

July 7, 1953

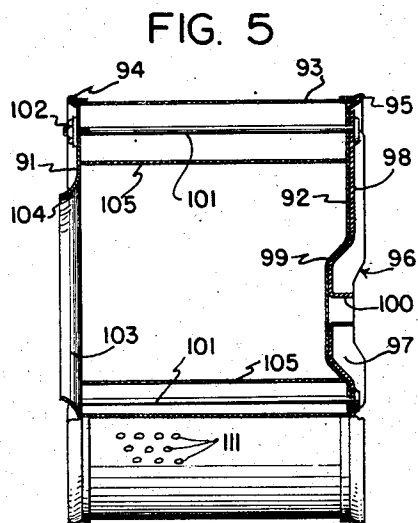
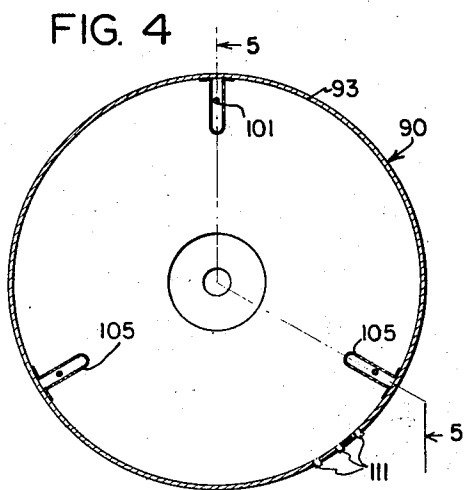
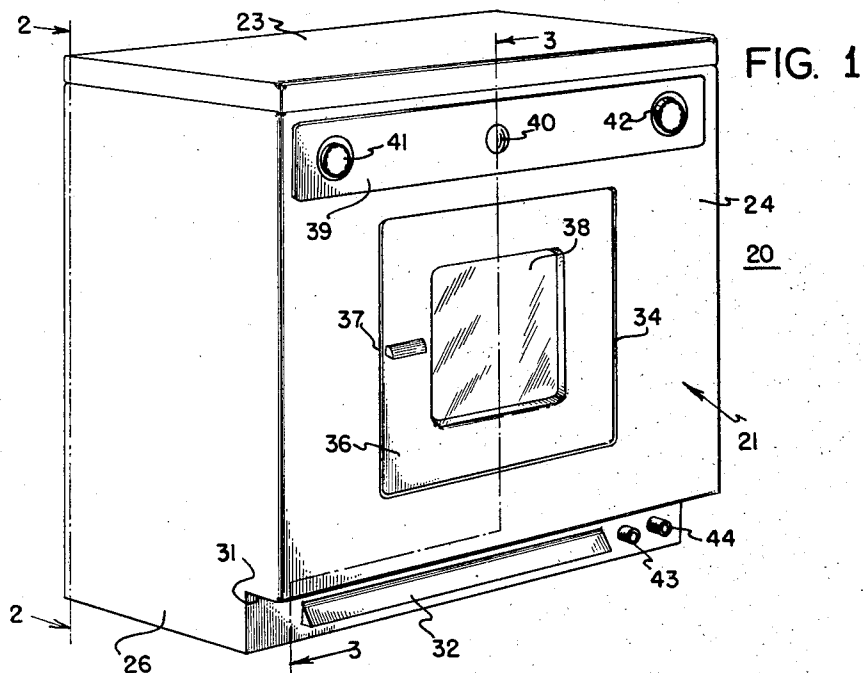
K. M. HAMMELL ET AL.

2,644,245

CLOTHES DRIER

Filed Feb. 10, 1949

5 Sheets-Sheet 1



Inventors

Kemper M. Hammell

Clifford E. Erickson

By

Smith, Olsen & Baird

Attys.

July 7, 1953

K. M. HAMMELL ET AL

2,644,245

CLOTHES DRIER

Filed Feb. 10, 1949

5 Sheets-Sheet 2

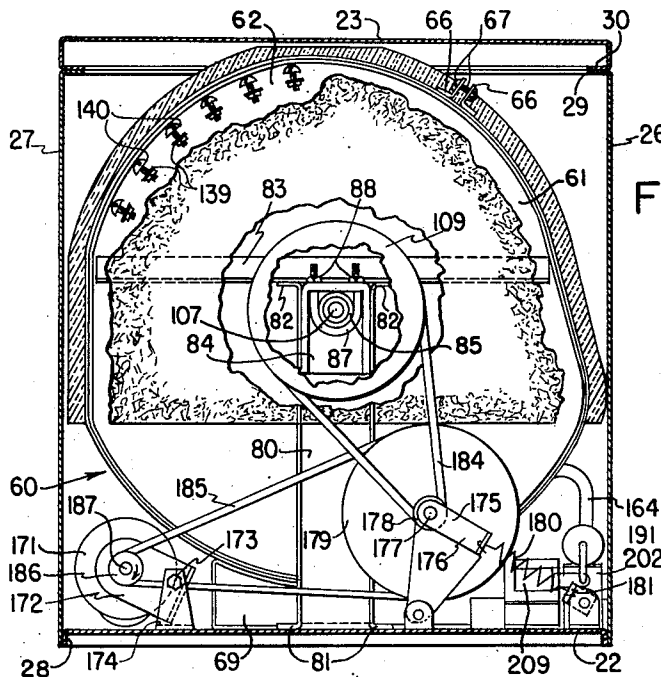


FIG. 2

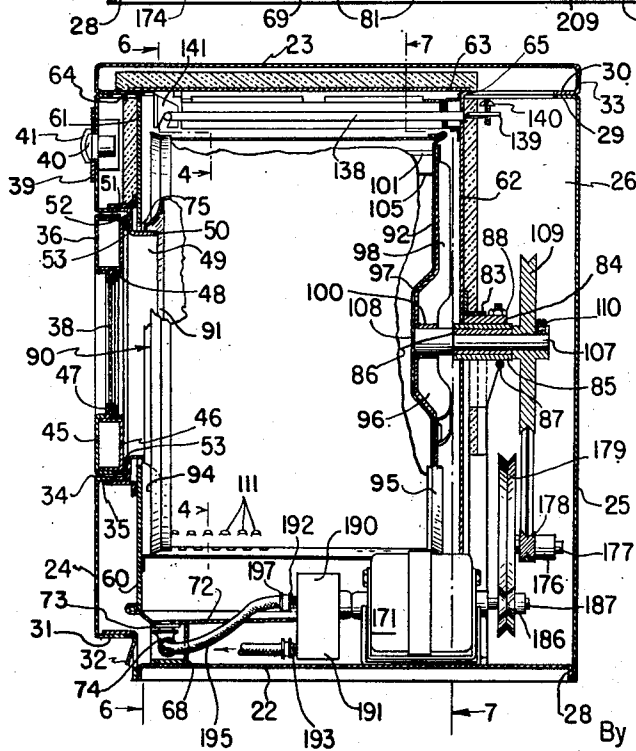


FIG. 3

Inventors
Kemper M. Hammell
Clifford E. Erickson

By
Smith, Olsen & Baird
Attys.

