

Nov. 1, 1960

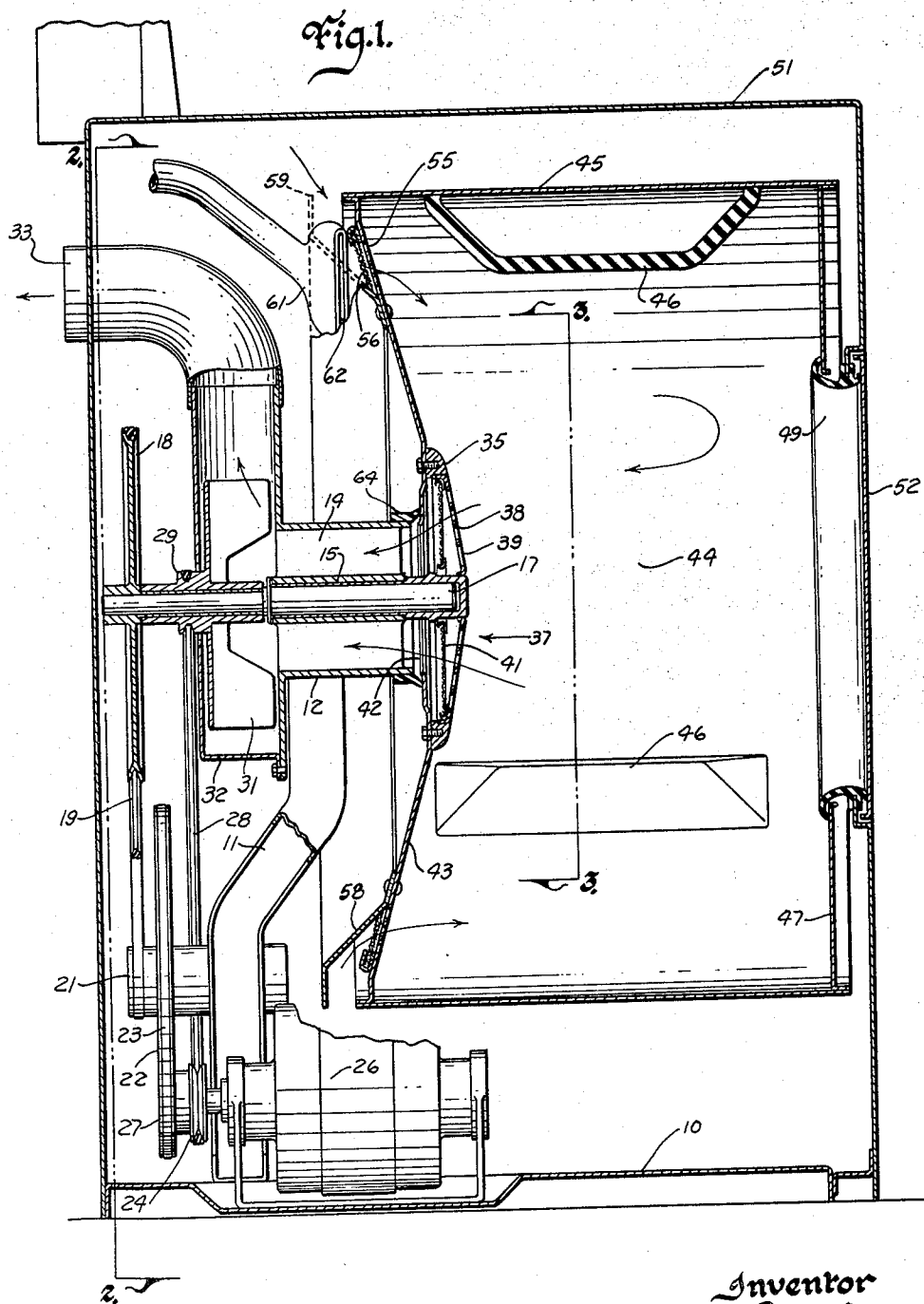
T. R. SMITH

2,958,140

CLOTHES DRIER WITH HEAT EXCHANGER

Filed April 8, 1957

4 Sheets-Sheet 1



Inventor
Thomas P. Smith
by James S. ~~Smith~~ Attorney

Nov. 1, 1960

T. R. SMITH

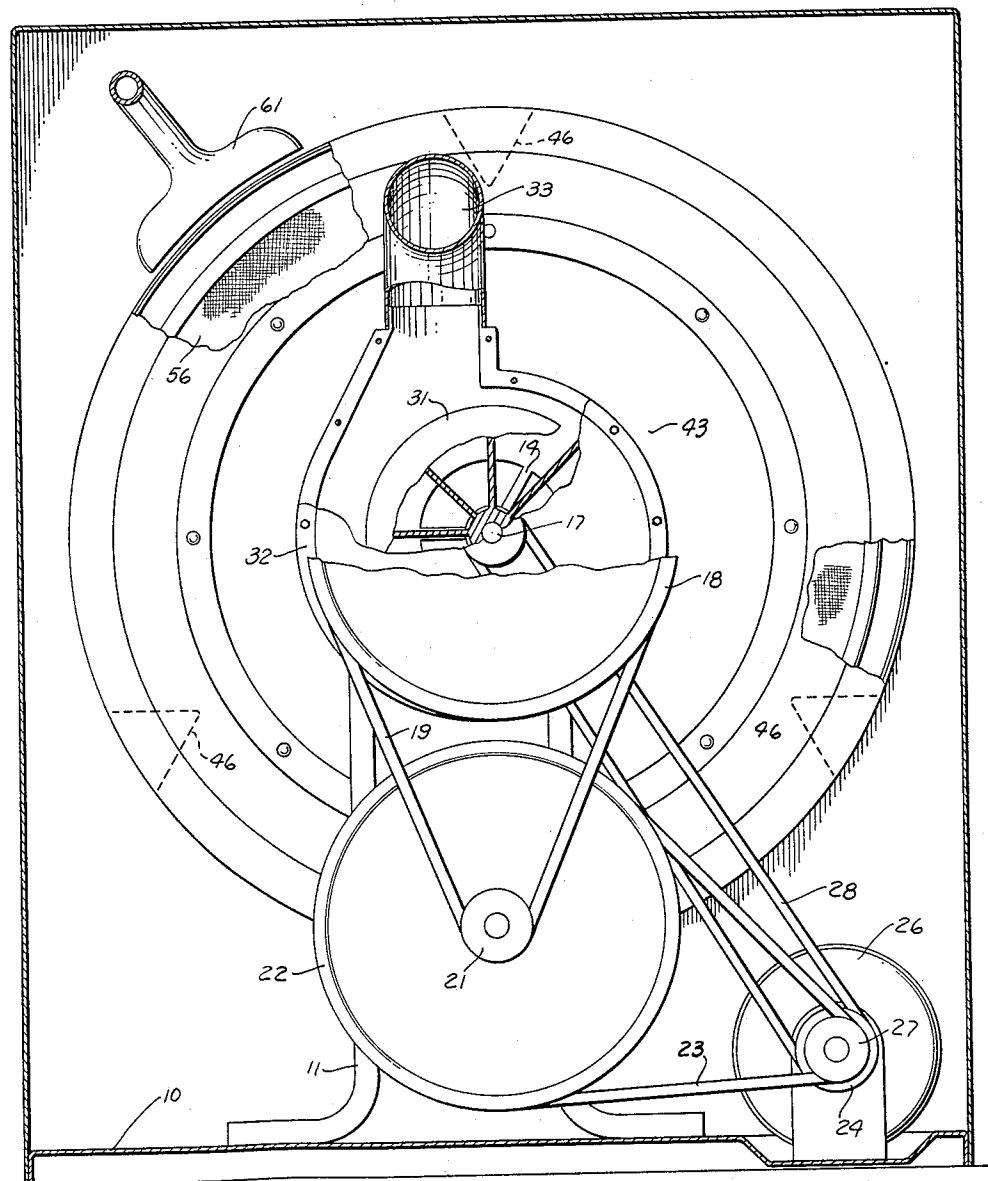
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CLOTHES DRIER WITH HEAT EXCHANGER

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4 Sheets-Sheet 2

Fig. 2.



Inventor
Thomas R. Smith
by *James S. Killester*
Attorney

Nov. 1, 1960

T. R. SMITH

2,958,140

CLOTHES DRIER WITH HEAT EXCHANGER

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Fig. 3.

