

Nov. 23, 1954

E. H. SMITH

2,694,867

DRIER

Filed Feb. 6, 1952

4 Sheets-Sheet 1

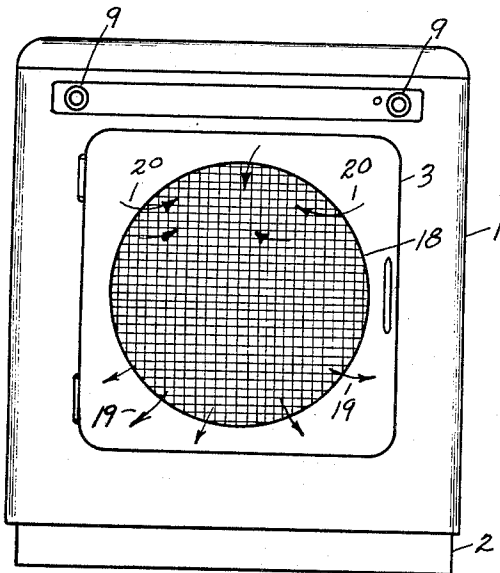


FIG. 1

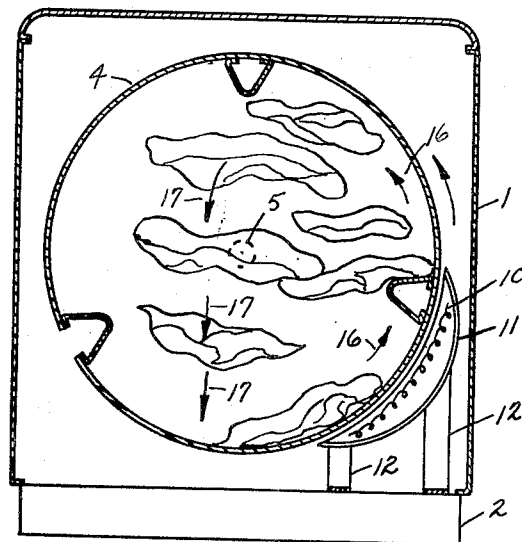


FIG. 2

33

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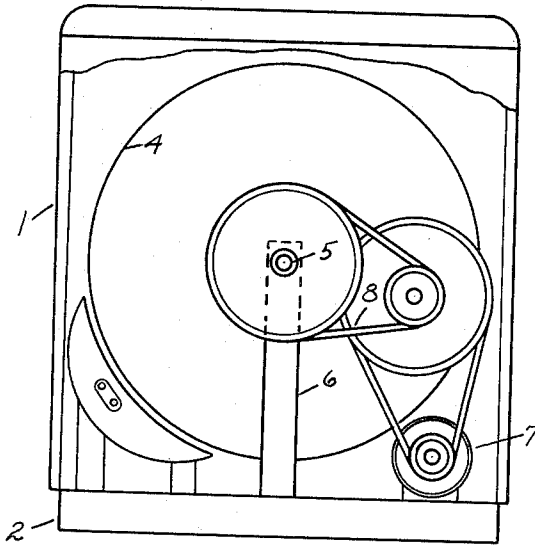