July 7, 1953

K. M. HAMMELL ET AL

2,644,245

CLOTHES DRIER

Filed Feb. 10, 1949

5 Sheets-Sheet 3

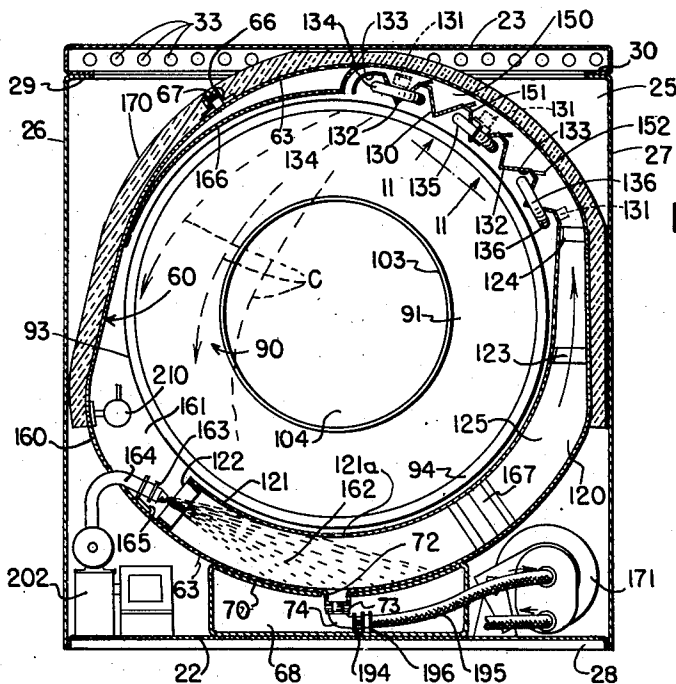


FIG. 6

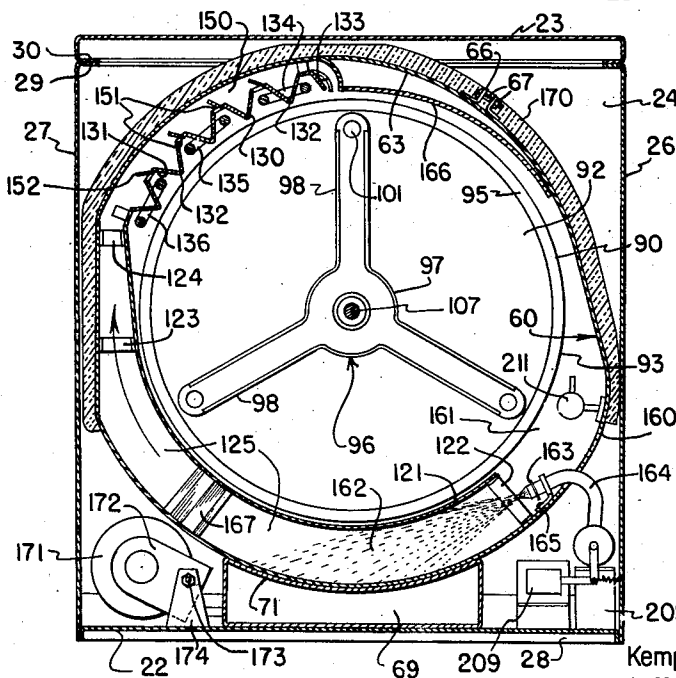


FIG. 7

Inventors
Kemper M. Hammell
Clifford E. Erickson

By
Smith, Olsen & Baird
Attys.