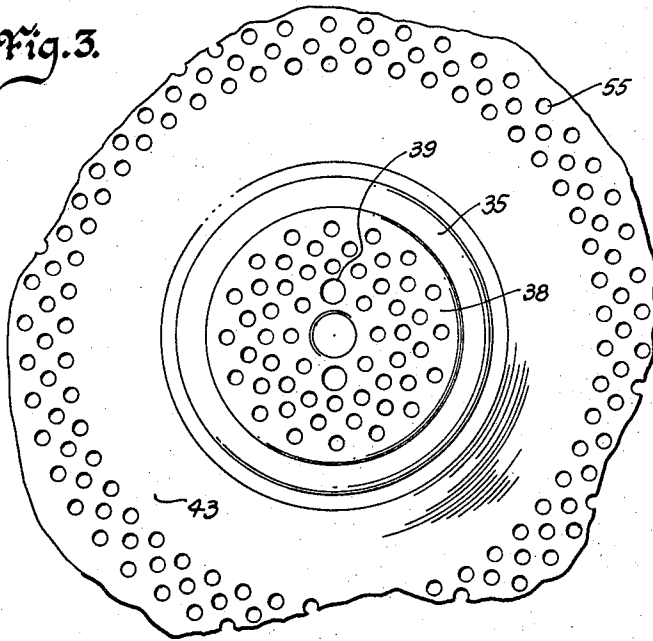


Fig. 4.

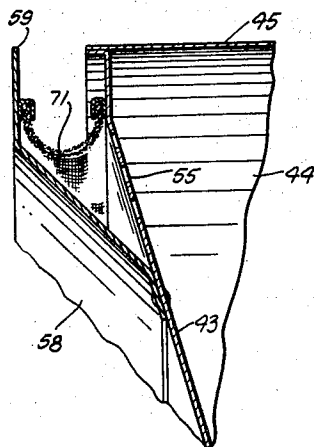
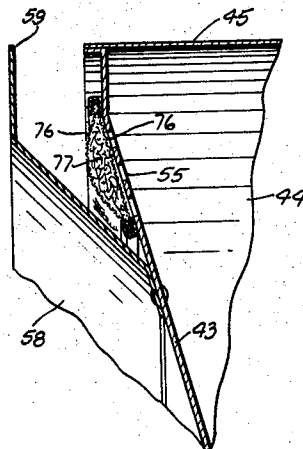


Fig. 5.



Inventor
Thomas R. Smith
by James S. [Signature]
Attorney

Nov. 1, 1960

T. R. SMITH

2,958,140

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Fig. 6.

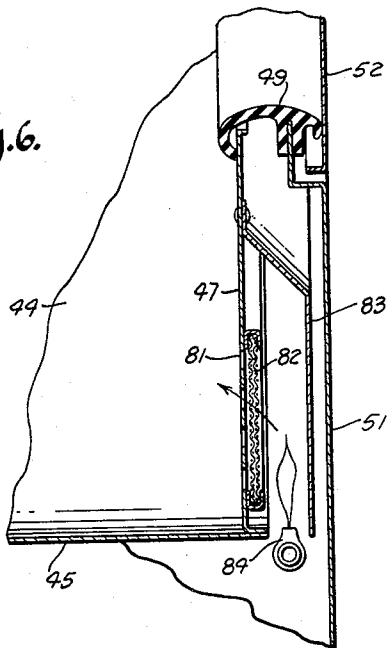


Fig. 7.

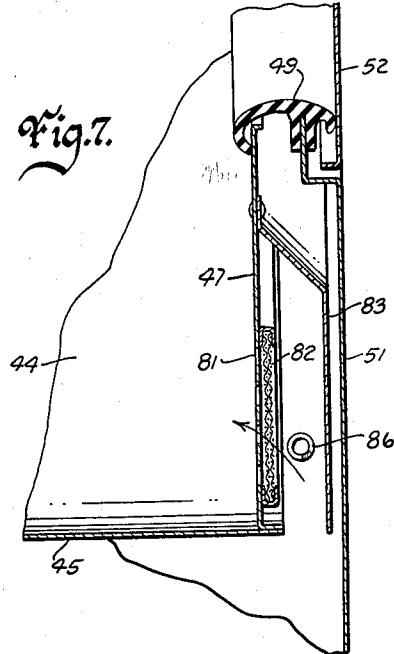
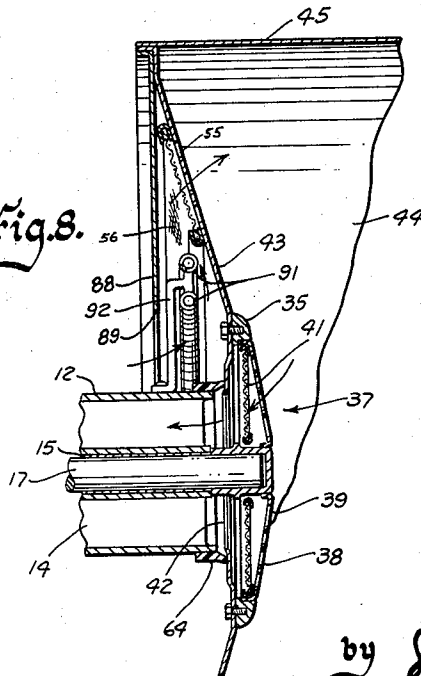


Fig. 8.



