The shield 42 which provides the reduced intake opening 43 also serves to protect the motor from any heat radiated from the heating element 40.

The shaft 52 of the motor also extends rearwardly therefrom to carry a pulley 53 connected by a belt to a pulley 54 carried on a shiftable bracket 55 mounted on the adjacent upright 21.

The pulley 54 is mounted on a common shaft with another pulley 56 connected by a belt 57 embracing the annular flange 25 of the drum. The annular flange 25 thus constitutes a pulley by which the drum is driven. The two belts are adapted to be held tight by a spring 58 acting on the bracket 55.

The opening provided by the annular flange 25 at the front of the machine is adapted to be closed, during operation of the machine, so that an excessive amount of air from the drying chamber will not be discharged therethrough. To this end, I provide a door 60 hinged to the front wall 11 of the casing 10 and having a plurality of vents 61 permitting the desired amount of discharge of air from the drying chamber.

The modified form shown in Fig 3 operates in substantially the same manner as the form shown in Figs. 1 and 2. It differs therefrom chiefly in the direction of flow of the recirculated air as well as the character of the blower for effecting such recirculation. Because of such difference in form of blower, the heating element in the form of Fig. 3 differs from that shown in Fig. 2 and the drive structure also differs in a number of detailed aspects.

Referring more specifically to Fig. 3, the form shown therein comprises a rectilinear casing 10 as in the previously described form, having a similar front wall 11. Within the casing 10 is the operating unit comprising a frame structure indicated generally at 70, a drum indicated generally at 71, and the drive mechanism indicated generally at 72. The drum 71 is of generally cylindrical form, insulated as in the case of the previous form, and having the same front end construction. Thus, the drum 71 is provided with a coaxial annular flange 73 at its front face, projecting through the front wall 11 of the casing 10 with a vented door 60 for closing the opening through the annular flange 73. The frame structure 70 comprises a base 74 having a rear upright 75 and a front upright 76 provided with a pair of rollers 77 supporting the annular flange 73.

The drum 71, at its rear end, is provided with a bulged rear wall 80 and a transverse partition 81 which, with the rear wall 80, provides an air passage 82. The partition 81 is provided with a plurality of apertures 84 adjacent its center as well as a plurality of apertures 85 adjacent its periphery, the two sets of apertures permitting recirculation of air from the drying chamber portion (to the left of the partition 81 as shown in Fig. 3) through the air passage 82. The partition 81 has rigidly secured thereto a drive shaft 86 extending rearwardly through the rear wall 80 and journaled in a bearing 87 provided on the upper end of the rear upright 75. Thus, the drum 71 is supported at its front end by rollers 77 and at its rear end by the shaft 86 and bearing 87.

The shaft 86 also provides a rotatable support for a blower to effect the recirculation. The blower in this instance is in the form of an impeller 90 comprising a plurality of radially extending blades positioned within the air passage 82 and extending from a hub 91 journaled on the shaft 86. Thus, rotation of the impeller 90 will cause air from the drying chamber to be drawn through the apertures 84 and discharged radially in the air passage 82 to return to the drying chamber through the apertures 85. To heat the air as it is recirculated, a heating element 92, comprising a plurality of coils, is mounted concentrically with the drum within the air passage 82 and encircling the impeller 90. Thus, air discharged by the impeller will be heated by the heating element 92 before returning to the drying chamber. Air from the space between the drum 71 and casing 10 is also drawn into the drum by the impeller 90 through a restricted central aperture 93 provided in the rear wall 80 of the drum. Thus, air from the drying chamber is recirculated through the air passage 82 while air from the space between the drum and the casing is introduced into the drum and mixed with the recirculated air. A corresponding volume of air will obviously be discharged through the outlet provided by the annular flange 73 at the front of the drum. The restricted size of the intake opening 93 causes the impeller to recirculate a greater amount of air from the drying chamber than the air drawn in through the intake opening 93. Air is admitted to the interior of the casing 10 through vents 94 in the front wall 11 of the casing.

The drive structure 72, in this instance, com-

prises a motor 100 mounted in a bracket 101 rigidly secured to the base 74 of the frame structure 70. The shaft of the motor, indicated at 102, extends rearwardly therefrom and is provided with a pair of pulleys 103 and 104. The pulley 103 is adapted to drive the impeller 90 and, to this end, the hub 91 of the impeller is provided with a pulley 105 at its rear end connected by a belt 106 to the pulley 103. The pulley 104 is utilized for driving the drum and, for this purpose, is connected by a belt 110 to an idler pulley 111 rotatably supported by the rear upright 75. Rotating with the idler pulley 111 is a second idler 112 connected by a belt 113 to a pulley 114 rigidly secured to the shaft 86. Thus, the motor 100 drives both the impeller 90 and the drum 71.