July 7, 1953

K. M. HAMMELL ET AL

2,644,245

CLOTHES DRIER

Filed Feb. 10, 1949

5 Sheets-Sheet 4

FIG. 8

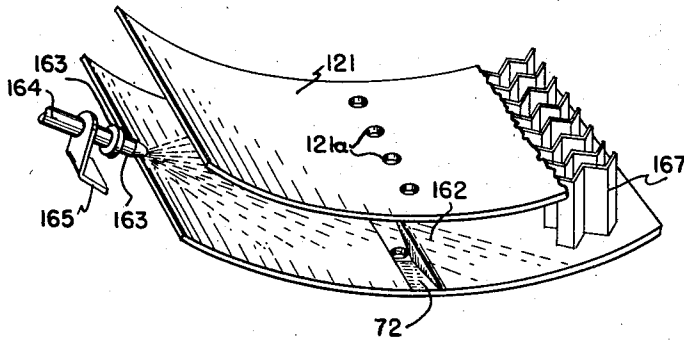


FIG. 9

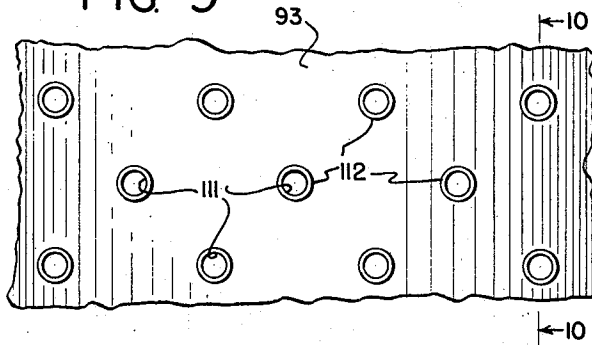


FIG. 10

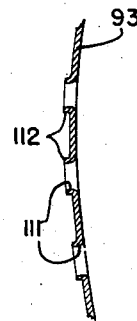
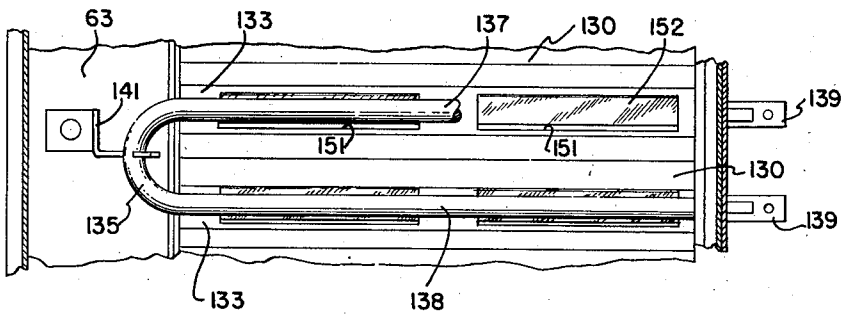


FIG. 11



Inventors
Kemper M. Hammell
Clifford E. Erickson
By *Smith, Olsen & Baird*
Attys.

July 7, 1953

K. M. HAMMELL ET AL

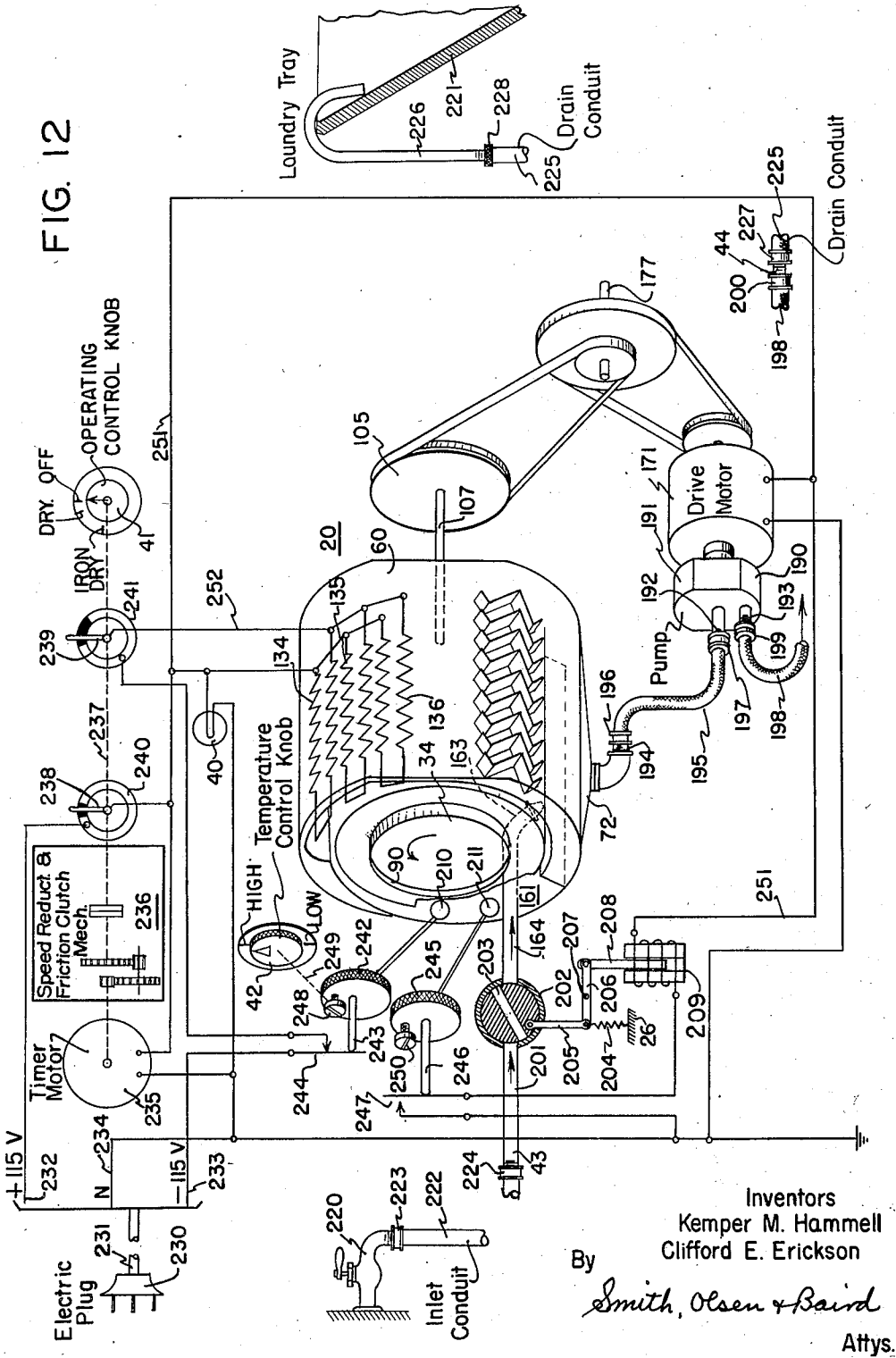
2,644,245

CLOTHES DRIER

Filed Feb. 10, 1949

5 Sheets-Sheet 5

FIG. 12



Inventors
Kemper M. Hammell
Clifford E. Erickson

By *Smith, Olsen & Baird*

Attys.

UNITED STATES PATENT OFFICE

2,644,245

CLOTHES DRIER

Kemper M. Hammell, Lombard, and Clifford E. Erickson, Chicago, Ill., assignors to General Electric Company, a corporation of New York

Application February 10, 1949, Serial No. 75,606

13 Claims. (Cl. 34—45)

1

The present invention relates to portable clothes drying machines of the home laundry type.

It is a general object of the present invention to provide an improved clothes drying machine of the type noted that employs a closed air circulating system so that no substantial amounts of heat or moisture or lint are transported from the machine into the laundry or other room in the home.

Another object of the invention is to provide a clothes drying machine including a drum adapted to receive and to tumble the clothes, which drum is provided with a casing that is to constructed and arranged that the rotation of the drum and the tumbling of the clothes therein produce the required circulation of air through the drum and the casing.