Inventor
Thomas R. Smith
by James S. *Widdleton*
Attorney

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2,958,140

CLOTHES DRIER WITH HEAT EXCHANGER

Thomas R. Smith, Newton, Iowa, assignor to The Maytag Company, Newton, Iowa, a corporation of Delaware

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14 Claims. (Cl. 34—133)

This invention relates to a means for heating the interior of a revoluble tumbler or drum of a domestic type clothes drier. It specifically relates to that type drier in which the clothes tumbler itself is provided with a heat exchanger positioned in the path of the air entering the drying chamber within the clothes drum.

In the preferred construction, the clothes drum is provided with a perforate end wall which is covered by a heat absorbent material such as metallic wool, layers of metal screen mesh, etc., which extends completely around the face of that perforate end wall and which is openly exposed to the outer periphery of the clothes drum. By applying heat to a sector of this ring of heat absorbent material and rotating the drum relative to the heat source, the air sucked into all portions of the perforate end wall will be forced through the heated ring of heat absorbent material and will be sufficiently elevated in temperature to provide adequate heat for evaporating moisture from clothing placed within the clothes tumbler without overheating any given area of the drum.

While suitable for both gas and electric operation this invention is especially advantageous for gas operation inasmuch as it allows the distribution of heat over a large area of the drum and prevents the extremely hot gases emanating from a gas burner from entering the perforate wall of the drum and scorching clothes within the drum.

In the accompanying drawings:

Figure 1 is a side elevational view, partially broken away, showing a clothes drier embodying my invention;

Figure 2 is a rear elevational view, partially broken away, taken on line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary view taken on line 3—3 of Figure 1 showing the front of the lint trap assembly for the clothes drier illustrated in Figure 1;

Figure 4 is an enlarged fragmentary sectional view taken through the rear portion of the clothes drum incorporating a modification of my invention;

Figure 5 is a view similar to that of Figure 4 showing a further modification;

Figure 6 is an enlarged fragmentary sectional view taken through the lower front central portion of a clothes tumbler incorporating a further modification;

Figure 7 is a view similar to that of Figure 6 showing the substitution of an electrical heating source for the gas heat source shown in Figure 6; and

Figure 8 is a fragmentary elevational view of a clothes drier differing from that shown in Figure 1 by the construction and positioning of the shroud and heater elements forming part of the heat exchanger unit.

Referring now to the accompanying drawings, Figure 1 shows a clothes drier provided with a base frame 10 which serves as a support for the two upstanding channel brace members 11 which are connected at their upper ends to the blower housing casting 12. Blower housing 12 is hollow to provide an air passageway therethrough for exit of air from the clothes drier as will be explained hereafter.

The interior of the hollow blower housing 12 is provided

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with three radially convergent webs 14 which join each other in the central portion of housing 12 to form a bearing 15 in the center of that housing.

Bearing 15 in turn journals the revoluble drum drive shaft 17 extending from both ends of casting 12. The rear end of shaft 17 is affixed to a large drive pulley 18 which is driven through belt 19 which in turn is connected to the small pulley 21. Pulley 21 is formed integrally with the large pulley 22 which is driven by the belt 23 connected to the rear pulley 24 on motor 26 which in turn is fastened to base frame 10. This pulley system produces the conventional reduction drive between motor 26 and the drum drive shaft 17.

Motor 26 through its front pulley 27 and belt 28 also rotates pulley 29 which is connected to the impeller member 31 revolubly mounted on drive shaft 17. With this arrangement motor 26 is capable of rotating the drum shaft 17 at approximately 50 revolutions per minute while rotating the impeller member 31 at approximately 1625 revolutions per minute within the blower housing cover 32 to exhaust air through the exhaust duct 33.

The front end of drive shaft 17 is attached to the drum spider 35 which is recessed to accommodate the lint trap generally indicated by the reference numeral 37 to filter lint from the air passing through the spokes of drum spider 35 and entering the blower housing casting 12.

Lint trap 37 is of two piece construction and includes a perforate conical front portion 38 provided with finger holes 39 to permit its easy removal from the recessed drum spider 35. Lint trap 37 also includes the lint screen 41 which is removably secured to the inner periphery of the perforate conical lint screen retainer 38 and is provided with a central aperture 42 to receive the central hub of drum spider 35 in a sealed relationship so that all lint passing rearwardly through the perforate conical plate 38 is caught on the lint screen 41 prior to its passage into the blower housing 12.