FIG. 3

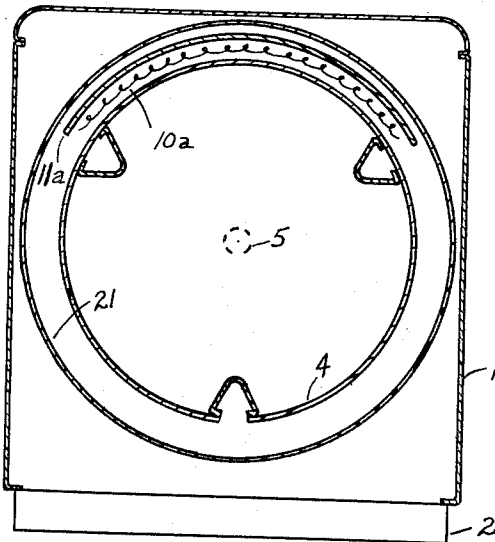


FIG. 5



FIG. 4

23g

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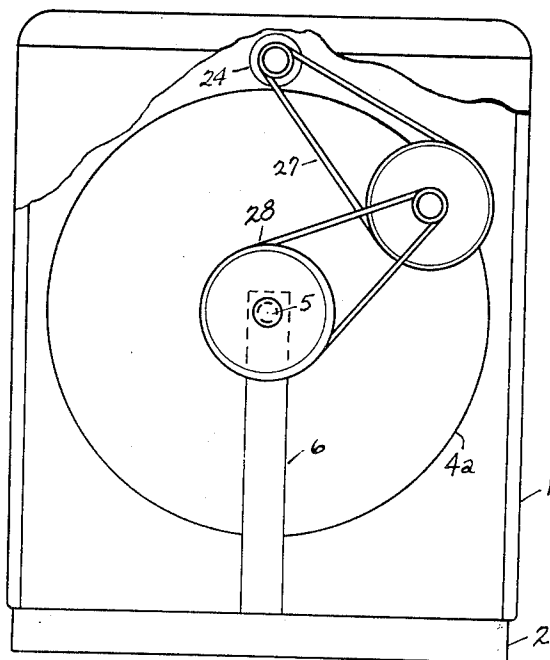
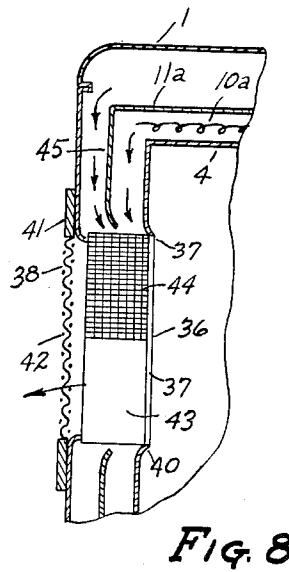
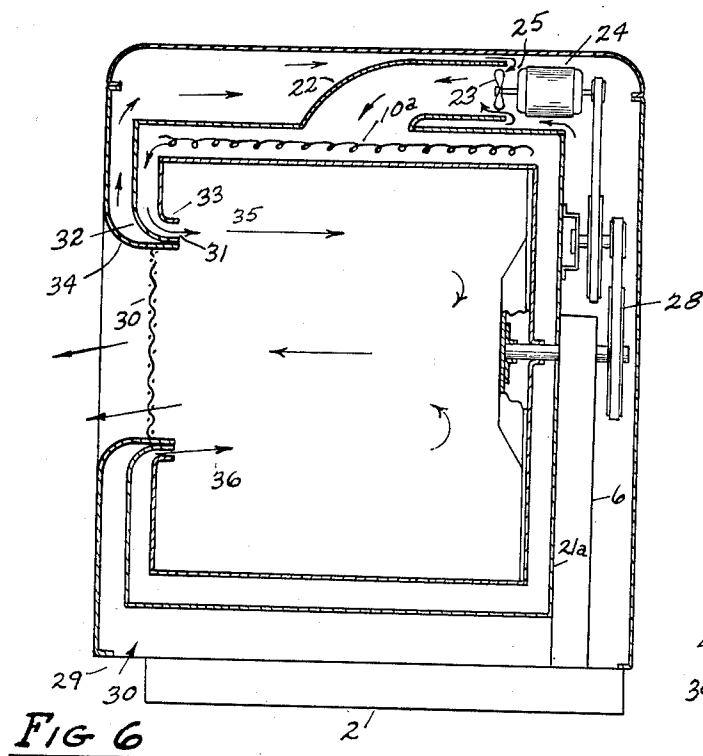
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DRIER

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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

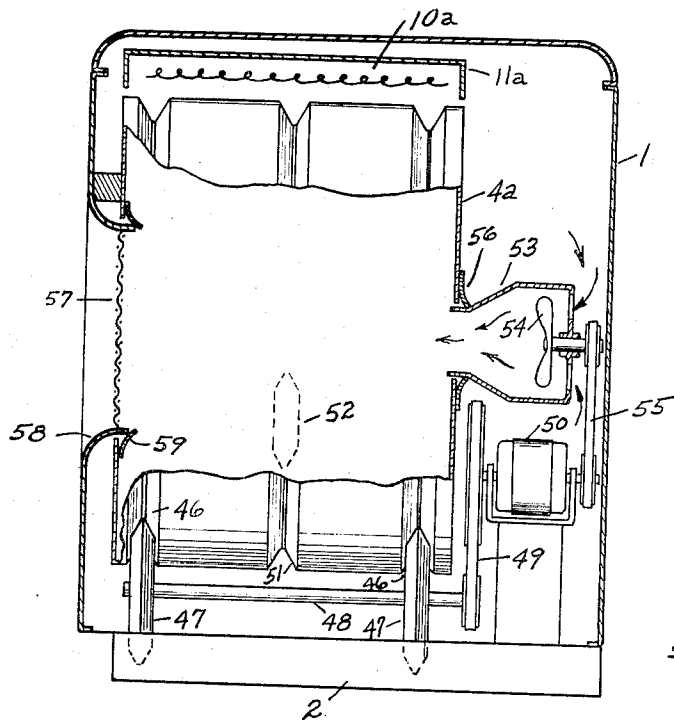


Fig. 9

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2,694,867

DRIER

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Application February 6, 1952, Serial No. 270,120