In each of the forms shown in Figs. 2 and 3, the air entering the drum through the intake opening at the rear thereof (intake 43 in the case of Fig. 2 and intake 93 in the case of Fig. 3) is drawn from the space between the casing and the drum and enters such space through vents provided in the front wall 11 of the casing (vents 44 in the form shown in Fig. 2 and vents 94 in the form shown in Fig. 3). Thus, outside air is utilized in each of these instances, and the air discharged from the drum is vented to the outside of the machine through the door 60.

In the form shown in Figs. 4 and 5, I have shown means for reusing the air discharged through the door 60, the moisture in such air being, in a large measure, condensed and removed from the air before being returned to the interior of the casing 10. In this way, I am able to maintain the humidity of the air drawn into the casing 10 fairly constant even though the air outside of the casing may vary considerably in humidity content. Furthermore, by the means shown in Figs. 4 and 5, the air returned to the casing is relatively clean so that the laundry being dried within the drum will not be subjected to any dust that might be carried by the air drawn from the outside of the machine. In each of the forms shown in Figs. 2 and 3 as well as the form shown in Figs. 4 and 5, I may provide a lint screen 115 fitting snugly within the annular flange at the front of the drum and carried by the door so as to collect any lint carried by the air discharged through the annular flange.

In the form shown in Figs. 4 and 5, air is discharged from the drum through the front annular flange 25 and a condenser is provided, which condenser is carried by the door and thus may be swung out of the way when laundry is being inserted or withdrawn from the drying chamber through the opening provided by the annular flange. In the preferred construction of a dryer provided with such condensing means, the front wall 11 of the casing is provided with a plurality of apertures in the form of vents 120 located adjacent the annular flange 25. The vents 120, in the present instance, are located immediately below the annular flange 25 and permit air to enter the casing. The door, indicated at 121, is hinged to the front wall 11 of the casing and is of sufficient extent to cover both the outlet provided by the annular flange and the vents 120. The door 121 is also of sufficient depth or thickness to provide a return passage, formed by a duct 122, connecting the outlet provided by the flange 25 with the vents 120, the duct 122 having a plurality of corresponding vents 123 adapted to be aligned with the vents 120 when the door is closed. Thus, air discharged from the drum through the annular flange 25 will flow through the return passage provided by the duct 122 to re-enter the casing through the vents 123 and 120.

To condense the moisture in the air as it moves through the return passage, I provide a spray 124 in the return passage. The spray 124 is provided with a connection 125 to a source of relatively cool water, the connection 125 being flexible to permit the door 121 to swing. The spray 124 is positioned to direct the cool water downwardly in the return passage and thus reduce the temperature of the discharged air. Such reduction in temperature will obviously result in condensation of a major portion of the moisture content of the air since the air, as it leaves the drum, is substantially saturated and at a relatively high temperature. The cool water as well as the condensate are collected in the bottom of the duct 122 and are carried off by a drain 126 having a flexible connection 127 to a sewer drain or the like.

Thus, with a condenser such as shown in Figs. 4 and 5, the air discharged from the drum has a major portion of its moisture content removed and is then returned to the casing for preheating by heat radiated from the drum and, in the case of the form shown in Fig. 2, by heat from the motor 51. The condensing means shown in Figs. 4 and 5, while being particularly adaptable for the particular forms of dryers shown in Figs. 2 and 3, may, of course, be employed with any form of dryer where moisture-laden air is discharged through the opening provided for the insertion and withdrawal of the laundry.

I claim:

1. A laundry dryer comprising a rotatably driven, generally cylindrical drum mounted on a horizontal axis, a partition within said drum extending transversely to the drum axis adjacent the rear end of the drum to provide a drying chamber constituting the major portion of the drum and an air passage in the rear of the drum, said partition having openings at its axis and adjacent its periphery and an imperforate annular portion in said partition between the openings at the axis and the periphery, heating means within said air passage, and rotary means mounted within the drum coaxially therewith for producing a flow of air through said openings in said partition for recirculation and reheating of the air within said drying chamber, said air passage having an axially located intake and said drying chamber having an axially located outlet whereby air from outside the drum is introduced into said flow and a portion of said flow is discharged from said drum, said imperforate annular portion confining at least the recirculated portion of said flow to passage over said heating means whereby said recirculated portion is heated thereby.