Another object of the invention is to provide a clothes drying machine of the type noted, wherein the casing comprises a scroll-shaped section cooperating with the rotating drum to provide a fan chamber such that the air is compressed and moved through the casing in a very substantial current, whereby no other form of fan or blower is required in the machine.

Another object of the invention is to provide a clothes drying machine incorporating an improved arrangement for subjecting the clothes contained in the tumbling drum and the air passed therethrough to radiant heat in order to obtain an efficient drying action.

A further object of the invention is to provide an improved clothes drying machine including a rotatable drum adapted to receive wet clothes to be dried, structures defining first and second chambers, facility for continuously circulating air from the first chamber into the drum into contact with the contained clothes and then into the second chamber and thence back into the first chamber, an arrangement for heating the air in the first chamber, and an arrangement for scrubbing the air with a finely divided spray of cool water in the second chamber, whereby moisture and lint are removed from the circulated air in the second chamber and transferred to the exterior of the machine.

A further object of the invention is to provide a portable clothes drying machine of the type noted and including a cabinet enclosing the casing housing the tumbling drum, wherein the cabinet carries a detachable inlet conduit for supplying cooling water to the second chamber and a detachable drain conduit for draining to the exterior the water and the condensate and the carried lint.

2

A further object of the invention is to provide a portable drying machine of the type noted, wherein the casing is provided with a sump for collecting the water and wherein the cabinet houses a pump for discharging the water from the sump into the drain conduit.

A further object of the invention is to provide a portable clothes drying machine of the type noted, wherein the cabinet also houses an electric motor for rotating the tumbling drum and for operating the pump and also carries a detachable circuit connector for supplying electric energy to the motor.

A further object of the invention is to provide a portable clothes drying machine of the type noted, wherein an electric heater is employed to preheat the air in the first chamber and also to subject the clothes and the air to radiant heat in the tumbling drum, and wherein a timer controlled electric circuit is employed for governing the supply of electric energy to the heater and to the motor.

A further object of the invention is to provide a portable clothes drying machine of the type noted, incorporating an improved timer and thermal responsive electrical control circuit for selectively governing operation thereof.

Further features of the invention pertain to the particular arrangement of the elements of the clothes drying machine, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 is a front perspective view of a portable clothes drying machine of the home laundry type embodying the present invention; Fig. 2 is a transverse sectional view, partly broken away, of the machine, taken in the direction of the arrows along the line 2—2 in Fig. 1, and illustrating the apparatus disposed in the rear portion of the cabinet; Fig. 3 is a longitudinal sectional view, partly broken away, of the machine, taken in the direction of the arrows along the offset line 3—3 in Fig. 1, and illustrating the apparatus disposed in the central and lower portions of the cabinet; Fig. 4 is a transverse sectional view of the perforated clothes-receiving drum incorporated in the machine, taken in the direction of the arrows along the line 4—4 in Fig. 3; Fig. 5 is a longitudinal sectional view of the drum, taken in the direction of the arrows along the offset line 5—5 in

Fig. 4; Fig. 6 is a transverse sectional view of the machine, taken adjacent to the front thereof in the direction of the arrows along the line 6—6 in Fig. 3; Fig. 7 is a transverse sectional view of the machine, taken adjacent to the rear thereof in the direction of the arrows along the line 7—7 in Fig. 3; Fig. 8 is an enlarged fragmentary perspective view of the lower portion of the casing enclosing the drum that is housed in the cabinet of the machine, illustrating the arrangement for scrubbing with a finely divided spray of cool water the air that is circulated in the casing and through the drum into contact with the contained clothes; Fig. 9 is a greatly enlarged fragmentary exterior view of the cylindrical side wall of the drum, illustrating the outwardly extending or extruded holes or perforations formed therein; Fig. 10 is a greatly enlarged fragmentary sectional view of the cylindrical side wall of the drum, taken in the direction of the arrows along the line 10—10 in Fig. 9; Fig. 11 is an enlarged fragmentary view of the middle heating element in the electric heater incorporated in the machine and disposed between the upper portion of the casing and the adjacent portion of the cylindrical side wall of the drum, this view being taken in the direction of the arrows 11—11 in Fig. 6; and Fig. 12 is a schematic perspective view of the machine and a diagrammatic illustration of the electric control circuit therefor, as well as a schematic illustration of associated conventional equipment normally located in a laundry room in a home.

Referring now to Figs. 1 to 7, inclusive, of the drawings, the portable clothes drying machine 20 there illustrated is especially designed for use in a home laundry and embodies the features of the present invention and comprises an upstanding cabinet 21 formed of sheet steel, or the like, and provided with a suitable exterior finish, such, for example, as white enamel. The cabinet 21 is of hollow construction comprising a supporting base or bottom wall 22, a top wall 23, a front wall 24, a rear wall 25, a left-hand side wall 26 and a right-hand side wall 27. The bottom wall or base 22 comprises a downwardly turned marginal flange 28 receiving the lower edges of the front wall 24, the rear wall 25 and the side walls 26 and 27 and carries suitable feet, not shown, adapted to engage a supporting floor. The front wall 24, the rear wall 25 and the side walls 26 and 27 are provided with an inwardly turned marginal flange 29 adjacent to the upper ends thereof that engage and support a cooperating inwardly turned marginal flange 30 provided about the lower portion of the top wall 23. The top wall 23 may be readily assembled and disassembled with respect to the front wall 24, the rear wall 25 and the side walls 26 and 27; and the last mentioned walls may be readily assembled and disassembled with respect to the bottom wall 22. The lower portion of the front wall 24 is rearwardly offset in order to provide a toe-receiving recess 31 permitting a person to work closely adjacent to the front wall 24. Preferably the cabinet 20 is of standard counter-line dimensions, whereby the distance between the lower edge of the marginal flange 28 of the bottom wall 22 and the top surface of the top wall 23 is 36 inches, the distance between the front wall 24 and the rear wall 25 is 27 inches, the distance between the side walls 26 and 27 is 31 inches, and the recess 31 is 4 inches by 4 inches. These dimensions of the cabinet 20 are given in terms of outside measurements permitting the machine 20 to be placed in a standard counter-

line disposed either in a laundry room or in a kitchen.