The rim of drum spider 35 encircles an air exhaust opening 42 formed in the rear wall 43 of clothes drum or tumbler 44 which is supported for rotation on a horizontal axis by reason of the rigid connection existing between spider 35 and rear wall 43. Drum 44 is provided, in the embodiments of my invention shown in Figures 1, 2 and 8, with an imperforate cylindrical side wall 45 carrying clothes elevating vanes 46 and a front wall 47 which is imperforate except for the access opening centrally positioned in that front wall. (The embodiments of Figures 6 and 7 include a perforate front drum wall construction.)

A conventional resilient annular door seal member 49 is carried in the cabinet access opening aligned with the access opening in wall 47 and extends into the drum 44 where it flares outwardly to provide an air seal between drum 44 and cabinet 51. The front door panel 52 hinged on cabinet 51 abuts door seal 49 to seal the access opening of cabinet 51.

In the embodiment of my invention shown in Figures 1 and 2 the outer portion of the rear drum wall 43 is provided with a number of concentric rows of holes 55 extending completely around that rear drum wall. These circular rows of holes 55 are covered by one or more layers of metal screen or mesh 56 which are fastened to the drum 44 on adjacent sides of these holes. An imperforate annular baffle or shroud member 58 extending toward the drum periphery in spaced relationship to holes 55 has its innermost portion rigidly fastened to the imperforate portion of rear drum wall 43 while its outer periphery terminates in edge 59. In this way shroud member 58 cooperates with the rear drum wall 43 to provide an openly facing annular recess or cavity for the heat absorbent material formed of screen 56. This annular recess channels the air into drum 44, reduces radiation losses and shields the flame emanating from the gas burner used to

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heat material 56. It may be desired to extend edge 59 beyond the periphery of drum 44 to provide an even greater radiation shield or air shield so as to provide a better control over the gas flame directed into this cavity.

As shown in Figures 1 and 2 the heat source provided for this clothes drier is in the form of a gas burner 61 having a slit 62 from which the gas flame emanates to impinge upon a sector of the periphery of the heat exchange material 56. Burner 61 is located intermediate shroud member 58 and the rear drum wall 43 with the degree of its projection into the annular recess formed by these members being determined by the magnitude of the flame, the amount of draft through drum 44, the heat absorbent material used, etc., so that the heat absorbing material 56 provides an efficient heat transfer from burner 61 to the interior of the drum without scorching any clothes that might be contiguous to holes 55.

The degree of angular coverage of the gas flame on the heat absorbent material will of course partially depend upon the ability of the heat absorbent material selected in leveling out the heat flow through holes 55. While it is preferable with this gas construction to heat only a sector of the heat absorbent material at any given instant, it is not intended that this application be a limitation to this invention. If desired, heat could also be simultaneously applied to the whole ring of material 56 even though this is not as practicable for a gas heat source as for an electrical heat source.

The heat source for this first embodiment of my invention is in the form of a stationary gas burner 61 positioned in the upper right quadrant of the annular recess formed by rear drum wall 43 and shroud 58. This location of burner 61 requires that a draft be present through the cavity formed by elements 43 and 58 before the flame emanating from the burner slit 62 will impinge against heat absorbent material 56 thereby serving as a safeguard against overheating of the fabrics within drum 44 in case of failure of belt 28 or clogging of lint trap 37.

In order to prevent leakage of the ambient atmosphere into the blower housing during the rotation of drum 44, a heat resistant seal 64 carried on the front peripheral edge of blower housing 12 engages rear drum wall 43 around the air exhaust opening 42.

In operation, motor 26 is energized through an external control circuit forming no part of this invention. This rotates drum 44 at its tumbling speed and causes impeller 31 to create a partial vacuum within that drum. Air from the ambient atmosphere enters drum 44 through heat absorbent material 56 and holes 55 and leaves that drum through lint trap 37 and exhaust opening 42 to be expelled through duct 33.

The controls for burner 61 are also energized through an external circuit so that a flame emanates from slit 62 carried in that burner. This flame preferably impinges on material 56 though it is not necessary that it does so to heat the latter material. While burner 61 does not, in this first embodiment of Figures 1 to 3, extend completely around the entire ring of material 56, it heats the entire mass of this material as the drum revolves at approximately 50 revolutions per minute. By absorbing the heat given off by the flame passing over it, the heat absorbent material 56 is capable of giving up heat to the interior of drum 44 as the relatively cool ambient air passes over it and enters drum 44 through holes 55.