9 Claims. (Cl. 34—133)

This invention is a tumble type clothes drier in which the tumbling of the clothes is used to expell the moisture-laden air, thereby eliminating the blower or fan heretofore considered necessary. Other features include a smooth surfaced drum receiving heat on its outer periphery by radiation and transferring heat to the clothes by conduction. The lint expelled is caught by a screened door which can easily be wiped clean when opened to unload the drum. Further objects and advantages appear in the specification and claims.

In the drawings, Fig. 1 is a front view of a drier; Fig. 2 is a vertical section; Fig. 3 is a back view; Fig. 4 is a fragmentary section through the drum; Fig. 5 is a vertical section through a drier having an air tight wrap around sheet enclosing the drum and heating element; Fig. 6 is a vertical section through a similar drier having a supplemental blower; Fig. 7 is a back view of the Fig. 6 drier; Fig. 8 is a fragmentary view of an arrangement utilizing the tumbling of the clothes to suck preheated air from the cabinet into the drum; and Fig. 9 is a section of another modification in which the preheated air from the cabinet is circulated axially through the drum.

Referring to the drawing, 1 indicates the cabinet mounted on a base 2; 3 indicates the door through which the clothes are loaded and unloaded; 4 indicates the drum journaled at 5 on a post 6 at the back of the base; 7 indicates the motor driving the drum through reduction belt drive 8; and 9 indicates the controls, on-off and drying cycle. The parts so far described are or may be of common construction and need not be further illustrated.

The heat necessary to evaporate the moisture in the clothes is supplied to the drum by a radiant electric heating element 10 housed within a reflector 11 supported on the base by standards 12. The heating element and reflector extend substantially the full axial length of the drum and are closely spaced from the outer periphery of the drum so as to concentrate heat thereon. The heat transfer to the drum is primarily by radiation so it is important that the peripheral surface of the drum have high absorption of radiant energy. Polished surfaces should be avoided. Oxidized or dull lacquered surfaces are even more efficient. For example, a drum having a polished aluminum outer surface will have its clothes drying efficiency increased by 50% if the inner and outer surfaces are given a coat of bright lacquer. The drying efficiency will be still further increased, if the outer surface of the drum is roughened with steel wool so as to present a dull surface to the radiant heat. The optimum condition of complete absorption of the radiant heat by the outer surface of the drum, of course, cannot be realized but it is possible by the proper surface treatment to absorb from 80% to 90% of radiant heat impinging on the outer surface of the drum. Of course, some of the heat impinging on the outer surface of the drum is reflected back toward the reflector 11 and re-reflected on the drum. There is, however, a loss at each reflection so that the maximum absorption is desirable. The material for the drum cannot be selected entirely on the basis of its absorption of radiant energy, because of the further requirement that the outer surface of the drum be a good conductor of heat so that the heat absorbed can be quickly transmitted to the interior of the drum where it is transferred to the clothes by direct conduction and radiation. The requirement of heat transmissibility from the outer to the inner surface of the drum is satisfied in general by metals, steel and aluminum, being examples

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of common structural materials used for the drums. In Fig. 4 is illustrated one of the drum materials having the desired characteristics. The outer periphery of the drum is made from polished aluminum sheet 13 having a coat of bright black lacquer 14 on the inner surface and a coat 15 of bright black lacquer roughened by steel wool on the outer surface. The roughening of the coat 15 raises the absorption of radiant energy. The aluminum sheet 13 has good conductivity of the heat absorbed by the coat 15 and keeps the temperature of the coat 15 to a low value at which re-radiation is a minimum. The smooth inner surface of the drum on which the coating 14 is applied presents a maximum of contact with the clothes so that heat may be conducted to the clothes and evaporate the moisture contained therein somewhat as in the process of ironing.