A laterally extending louver 32 is formed in the front wall 24 adjacent to the lower edge thereof and within the recess 31, and a series of laterally spaced-apart holes 33 are formed in the rear of the top wall 23; whereby the interior of the cabinet 20 may be ventilated, for a purpose more fully explained hereinafter, by an upwardly directed convection current of ambient air, the current of air passing through the louver 32 into the front lower portion of the cabinet 20 and thence upwardly and rearwardly therethrough and out through the holes 33. Also a substantially square centrally disposed front opening 34 is provided in the front wall 24, the front opening 34 being surrounded by an inwardly directed marginal flange 35 that receives a cooperating door 36. The door 36 is hinged adjacent to the right-hand side thereof within the marginal flange 35 in any suitable manner, not shown, and may be swung outwardly into an open position with respect to the front opening 34. The left-hand side of the door 36 is provided with a suitable handle 37 to facilitate movements thereof with respect to the front opening 34 into open and closed positions, and the central portion of the door 36 supports a transparent pane 38 formed of glass, or the like, rendering the interior of the cabinet 21 visible from the exterior when the door 36 occupies its closed position. Finally, the upper portion of the front wall 24 carries a laterally extending control and trim panel 39 disposed above the upper edge of the front opening 34 and just below the top wall 23. The panel 39 is suitably secured to the front wall 24 and has a centrally disposed opening therein through which a pilot light 40 is visible, the pilot light 40 being suitably mounted within the cabinet 21 and indicating operation of the machine 20 as explained more fully hereinafter. Also electric control and timer apparatus is mounted within the upper left-hand portion of the cabinet 21 and provided with a control shaft extending through the front wall 24 and panel 39, this control shaft carrying a control knob 41 that cooperates with associated indicia provided on the panel 39; further, thermostatically governed electrical control apparatus is mounted within the upper right-hand portion of the cabinet 20 and provided with a control shaft extending through the front wall 24 and the panel 39, this control shaft carrying a control knob 42 that cooperates with associated indicia provided on the panel 39. As explained more fully hereinafter in conjunction with Fig. 12, the control knob 41 is selectively rotatable in the clockwise direction in order selectively to set the desired time of operation of the machine and the consequent drying of the clothes either to an iron-dry condition, or to a dry condition, in a well-known manner; and the knob 42 is selectively rotatable in the clockwise direction in order selectively to set the desired temperature within the machine 20 between low and high temperature conditions, in a well-known manner. Finally, two threaded fixtures 43 and 44 are carried by the lower right-hand portion of the front wall 24 within the recess 31, the fixtures 43 and 44 being respectively included in an inlet conduit system, and in a drain conduit system, as explained more fully hereinafter in conjunction with Fig. 12.

As best shown in Fig. 3, the door 36 comprises outer and inner body sheets 45 and 46, each of substantially channel-shaped cross section. The outwardly directed edges of the inner body sheet

5

46 are disposed within the inwardly directed edges of the outer body sheet 45 and are suitably secured in place framing the glass pane 38. Preferably the glass pane 38 is positioned within a surrounding resilient gasket 47 formed of rubber, or the like, and the gasket 47 is directly clamped between the inwardly directed edge of the outer body sheet 45 and an associated surrounding frame 48 secured within the outwardly directed edge of the inner body sheet 46. As previously noted, the door 36 is hinged within the inwardly directed marginal flange 35 and cooperates with an associated throat collar 49 that is substantially Z-shaped in cross section. More particularly the throat collar 49 may be formed of molded fiber or other plastic composition and comprises an inwardly directed substantially circular flange 50 projecting into the cabinet 20 and an outwardly directed substantially square flange 51 secured directly within the inwardly directed marginal flange 35 surrounding the front opening 34. Preferably the flange 51 is detachably secured in place within the flange 35 in any suitable manner, whereby the throat collar 49 provides a substantially vertically disposed connecting section 52 extending between the flanges 50 and 51 and cooperating with the inner body sheet 46. Specifically, a substantially square flexible gasket 53 formed of rubber, or the like, is directly secured to the section 52 of the throat collar 49 and directly engages the adjacent surface of the inner body sheet 46 when the door 36 occupies its closed position. Thus it will be understood that when the door 36 occupies its closed position with respect to the front opening 34 that the inner body sheet 46 is effectively sealed to the throat collar 49 by the gasket 53.

Also the machine 20 comprises an upstanding casing 60 housed within the cabinet 21 and supported upon the base 22, the casing 60 being substantially tubular in form and including front and rear end walls 61 and 62 and a side wall 63. The end walls 61 and 62 have a generally annular configuration, and the side wall 63 has a generally cylindrical configuration. The end wall 61 is provided with a forwardly extending marginal flange 64 telescoped in the front end of the sidewall 63, and the rear wall 62 has a rearwardly directed marginal flange 65 telescoped within the rear end of the side wall 63. Preferably the side wall 63 is of one piece wrap-around construction, and the opposite ends thereof are secured in abutting relation by a plurality of pairs of cooperating clamping lugs 66 drawn together by appropriate bolts 67 provided with associated nuts. The casing 60 is supported upon the base 22 in spaced relation thereto by front and rear foot brackets 68 and 69. The front bracket 68 is substantially channel-shaped in cross section, whereby it is provided with a substantially arcuate shaped cradle 70 directly receiving and supporting the adjacent substantially cylindrical lower surface of the side wall 63 adjacent to the front end wall 61; and likewise the rear bracket 69 is substantially channel-shaped in cross section, whereby it is provided with a substantially arcuate shaped cradle 71 directly receiving and supporting the adjacent substantially cylindrical lower surface of the side wall 63 adjacent to the rear end wall 62. Further, a longitudinally extending downwardly depressed sump 72 is formed in the lowermost portion of the side wall 63, which sump 72 slopes rearwardly from the front end wall 61 and forwardly from the rear end

6

wall 62 terminating at the lowermost portion thereof into a threaded fixture 73 carrying an associated elbow 74. It will be understood that the sump 72, the fixture 73 and the elbow 74 are secured together in liquid-tight relation, and that similarly the joints between the side wall 63 and the flanges 64 and 65 are liquid-tight. Finally, a substantially circular front opening 75 is formed in the central portion of the front end wall 61 and disposed in surrounding relation with respect to the inwardly directed flange 50 carried by the throat collar 49, whereby the inwardly directed flange 50 projects through the front opening 75 into the casing 60. Accordingly, the casing 60 is substantially fluid-tight, except for the clearance between the front opening 75 and the throat collar 49, whereby the casing 60 defines a substantially closed system for circulating air, as explained more fully hereinafter.