2. A laundry dryer comprising a casing having an opening, a rotatably driven drum mounted within said casing in spaced relation thereto, said drum having an internal partition to provide a drying chamber and an air passage communicating with said chamber, a rotatably driven blower mounted in said drum for producing a flow of air recirculated from said drying chamber through said passage and back to said chamber, said passage having an intake communicating with the space between said drum and said casing and said drying chamber having an outlet to the exterior of said casing whereby air from said space is introduced into said flow and a portion of said space is introduced into said flow and a portion of said flow is discharged to the exterior of said casing, and heating means located in the discharge from said blower with said internal parti-

tion having an imperforate portion confining the discharge of air from said blower to flow over said heating means for heating both the recirculated air and the air introduced therein, said introduced air being preheated by heat radiated from the drum within the casing.

3. A laundry dryer comprising a casing, a rotatably driven, generally cylindrical drum mounted on a horizontal axis within and in spaced relation to said casing and having an annular flange at one end projecting through the wall of the casing to provide an outlet, a transverse partition within said drum adjacent the opposite end to divide the interior of the drum into a drying chamber and an air passage at said opposite end with openings in said partition, said air passage having an axially loacted opening providing an intake from the space between the drum and the casing, and said casing having an opening from said space to the exterior, a rotatably driven blower mounted axially within said drum at said opposite end to produce a flow of air recirculated from said drying chamber through said passage and back to said drying chamber, said blower also being adapted to draw air through said intake to mix with said flow, a portion of said flow thereby being forced out through said outlet, and heating means within said air passage and located in the discharge from said blower for heating both the recirculated air and the air drawn in through said intake.

4. A laundry dryer comprising a casing, a rotatably driven, generally cylindrical drum mounted on a horizontal axis and having a pair of axially positioned annular flanges at its ends, the flange at one end projecting through the casing to provide an air outlet, the drum having a centrally and peripherally apertured internal partition adjacent the other end to provide a drying chamber and air passage for recirculation of air from the drying chamber, a motor mounted within the flange at said other end, a fan mounted within said drum at the aperture in said partition and driven by said motor, a heating element located in said passage between said fan and said motor, and a shield within the annular flange adjacent the motor to provide a restricted intake for air and to protect the motor from heat radiated from said heating element, the air passing through said intake being adapted to cool the motor and thereafter to pass through said heating element before entering the drying chamber.

5. A laundry dryer comprising a rotatably driven, generally cylindrical drum having end walls with an outlet in one end wall, a transverse partition in said drum providing a drying chamber between it and said one end wall and an air passage between it and the other end wall, said partition being apertured adjacent its center and its periphery to permit recirculation through said air passage of the air in said drying chamber, said other end wall having a centrally located intake for admitting air from outside the drum, and a rotatably driven impeller located in said air passage between said partition and said other end wall for drawing air from said drying chamber and through said intake and for discharging said air into the drying chamber, and a heating element in said air passage encircling said impeller to heat said air before being discharged into the drying chamber, a portion of the air

discharged into the drying chamber passing out through said outlet.

6. A laundry dryer operating unit adapted to be enclosed in a casing, comprising a frame comprising a base and a pair of spaced uprights at the ends of the base, a generally cylindrical drum having an annular flange at one end rotatably supported by one of said uprights, a transverse partition within said drum adjacent the other end thereof and dividing the drum into a drying chamber and an air passage, said air passage having an intake for admitting outside air, a shaft rigid with said partition and projecting from said other end through said intake, the outer end of said shaft being rotatably supported by the other upright, an impeller rotatably mounted on said shaft within said air passage for recirculating air from said chamber through said air passage and for drawing in air through said intake, a motor mounted on said base, and belt drive connections between said motor and said impeller and between said motor and said shaft.

7. A laundry dryer comprising a rotatably driven generally cylindrical drum having a partition therein extending transversely to the drum axis adjacent one end of the drum to provide a drying chamber constituting the major portion of the drum and an air passage at said one end of the drum, said partition having openings at its axis and adjacent its periphery and said one end of the drum having a central opening, heating means mounted within said air passage, and rotary means mounted within said air passage means for drawing a stream of air from the drum through certain of said openings in the partition and for drawing a stream of air from outside of the drum through said central opening and for discharging both streams of air into the drum through other of said openings in the partition, said end of the drum being imperforate except for said central opening and said partition having an imperforate annular portion between the openings at its axis and adjacent its periphery whereby both of said streams of air flow over said heating means and mix with each other before entering said drying chamber, said drum having an outlet remote from said partition for discharge of air from the drying chamber.

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