As the clothes are rotated, there is a tumbling action illustrated diagrammatically in Fig. 2. The clothes in contact with the bottom and side walls of the interior of the drum are carried up in the direction of arrows 16 and upon reaching a point somewhere near the top of the drum fall downward in the direction of the arrows 17. This is the familiar tumbling action which continually re-distributes the clothes so that different parts thereof come in contact with the drum and are heated by conduction. As the clothes fall toward the lower part of the drum, the air between the clothes and the drum is expelled out through the lower part of a screen 18 on the door 3, the general direction of the flow of the expelled air being indicated as 19. The expelled air, of course, carries with it the water vapor and any entrained particles of lint which are caught on the inner surface of the screen 18. Throughout the tumbling action of the clothes, there is an outward expelling of the air in the direction of the arrows 19 which, of course, is not of constant intensity but tends to be in the nature of puffs corresponding to the separate articles of clothing. The same tumbling action which expels air in the direction of the arrows 19 at the bottom of the screen 18 sucks in air in the general direction of the arrows 20 at the top of the screen. With the arrangement shown in Fig. 1, the air sucked into the drum comes from the outside air. With this arrangement, the drying efficiency as measured by the rate of evaporation of moisture from the clothes is equal to the average results obtained with commercial driers. It would be preferable if the air sucked into the drum were taken from the interior of the cabinet 1 so that the air coming into the drum would in effect be pre-heated by the heat radiated from the outside of the reflector 11 and from the outside of the drum 4. It also would be desirable that the heat impinging on the inner walls of the cabinet be reflected back toward the drum so that the heat loss from the outside of the cabinet can be minimized. These are refinements which would still further increase the efficiency.

It would also be possible to substitute a gas heater for the electric heating element 10. With a gas heating element of the radiant type, the outer surface of the drum should be chosen for its absorption of radiant energy. If the gas heating element were not of the radiant type, then the outer surface of the drum should be selected for its absorption of heat from the gas flame by conduction and convection.

The location of the heating element 10 is not critical. Since the heat is transferred to the clothes primarily by conduction, it in general is desirable that the hottest point on the outer surface of the drum be at the point of initial contact of the clothes with the drum. This general requirement is satisfied by locating the heating elements in either of the lower corners. The heating elements could be located directly beneath the bottom of the drum, but then the clothes might be endangered if the belt should break and thereby stop the rotation of the drum. It however, would be equally satisfactory if the heating element were located in the top of the drum since the drum temperatures are kept low enough so that re-radiation from the outer surface of the drum is not an important loss, particularly if the air sucked into the upper part of the drum by the tumbling action of the clothes is withdrawn from the interior of the cabinet

so that the heat lost from the outer surface of the drum is used to preheat the air drawn into the drum.

Another factor in improving the drying efficiency is to cut down the circulation of air from the outer surface of the drum. By adding to the construction of Fig. 2 an air tight shell enclosing the drum and reflector and spaced from the cabinet, the drying efficiency becomes equal to the commercial standards. This in effect prevents the churning of air within the cabinet which constantly changes the cabinet air.

In the Fig. 5 drier, the heating element 10a is spread over the upper half of the drum 4 beneath a reflector 11a. Around the reflector and drum is an air tight shell 21 enclosing the periphery and the front and back of the drum. The shell 21 should be of reflective metal so the radiant transfer to the shell will be at minimum. The combination of a drum having an exterior surface treated to receive radiation, a heating element radiating to the drum, and an air tight reflective shell around the drum and heating element equals commercial performance. By way of illustration, for a drier heat input at which moisture evaporation of 10 lbs./hour is commercial performance, the Fig. 2 drier with aluminum sheet periphery will evaporate 3½ lbs./hour; painting the exterior of the aluminum sheet with black lacquer raises the drying to 7-8 lbs./hour; and adding the air tight shell 21 raises the drying to 10 lbs./hour, all of these figures being for the same size load of identical material so the results are truly comparable and are not affected by differences in the material being dried.

In Fig. 5, the air tight wrap around sheet 21 cuts down convection losses from the outside of the drum, but there still remains some heating of the air within the cabinet. In Fig. 6, the cabinet air preheated by the losses from the exterior of the wrap around sheet is forced under positive pressure into the space between the wrap around sheet and the exterior of the imperforate drum where the air is further preheated. Then, the air is discharged axially into the front of the drum. With such an arrangement, the evaporation of moisture from the clothes is due both to the heat transfer to the clothes from the imperforate inner surface of the drum and to convection from the preheated air. This combination produces more uniform drying, particularly of the larger pieces which cannot make uniform contact with the drum.