A substantially centrally disposed upstanding channel 80 is carried by the base 22 rearwardly of and adjacent to the rear end wall 62, the lower end of the channel 80 being provided with outwardly extending feet 81 suitably secured to the base 22, the upper end of the channel 80 being provided with outwardly extending arms 82 that are secured to a transversely extending reinforcing angle iron 83 that is rigidly secured to the rear end wall 62. Also a substantially inverted U-shaped bracket 84 is secured within the upper end of the channel 80 and carries a cylindrical tube 85 supporting a sleeve bearing 86, the tube 85 being clamped to the adjacent upper portion of the bracket 84 by an arrangement including a U-shaped bolt 87 the opposite ends of which are threaded and carry cooperating nuts 88, the ends of the bolt 87 projecting through holes formed in the upper portion of the bracket 84. Thus the rear end wall 62 and the sleeve bearing 86 are firmly anchored in place upon the channel 80. The front ends of the tube 85 and the sleeve bearing 86 project through a centrally disposed opening formed in the rear end wall 62 into the casing 60.

Further the machine 20 comprises a substantially cylindrical tumbling drum 90 disposed within the casing 60 and comprising a substantially annular front end wall 91, a substantially annular rear end wall 92 and a substantially cylindrical side wall 93. The front end wall 91 is provided with a circumferentially extending marginal recess or bead 94 that receives the adjacent front edge of the side wall 93, and the rear end wall 92 is provided with a circumferentially extending marginal recess or bead 95 that receives the adjacent rear edge of the side wall 93. The outer surface of the rear end wall 92 carries a spider 96 provided with a forwardly projecting central hub portion 97 carrying three radially extending substantially equally spaced-apart arms 98. The hub 97 of the spider 96 is arranged in a forwardly directed emboss 99 formed in the central portion of the rear end wall 92 and is provided with a substantially centrally disposed sleeve 100. The outer ends of the three arms 98 have holes formed therein through which longitudinally extending rods or bolts 101 project and thence through aligned openings respectively formed in the rear end wall 92 and in the front end wall 91, the front ends of the rods 101 being threaded in order to receive cooperating nuts 102. Thus it will be understood that the rods 101 extending through the aligned openings formed in the arms 98 and

in the front and rear end walls 91 and 92 securely clamp together the component elements of the drum 90. The central portion of the front end wall 91 terminates in a forwardly directed curved lip 103 surrounding a substantially circular opening 104 formed therein. Finally three longitudinally extending and radially directed vanes 105, each substantially U-shaped in cross section, are secured in substantially equally spaced-apart circumferential relation to the interior surface of the side wall 93, the vanes 105 enveloping the rods 101 extending between the end walls 91 and 92.

The drum 90 is rigidly secured to an operating shaft 107, that is, in turn, rotatably mounted in the sleeve bearing 86. More particularly, the front end of the operating shaft 107 terminates in an enlarged head 108 that is firmly pressed and rigidly secured within the sleeve 100 carried by the hub portion 97 of the spider 96; while the intermediate portion of the operating shaft 107 is journaled within the sleeve bearing 86. A sheath pulley 109 is affixed to the rear end of the operating shaft 107 by an arrangement including a set screw 110. Accordingly, the midsection of the operating shaft 107 is positioned with respect to the sleeve bearing 86 by the cooperation between the head 108 and the hub of the pulley 109 with the respectively adjacent ends of the sleeve bearing 86 and the tube 85, whereby the operating shaft 107 may be freely rotated by the pulley 109. When the pulley 109 is thus rotated the operating shaft 107 is rotated in order to effect rotation of the drum 90 within the casing 60. This mounting arrangement of the drum 90 upon the operating shaft 107 retains the drum 90 in proper axial alignment within the casing 60 and in such position that the forwardly directed curved lip 103 is disposed within the front opening 75 formed in the front end wall 61 of the casing 60 and between the edge of the front opening 75 and the rearwardly projecting flange 59 of the throat collar 49. Thus when the drum 90 is rotated the lip 103 substantially closes the gap between the edge of the front opening 75 and the flange 50 without engaging or scrubbing either of these two adjacent parts.

As best shown in Figs. 9 and 10, the cylindrical side wall 93 is of foraminous or perforated construction, including substantially uniformly spaced-apart holes 111. Preferably the holes 111 are outwardly extruded in the side wall 93 in order to provide substantially circular outwardly projecting lips 112, whereby the interior surface of the side wall 93 is smooth and free of jagged or rough edges in order to prevent damage to clothes as they are tumbled within the drum 90. Thus it will be understood that when the door 36 occupies its open position that wet clothes to be dried may be placed through the front opening 34 in the cabinet 21 and through the throat collar 49 into the interior of the drum 90. Thereafter when the door 36 is closed an effective seal is produced by the gasket 53 between the door 36 and the throat collar 49, whereby the cabinet 21 and the casing 60 are effectively closed. At this time when the drum 90 is rotated the wet clothes are tumbled by the vanes 105, while air in the casing 60 is circulated through the drum 90 into contact with the wet clothes as they are tumbled, as explained more fully hereinafter.