The damp fabrics contained within that drum are therefore tumbled in air elevated in temperature by the heat given up by screen material 56 in this heat transfer process. A limited amount of heat also passes from burner 61 directly into drum 44. Evaporation of the moisture retained in these fabrics takes place and the resulting hot humid air is expelled from drum 44 by impeller 31 as long as the drying action continues. It will be apparent from this explanation that the average tem-

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perature of the large ring of heat absorbent material, as well as the drum itself, need not be of a great magnitude in order to supply an adequate amount of heat to the interior of drum 44.

The fragmentary view of Figure 4 shows a slight modification of the heat exchanger basically described for the drier shown in Figures 1, 2 and 3. In the modification of Figure 4, the wire mesh 71 is fastened to the drum wall 43 but instead of having its lower end also fastened to drum wall 43 as in Figures 1 and 2, wire mesh 71 bridges drum wall 43 and shroud 59 in a U-shaped cross section so as to move mesh 71 away from the cylindrical row of holes 55. Shroud 58 therefore not only functions as a means for channelling air through heat absorbent material 71 into drum 44 and provides an air shield for the gas burner and a radiation shield to conserve heat but also serves as a support for holding material 71 away from holes 55. While otherwise functioning the same as the first embodiment of this invention, the embodiment of Figure 4 is less apt to scorch clothing within drum 44 if burner 61 is not properly regulated.

The embodiment of Figure 5 is similar to the embodiment shown in Figure 1. The embodiment of Figure 5 however not only utilizes a wire mesh 76 against wall 43 and on the outer surface of the heat absorbent material but also incorporates a metallic wool filler 77 such as aluminum, steel or copper wool within the two sheets of wire mesh 76. This embodiment provides an increased surface and mass of heat absorbent material as well as numerous interstices through which air may pass so that large quantities of heat may be supplied to the drum through the heat exchanger process. Wire mesh 76 therefore functions as a retaining member to confine the loose strands of the metallic wool 77 as well as functioning as a heat exchanger material. This embodiment operates in a manner similar to the previously described embodiments.

The burner 61 shown in Figures 1 and 2, and which is also applicable to the embodiments of Figures 4 and 5, is positioned in an upper quadrant of the clothes drier illustrated in Figures 1 and 2 so as to require the draft created through the clothes drum 44 to draw the gas flame down toward the heat absorbent material carried in the cavity formed between the drum and heater shroud. With this positioning of burner 61, little or no flame can enter the recess formed by shroud 58 and rear drum wall 43 if impeller 31 ceases to rotate or if lint trap 37 becomes clogged since the absence of a draft through drum 44 allows the flame emanating from burner 61 to rise vertically above the burner rather than being drawn down towards material 56. This positioning of burner 61 therefore prevents an overheating of the interior of drum 44 if the draft through that drum should be terminated for any reason. The location of the gas burner 61 in an upper quadrant is also preferable by reason of the fact that should drum 44 cease to rotate for any reason the heat source will not be concentrated on one spot at the lower portion of drum 44 in such close proximity to the clothing positioned within the lower confines of that immobilized and stationary tumbler.

While the heat absorbent material has been shown as being positioned on the rear drum wall 43 of drum 44, it may also be placed over holes 81 in the modified front wall 47 of the clothes drum 44 in a manner similar to that shown by numeral 82 in Figure 6. In such a case, the rear drum wall would preferably be imperforate except for the exhaust opening 42. In Figure 6, numeral 83 indicates the positioning of the front annular shroud, which in this modification, is quite similar to that of Figure 1. Figure 6 also indicates that the positioning of the segmental gas burner 84 need not be limited to the upper quadrant but may also be located on the lower most portion of drum 44 if control over that burner is constantly maintained. The device shown in this em-

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bodiment operates similar to the previously described embodiments.

While this invention is primarily directed toward a clothes drier to be heated by a gas burner, it need not necessarily be limited to that type heat source. Figure 7 shows a slight modification over the embodiment shown in Figure 6 in that an electrical heating element 86 is substituted for the gas source shown in Figure 6. While the electric heating element 86, like the gas source, may be positioned over a limited sector of the heat absorbent material or even be positioned completely around the heat absorbent material, it differs in one respect from the gas source modifications in that the electric element itself is unaffected by the air draft through drum 44 and may be located deeper in the annular manifold cavity formed between the shroud 83 and the perforate drum wall 47. The flame of the gas burner, on the other hand, may be drawn through material 82 into the drum if the burner is positioned too deeply in this recess.