In the Fig. 6 structure, the cabinet 1, base 2, drum 4, and drum support 5, 6, heating element 10a are the same as previously described. The air tight wrap around sheet 21a is modified by connecting duct 22 for a fan 23 mounted on the shaft of a motor 24. The point at which the duct discharges into the space between the drum and the enclosing wrap around sheet is not critical, since a positive pressure is created. The intake 25 for the duct 22 should suck in the warmest air from the cabinet. These requirements can be met with a variety of locations of the duct different from that shown where the duct is at the top of the cabinet with its intake 25 at the back and its discharge to the uppermost section of the wrap around sheet 21a midway between the front and back. The same motor 24 which drives the fan also drives the drum through a double V-belt reduction 27, 28. This drive is adapted to almost any location of the duct 22 around the periphery of the drum. For the location of the duct illustrated, the air inlet to the cabinet can conveniently be under the toe space 29 as indicated by arrow 30. The air within the wrap around sheet is discharged into the drum through an annular opening 31 between a collar 32 fixed to the wrap around sheet and a flange 33 on the drum. The opening 31 is preferably of greatest width at the top so the greater part of the air flows in at the upper part of the positive pressure. There is never any tendency for air to flow in the reverse direction through the opening 31. This keeps the wrap around sheet free from lint. In order to keep lint out of the cabinet, a collar 34 on the cabinet is extended within and sealed to the collar 32. Across the throat of the collar 34 is a screen 35 which filters the air discharged from the drum and also serves as a door for loading and unloading. The greatest outflow of air from the drum is toward the bottom where the puffing action of the tumbling clothes supplements the pressure from the fan 23.

The Fig. 6 drier provides a high degree of efficiency and uniformity of drying. The tumbling clothes come into good heat transfer relation to the inner surface of the drum, the primary heat transfer being by conduction with convection and radiation lesser factors.

If the exterior of the drum is treated to absorb radiation, the heat transfer from the drum directly to the clothes can equal commercial practice. In addition, there is drying from the heated air blast discharged through the opening in the direction of arrows 35 and 36. This heated air blows into the center of the tumbling mass and effectively dries the part of the clothes having the poorest heat transfer relation to the drum. How deeply the air blast penetrates the mass of clothes depends upon the air pressure and the size of the load being dried. For the heavier loads where there is greater possibility that some clothes may remain in poor heat transfer relation to the drum throughout the drying cycle, the air blast is most effective in increasing both the rate and uniformity of drying.

The lint problem is well taken care of in the Fig. 6 drier. The cabinet is under negative (suction) pressure. The air tight wrap around sheet is under positive pressure so there is no tendency for lint to blow back into the wrap around sheet. The screened center outlet from the drum, which also serves as a door for loading and unloading, can be wiped off easily after each load is dried. Thus, the lint is trapped on an easily cleaned screen and is kept from flying around the cabinet or from clogging the space between the drum and the wrap around sheet.

In Fig. 8 is shown another drier in which the primary heat transfer from the heater is by radiation to the outer surface of an imperforate drum. In this drier, the imperforate drum 4 is suitably supported and driven and at the upper part is the heating element 10a beneath a reflector 11a which concentrates the heat against the outer surface of the drum. In order that the heat transfer may be a maximum, the outer surface of the drum is preferably treated to absorb radiant energy. In the case of the reflector 11a, the surface should be treated to reflect radiant energy. This results in a drier having performance characteristics similar to the drier disclosed in Fig. 2. In order to still further increase the drying efficiency, a collar 36 is arranged between the end opening 37 of the drum and an aligned opening 38 in the front wall of the cabinet 1. At the inner end, the collar is provided with a smooth annular surface 39 which makes sealing engagement with a flexible lip 40 on the drum. The collar has an air tight fit with the opening 38 in the cabinet. The collar accordingly provides a passageway leading from the opening 37 in the drum to the front opening 38 in the cabinet. As in Fig. 1, the cabinet opening 38 is closed by a door 41 having a screen 42 for intercepting lint. During the operation of the drier, the tumbling action of the clothes creates a suction at the upper part of the opening 37 and a pressure at the lower part. This is a puffing action which is utilized to expel the moisture-laden air from the drum and to draw in dry air to replace that which is expelled. Since the tumbling action of the clothes causes a puffing of the air, it cannot be categorically said that there will always exist a suction at the upper part of the opening 36. Occasionally there may be a positive pressure which would tend to puff air with the entrained lint in a reverse direction out through the upper part of the opening 36. This would cause lint to collect in the cabinet. To prevent the discharge of lint into the cabinet, the collar 36 has an imperforate section 43 at the lower part where there is always positive pressure and a screen section 44 at the upper part where the pressure is sometimes negative and sometimes positive. In general, as the clothes tumble, air is sucked into the drum through the screened section 44 and is expelled out through the lower part of the collar 36 lying within the imperforate section 43. If there is any tendency for reverse flow through the screened section 44, the lint is caught on the inner surface of the screen and cannot flow through the screen into the cabinet. In order to obtain a better distribution of the air flow into the drum through the screened section 44, the reflector 11a has a depending section 45 which divides the air stream sucked into the drum through the screened section 44. The air to the left of the depending section 45 comes from the upper part of the cabinet and tends to keep the cabinet cooler and at the same time to provide the drum with preheated air. The air to the right of the depending section 45 is hotter, since it is heated by contact with the drum 4 and with the heating element 10a, both of which are much higher temperature than the reflector 11a and the air within the upper part of the cabinet. With this arrangement, the natural tumbling action of the clothes is