The longitudinal axis of the drum 90 is disposed eccentric with respect to the longitudinal axis of the casing 60 so that the upper left-hand portion or quadrant of the cylindrical side wall

93 is disposed somewhat closer to the adjacent upper left-hand portion or quadrant of the side wall 63 than are the other portions or quadrants of the cylindrical side wall 93 with respect to the adjacent other portions or quadrants of the side wall 63, as clearly shown in Fig. 6. Accordingly, a substantially cusp-shaped space 120 is defined between the cylindrical side wall 93 of the drum 90 and the adjacent side wall 63 of the casing 60, this cusp-shaped space 120 extending substantially through an angle of approximately 270 degrees and disposed adjacent to the lower left, the lower right and the upper right portions or quadrants of the cylindrical side wall 93 of the drum 90. A substantially arcuate shaped baffle 121 is disposed in this cusp-shaped space 120 and extends longitudinally between the end walls 61 and 62 of the casing 60. The baffle 121 is thus disposed closely adjacent to, but in spaced-apart relation with respect to, the adjacent portion of the cylindrical side wall 93 of the drum 90, the baffle 121 being retained in place by a plurality of circumferentially spaced-apart brackets 122, 123 and 124, as best shown in Fig. 6. Accordingly, the baffle 121 cooperates with the adjacent portion of the side wall 63 to define a substantially arcuate shaped passage 125 extending between the lower left-hand portion or quadrant of the drum 90 and the upper right-hand portion or quadrant of the drum 90. A substantially arcuate shaped reflector 130 is arranged adjacent to the upper right-hand portion or quadrant of the cylindrical side wall 93 of the drum 90, which reflector 130 extends longitudinally between the end walls 61 and 62 of the casing 60 and is secured in place by suitable brackets 131. The reflector 130 is arranged mutually between the upper right-hand portion or quadrant of the cylindrical side wall 93 of the drum 90 and the adjacent portion or quadrant of the side wall 63 of the casing 60. The reflector 130 comprises a plurality of zigzag offsets 132 defining a corresponding plurality of pockets 133 therein. Preferably the reflector 130 is provided with an interior surface carrying a mirror-like bright chromium coating to provide an efficient reflection of radiant heat. Also three substantially U-shaped longitudinally extending electric heating elements 134, 135 and 136 are arranged between the reflector 130 and the adjacent upper portion or quadrant of the cylindrical side wall 93 of the drum 90 and in spaced relation with respect thereto.

As best shown in Fig. 11, the middle heating element 135 is of the hairpin type including two longitudinally extending rod-like sections 137 and 138 respectively disposed in two adjacent pockets 133 formed in the reflector 130. Each of the heating elements 135, etc., is of the sheathed-conductor type including a resistance conductor embedded in a mass of compacted heat-conducting and electrical-insulating material disposed in the associated sheath, the opposite ends of the electric resistance conductor carrying appropriate terminals 139. The ends of the sheath provided in the portions 137 and 138 are secured in openings provided in the rear end wall 62 and the terminals 139 project rearwardly therefrom, as clearly shown in Figs. 2, 3 and 11. Of course, it will be understood that the various terminals 139 are suitably insulated from the end wall 62 and are adapted to be connected in an electric circuit by terminal screws 140 carried thereby, as explained more fully hereinafter in conjunction with Fig. 12. The substan-

tially U-shaped end of the heating element 135 may be anchored to an adjacent portion of the side wall 63 by an appropriate bracket 141 secured thereto in order to prevent vibration of the heating element 135 during operation of the machine 20. Also the other heating elements 134 and 136 are constructed and arranged in a manner identical to that of the heating element 135 and are secured in place in a similar manner.

When electric current is supplied to the heating elements 134, 135 and 136 they are heated to a red heat, whereby radiant heat therefrom is projected directly onto the adjacent portion or quadrant of the cylindrical side wall 93 of the drum 90 and through the holes 111 formed in the side wall 93 into the drum 90 for the purpose of heating both the clothes and the air in the drum 90. Also radiant heat from the heating elements 134, 135 and 136 impinges upon the reflector 130, whereby the reflector 130 having a highly polished surface reflects this radiant heat back onto the side wall 93 and into the drum 90 in an efficient manner. However the reflector 130 is heated by the radiant heat impinging thereupon and effects heating of the air in the space disposed between the reflector 130 and the adjacent portion of the side wall 62 of the casing 60. In fact, the upper end of the baffle 121 joins the lower end of the reflector 130, whereby the passage 125 continues between the reflector 130 and the adjacent portion of the side wall 63. More particularly, the reflector 130 cooperates with the adjacent portion or quadrant of the side wall 63 of the casing 60 to define a first or preheat chamber 150 therebetween so that the air in the chamber 150 is preheated before entering the drum 90 as explained more fully hereinafter. Further, a number of openings 151 are formed in the bottom of the pockets 133 and communicate between the pockets 133 and the first chamber 150. Each of the openings is formed in the bottom of the adjacent pocket 133 by punching or outwardly projecting a louver 152 from the stock of the reflector 130, whereby the outwardly projecting louvers 152 cause the air in the first chamber 150 to be deflected through the associated openings 151 into the adjacent pockets 133 and thence into contact with the heating elements 135, etc., disposed in the pockets 133. Thus it will be understood that air moving upwardly in the passage 125 enters the first chamber 150 and is preheated therein by virtue of the hot wall of the reflector 130. Thence the air in the first chamber 150 is directed by the louvers 152 through the openings 151 and into contact with the heating elements 134, 135 and 136, and then the air passes through the holes 111 formed in the side wall 93 into the drum 90. Thus the air in the chamber 150 is preheated therein and is then heated further before passage into the drum 90.

As best shown in Fig. 6, the lower left-hand portion or quadrant of the side wall 63 of the casing 60 comprises a scroll-shaped section 160 disposed ahead of the passage 125 that cooperates with the adjacent lower left-hand portion or quadrant of the side wall 93 of the drum 90 to define a fan chamber 161 therebetween, the fan chamber 161 communicating with the interior of the drum 90 through the holes 111 formed in the side wall 93, and also communicating with the adjacent end of the passage 125. The fan chamber 161 causes air to be compressed therein and pumped into the adjacent end of the passage 125 when the drum 90 is rotated