While it is preferable that the heat absorbent material be openly exposed to the periphery of the clothes drier as shown in the embodiments of Figures 1-7, inclusive, to reduce the heat applied per unit area of the heat absorbent material, this invention could also be used when the heat exchanger was exposed to the rotational axis of the drum as in Figure 8. In that figure, the perforate rear drum wall 43 is provided with apertures 55 covered by a screen material 56 which is shielded in turn by a circular shroud or manifold member 88 connected to rear wall 43 and provided with a centrally located air access opening 89 concentric to the periphery of casting 12.

The electric heating element 91 carried on supporting bracket 92 and encircling all or portion of blower housing 12 supplies the heat necessary for raising the temperature of heat absorbent material 56 so that air passing through air access opening 89 will be heated by both the heating element 91 and the heated material 56. In its operation, the modification of Figure 8 functions in a similar manner to that of the previously described embodiments except that all air entering opening 89 flows past electric heater 91 and through screen material 56. All of the air is therefore at least partially elevated in temperature prior to passing through material 56.

While I have indicated that the positioning of the heat absorbent material could be located on either of the two end walls of the clothes tumbler, it should be apparent that the cylindrical side wall 45 may be modified in a similar respect to accommodate this invention which is primarily directed towards a means of heating the interior of a clothes drum through a heat exchanger medium. Other constructions, combinations and arrangements of my invention as disclosed or taught by the foregoing specification and drawings are also intended to be included in this invention as covered by the following claims.

I claim:

1. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, an opening describing a circular perforate portion in said drum, heat absorbent material extending over said opening, a shroud member extending over said opening and said heat absorbent material in spaced relationship to said drum, heating means located exteriorly of said drum and directed between said drum and said shroud for heating successive portions of said heat absorbent material, means for rotating said heat absorbent material relative to said heating means, and means for drawing air into said drum past said heat absorbent material and through said opening to heat the interior of said drum by effecting a heat transfer between said heat absorbent material and the air entering said drum, said drum being further provided with an air outlet means spaced from said heat absorbent material.

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2. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, a series of openings describing a circular perforate portion in said drum providing an air intake into said drum, a mass of heat absorbent material covering said openings and providing interstices through which air entering said drum may pass, heating means located adjacent said drum for heating successive portions of said heat absorbent material to effect a heat transfer to air passing through said heat absorbent material, a shroud member over said openings and heating means, means for moving said heat absorbent material relative to said heating means, and means for drawing air into said drum through said interstices and said openings, said drum being further provided with an air outlet means spaced from said heat absorbent material.

3. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, a series of openings describing a circular perforate portion in said drum providing an air intake into said drum, a ring of heat absorbent material connected to said drum and extending over said openings, said heat absorbent material providing interstices through which air entering said drum through said openings may pass, a shroud member extending over said openings in spaced relationship to said drum, heating means located exteriorly of said drum between said shroud and said heat absorbent material for heating successive portions of said heat absorbent material, means for rotating said drum to tumble said fabrics and move said heat absorbent material relative to said heating means, and means for drawing air into said drum through said interstices and said opening to effect a heat transfer from said heating means to the air entering said drum, said drum being further provided with air outlet means spaced from said heat absorbent material.

4. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, said clothes drum including an end wall provided with circular rows of holes therein, a ring of heat absorbent material carried on said drum and extending over said rows of holes, a shroud member extending over said heat absorbent material and in spaced relationship thereto, stationary heating means directed toward said heat absorbent material and located intermediate said drum and said shroud for heating successive portions of said heat absorbent material, means for rotating said drum to tumble said fabrics and move said heat absorbent material relative to said heating means, and means for drawing air into said drum past said heat absorbent material to effect a heat transfer from said heating means to the interior of said drum through said heat absorbent material, said drum being further provided with air outlet means spaced from said heat absorbent material.

5. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, said drum being provided with a perforate end wall portion, a layer of metallic wool covering said perforate end wall portion, heating means located adjacent said drum for heating said metallic wool, and air translating means for moving air through said metallic wool and into said drum through said perforate end wall portion to heat the interior of said drum by means of the heat transfer effected between said metallic wool and the air passing therethrough.

6. In a clothes drier for drying damp fabrics, a clothes drum provided with a perforate wall portion, a layer of metallic wool covering said perforate wall portion, stationary means located adjacent said drum for heating said metallic wool, means for rotating said drum to move said metallic wool relative to said heating means, and air translating means for moving air into said drum through said metallic wool to heat the interior of said drum by the heat given up by said metallic wool to the air entering said drum.