utilized to supply the drum with preheated air and to expel moisture-laden air from the drum.

In Fig. 9 there is shown another drier in which the primary heat transfer to the clothes is by radiation to the outer surface of an imperforate drum and the secondary heat transfer to the clothes is by the circulation of air preheated by contact with the exterior of the drum. In this drier, the drum 4a is provided with peripheral grooves 46 receiving driving rollers 47 fixed on a drive shaft 48 driven by a belt and pulley 49 from a motor 50. The drum also has an intermediate V-groove 51 for receiving an idler roller 52. The rollers 47 and 52 are suitably supported on the base and provide a three-point friction drive which stably supports the drum. The three point drum support is not my invention and is not being claimed in this application but is being claimed in application Serial No. 404,181, filed January 15, 1954. In the upper part of the cabinet is the arcuate heating element 10a and associated reflector 11a which, as shown in Fig. 5, radiate heat to the outer surface of the imperforate drum over the uppermost quadrant. Naturally, it is desirable that the maximum heat be transferred to the drum so that the exterior surface of the drum is treated to absorb radiation. With this arrangement, there will be an appreciable heat loss from the outer surface of the drum 4a and from the outer surface of the reflector 11a. This heat loss will heat the air within the cabinet, but because of the continuous rotation and churning of the air by the rotation of the drum, there will be a continual interchange of cabinet air with the resultant wasted heat loss. In the present construction, this heat loss is avoided and in fact is utilized to supplement the drying of the clothes.

At the back of the drum, there is a blower housing 53 for a fan 54 driven by a belt 55 from the motor 50. The housing has its discharge end coaxial with the drum and sealed to the drum by a flexible lip 56 carried by the drum. The intake end of the housing 53 is arranged to draw air from within the cabinet and by arranging suitable intake louvers to the cabinet (not shown) can easily draw the major portion of the air from the upper part of the cabinet where the temperatures would be highest. The air is discharged axially into the drum and flows through the tumbling clothes. The air flows out through the front of the cabinet through a screened closure 57 which serves both as a lint trap and as a door through which clothes may be loaded and unloaded. At the front, the cabinet is provided with a collar 58 which makes sealing contact with a flexible lip 59 carried by the drum. With this arrangement, heat which would otherwise be wasted by heating the air inside the cabinet is salvaged through the medium of the fan 54 and transmitted to the center of the mass of clothes to aid in the drying. Directing the air into the center of the clothes reaches the clothes which are in poorest heat transfer relation to the inner surface of the drum. This is advantageous not only from the point of view of increasing the drying efficiency, but in increasing the uniformity of pieces which might not come into good heat transfer relation with the drum. The positive pressure of the warm air within the drum does not cause any lint problem, because the drum is sealed by the flexible lips 56 and 59. All of the lint in the air passes through the screen 57 which can easily be cleaned each time the clothes are unloaded.

What is claimed as new is:

1. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, the peripheral wall being of metal having its outer surface treated to absorb radiant energy, a stationary radiant heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a stationary air tight shell around the drum reflecting heat back to the drum and preventing convection from the outer surface of the drum, a cabinet housing the drum with its enclosing shell, an air inlet to and an air outlet from the drum, said cabinet having a wall provided with an opening registering with the outlet from the drum, and a seal between the cabinet and shell blocking the flow of lint from the drum outlet to the interior of the cabinet.

2. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, the peripheral wall being of metal having its outer surface treated to absorb radiant energy, a stationary

radiant heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a stationary air tight shell around the drum reflecting heat back to the drum and preventing convection from the outer surface of the drum, a cabinet housing the drum with its enclosing shell, a fan having its inlet communicating with the cabinet and its discharge directed between the shell and drum to maintain a positive pressure therebetween, a central opening in one of the drum end walls, said shell having a wall forming an outlet leading from the space between the shell and drum into the central opening in the drum, said cabinet having a wall provided with an opening registering with and radially inward of the central opening in the drum through which clothes are loaded and unloaded, and a seal between the cabinet and shell blocking the flow of air from the drum outlet into the interior of the cabinet.

3. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, the peripheral wall being of metal having its outer surface treated to absorb radiant energy, a stationary radiant heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a cabinet housing the drum and heater, a fan having its inlet drawing air from the cabinet and its outlet discharging axially into the drum, an outlet opening in an end wall of the drum for the air discharged therein by the fan, said cabinet having a wall forming an opening registering with the drum outlet, and means between said wall of the cabinet and said end wall of the drum blocking the flow of lint from the drum outlet to the interior of the cabinet.

4. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, a stationary heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a cabinet housing the drum and heater having a wall provided with an outlet, an air inlet to the drum from the interior of the cabinet, an air outlet from the drum registering with the cabinet outlet, and a seal between the drum and cabinet outlets blocking the flow of air from the drum outlet to the interior of the cabinet.

5. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, a stationary heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a cabinet housing the drum and heater having a wall provided with an outlet, an air inlet to the drum from the interior of the cabinet and an air outlet from the drum registering with the cabinet outlet, said inlet and outlet being located in an end wall of the drum, a fan sucking air from the interior of the cabinet and discharging it into the drum inlet, and means between the air outlet from the drum and the cabinet outlet blocking a back flow of the lint from the drum outlet into the interior of the cabinet.

6. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, the peripheral wall being of metal having its outer surface treated to absorb radiant energy, a stationary radiant heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side walls of the drum to the top and dropped diametrically downward to the bottom of the drum, a central opening in the front end wall of the drum, a cabinet housing the drum and heater having its front spaced from the front end wall of the drum, a stationary collar extending axially to the front of the cabinet from the central opening in the front wall of the drum, and a seal between the collar and the front wall of the rotating drum around the central opening,

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said collar being screened in its upper part whereby the suction created by the tumbling clothes draws air into the drum from the cabinet.

7. The dryer construction of claim 6 having a shield spaced between the front of the cabinet and the front end wall of the drum and extending transverse to the screened upper part of the collar and directing the hotter air adjacent the drum into the screened part of the collar adjacent the drum.

8. A tumble type clothes drier having a generally horizontal rotating drum with imperforate peripheral and end walls, the peripheral wall being of metal having its outer surface treated to absorb radiant energy, a stationary radiant heater spaced from and directing heat against the outer peripheral wall of the drum, means for rotating the drum on its axis to cause the clothes to be carried up the inner side wall of the drum to the top and dropped diametrically downward to the bottom of the drum, a central opening in the front end wall of the drum, a cabinet housing the drum and heater having its front spaced from the front end wall of the drum, a stationary collar extending axially to the front of the cabinet from the central opening in the front wall of the drum, and a seal between the collar and the front wall of the rotating drum around the central opening, said collar being screened in its upper part whereby the suction created by the tumbling clothes draws air into the drum from the cabinet, and said collar being imperforate in its lower part whereby the air expelled from the drum by the tumbling clothes is blocked from re-entering the space between the drum and the cabinet.

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9. In a tumble type clothes drier, a generally horizontal drum having imperforate peripheral and end walls, a stationary heater spaced from and radiating to the outer peripheral wall of the drum, a cabinet housing the drum and heater, inlet and outlet openings respectively in opposite end walls of the drum, a fan sucking air from the interior of the cabinet and having discharge directed into the drum inlet opening, a collar conducting air from the drum outlet out of the cabinet, and sealing means between the fan discharge and the drum inlet and between the collar and the rotating drum preventing back flow from the drum into the interior of the cabinet.

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