7. In a clothes drier, a clothes drum provided with an end wall having a circular perforate portion therein, an

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annular mass of metal wool covering said circular perforate portion, means fastening said metal wool to said drum, stationary heating means located adjacent said drum for heating said metal wool, means for rotating said drum to move said metal wool relative to said heating means to heat the entire mass of metal wool, and means for drawing air through said metal wool and into said drum through said circular perforate portion to heat the interior of said drum by effecting a heat transfer from said metal wool to the air passing through said circular perforate portion.

8. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, said drum being provided with a circular perforate wall portion, a layer of heat absorbent material covering said perforate wall portion, a baffle member connected to said drum and having an edge extending in spaced relationship over said perforate portion, heating means positioned intermediate said edge and said perforate wall portion to heat successive portions of said heat absorbent material, and air translating means for moving air through said heat absorbent material into said drum to effect a heat transfer from said heat absorbent material to the interior of said drum, said drum being further provided with air outlet means spaced from said heat absorbent material.

9. In a clothes drier for drying damp fabrics, a clothes drum having an end wall provided with a circular row of holes therein, a layer of heat absorbent material extending over said holes, a shroud member connected to said drum and having an edge spaced from said drum, said shroud member extending over said heat absorbent material to define a cavity between said shroud member and said drum, heating means positioned intermediate said edge and said cylindrical row of holes for heating said heat absorbent material, means for rotating said drum to move said heat absorbent material relative to said heating means, and air translating means for moving air through said heat absorbent material and into said drum to effect a heat transfer from said heat absorbent material to the air passing into said drum.

10. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, said clothes drum including an end wall provided with a circular row of holes therein, a shroud member attached to said drum and extending over said holes in spaced relationship to said drum to form an annular recess in cooperation with said drum, a mass of heat absorbent material positioned within said recess and fastened to said drum for rotation with said drum, stationary heating means positioned adjacent said drum for heating said heat absorbent material, means for rotating said drum to move said heat absorbent material relative to said stationary heating means to heat the entire mass of heat absorbent material, and means for moving air into said drum through said heat absorbent material to effect a heat transfer from said heat absorbent material to the air entering said drum.

11. In a clothes drier for drying damp fabrics, a clothes drum having an end wall provided with a circular row of holes therein, a shroud member attached to said drum and extending over said holes in spaced relationship to said drum to form an annular recess in cooperation with said end wall, a mass of heat absorbent material including a metallic mesh covering said circular row of holes in said end wall, stationary heating means positioned adjacent said drum for heating said heat absorbent material, means for rotating said drum relative

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to said heating means to heat the entire mass of heat absorbent material, and air translating means for moving air into said drum through said holes and said heat absorbent material to effect a heat transfer from said heat absorbent material to the air entering said drum.

12. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics having a circular perforate end wall portion, a layer of heat absorbent material extending over said perforate end wall portion, a shroud member extending over said perforate portion of said end wall in spaced relationship to said drum, means for rotating said drum and heat absorbent material, stationary heating means positioned intermediate said shroud and said heat absorbent material to heat successive portions of said rotating heat absorbent material, and air translating means for moving air through said heat absorbent material and into said drum to effect a heat transfer from said heat absorbent material to the air passing into said drum, said drum being further provided with air outlet means spaced from said heat absorbent material.

13. In a clothes drier for drying damp fabrics, a clothes drum for receiving said fabrics, said clothes drum including an end wall provided with an annular perforate portion, a shroud member extending over said perforate portion in spaced relationship to said drum to form an annular recess in cooperation with said drum, a layer of heat absorbent material extending over said perforate portion and fastened to said drum for rotation with said drum, stationary heating means positioned adjacent said drum and directed into said annular recess for heating successive portions of said heat absorbent material, means for rotating said drum to move said heat absorbent material relative to said stationary heating means, and means for moving air into said drum through said heat absorbent material to effect a heat transfer from said heat absorbent material to the air entering said drum, said drum being further provided with air outlet means spaced from said heat absorbent material.

14. In a clothes drier for drying damp fabrics, a clothes drum having an end wall provided with an annular pattern of holes therein, a layer of heat absorbent material extending over said holes, a shroud member extending over said holes in spaced relationship to said drum to form an annular recess in cooperation with said drum, heating means in juxtaposition to said shroud for heating successive portions of said heat absorbent material, means for rotating said drum to move said heat absorbent material relative to said heating means, an air translating means for moving air through said heat absorbent material and into said drum to effect a heat transfer from said heat absorbent material to the air passing into said drum, said drum being further provided with air outlet means spaced from said heat absorbent material.

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