in the counterclockwise direction, as viewed in Fig. 6. The lower portion of the baffle 121 disposed above the sump 72 cooperates with the adjacent lower portion of the side wall 63 of the casing 60 to define a condensing or second chamber 162 directly communicating with the fan chamber 161 and through the passage 125 with the first or preheating chamber 150. A nozzle 163 carried by a conduit 164 is arranged within the fan chamber 161 and supported by an associated bracket 165 secured to the lower portion of the side wall 63. As clearly shown in Fig. 8, the nozzle 163 is adapted to project a finely divided spray of cool water downwardly and toward the right into the condensing or second chamber 162 so that the air moving from the fan chamber 161 into the second or condensing chamber 162 is thoroughly scrubbed and cooled for a purpose more fully explained hereinafter. The water that is sprayed by the nozzle 163 entirely covers the cross section of the second or condensing chamber 162 and is projected in the same direction as the air moving through the second or condensing chamber 162 in order to effect thorough scrubbing thereof, which water then accumulates in the lower portion of the casing 60 and drains by gravity into the sump 72 and thence through the connection 73 into the elbow 74. In order to complete the air circulating system a substantially arcuate shaped deflector 166 is secured to the upper portion of the side wall 63 and abuts the left-hand portion of the side wall 63, the deflector 166 extending longitudinally between the end walls 61 and 62 and being spaced closely adjacent to and in cooperating relation with the associated upper left-hand portion or quadrant of the side wall 93 of the drum 90. Further, a series of radially projecting and circumferentially extending longitudinally spaced-apart baffles 167 are disposed between the lower right-hand baffles 121 and the adjacent lower right-hand portion of the side wall 63 of the casing 60. Each of the baffles 167 is of zigzag configuration, as clearly illustrated in Fig. 8. The baffles 167 are arranged in nested relation in order to provide a zigzag water and condensate de-entraining section within the passage 125 behind the second or condensing chamber 162 and ahead of the first or preheating chamber 150, and are utilized for a purpose more fully explained hereinafter.

Considering now the general operation of the machine 20 it will be understood that when the drum 90 is rotated in the counterclockwise direction as viewed in Fig. 6, the vanes 105 and the cylindrical side wall 93 thereof and the contained clothes tumbling therein as indicated by boundary lines C cooperate with the side wall 63 of the casing 60 and with the baffle 121 to pump air contained in the drum 90 through the holes 111 in the side wall 93 thereof into the fan chamber 161; whereby the air is compressed in the fan chamber 161 and forced into the adjacent end of the second chamber 162 and thence moves through the de-entraining baffles 167 and the passage 125 into the first chamber 150 under positive pressure. More specifically, the clothes tumbling in the drum 90 cascade from a position disposed adjacent to the top thereof to a position disposed somewhat above the bottom thereof, as indicated by the boundary lines C, the last-mentioned position being disposed over the fan chamber 161. The air in the first chamber 150 then flows through the openings 151 formed in the reflector 130 and between the ex-

treme left-hand end of the reflector 130 and the adjacent right-hand end of the deflector 166, as viewed in Fig. 6, onto the adjacent upper right-hand portion or quadrant of the cylindrical side wall 93 of the drum 90. This air then passes through the holes 111 formed in the side wall 93 into the drum 90 and into contact with the contained clothes undergoing tumbling therein. Thus it will be understood that the air is circulated into the closed system from the fan chamber 161 through the second chamber 162 and the passage 125 into the first chamber 150 and thence into the drum 90 and back into the fan chamber 161 continuously by virtue of the rotation of the drum 90. This pumping action is obtained not only by the fanning action of the vanes 105 upon the air in the drum 90, but also by the action of the clothes falling through the space in the drum 90 between the boundary lines C as they are undergoing tumbling. Accordingly, it will be understood that the machine 20 does not require any auxiliary fan or blower to obtain a positive circulation of air within the casing 60 as explained above.

As a constructional example it has been discovered that by utilizing a drum 90 having a length of substantially 18 inches and a diameter of substantially 27 inches that a circulation of air between 50 and 75 cubic feet per minute is obtained through the casing 60 when the drum 90 is rotated at approximately 50 R. P. M. and when the drum 90 contains approximately 9 lbs. of clothes in wet condition. The rate of circulation is considerably decreased when a smaller weight of wet clothes is tumbled, and also the rate of circulation decreases noticeably as the clothes are dried. Under normal initial conditions the rate of circulation mentioned was obtained employing 9 lbs. of clothes carrying 9 lbs. of water.

Continuing now with the operation of the machine 20 in the initial portion of the cycle, assume that the drum 90 is rotating at approximately 50 R. P. M. in order to tumble the wet clothes and that a circulation of air of approximately 50 cubic feet per minute is obtained in the casing 60. Further, assume that the clothes weigh approximately 9 lbs. and carry approximately 9 lbs. of water, and that cool water at a temperature of about 60 degrees F. is supplied to the nozzle 163 at a rate of approximately 22 gallons per hour, and finally that current is supplied to the heating elements 134, 135 and 136 in order to cause them to be heated to red heat and to develop approximately 4400 watts. Under these initial operating conditions the air entering the first or preheating chamber 150 from the passage 125 may have a temperature of approximately 120 degrees F. and may be substantially 100 per cent saturated. In the first or preheating chamber 150 the air may be heated to a temperature of approximately 170 degrees F. in order to effect a corresponding reduction in the relative humidity thereof. Next the air passing through the openings 151 in the reflector 130 and into direct contact with the heating elements 134, 135 and 136 is further heated to a temperature of approximately 270 degrees F., and then the air passes through the holes 111 in the cylindrical side wall 93 into the drum 90. The air is cooled somewhat in passing into the drum 90 and may have a temperature of about 200 degrees F. upon contacting the clothes and low relative humidity. Due to the radiant heat in the drum 90 the clothes therein are continuously heated, and the hot dry air in the drum 90 contacting the wet

clothes contained therein effects drying of the wet clothes, whereby the temperature of the air is considerably reduced and the relative humidity thereof is increased to substantially 100 per cent saturation. The air entering the fan chamber 161 may have a temperature of approximately 145 degrees F. and may be approximately 100 per cent saturated. The air is then compressed in the fan chamber 161 and swept into the second or condensing chamber 162, wherein it is thoroughly scrubbed with the finely divided spray of cool water at the temperature of approximately 60 degrees F. Accordingly, the temperature of the air is appreciably reduced in order to effect the precipitation of moisture therefrom, whereby the temperature of the air may be approximately 120 degrees F. as it passes through the de-entraining baffles 167 in the passage 125 to be returned to the first or preheating chamber 150. The air passing from the second or condensing chamber 162 is not only 100 per cent saturated, but carries considerable entrained condensate as well as considerable water spray when it reaches the de-entraining baffles 167; however, the air in passing through the sinuous passages provided by the de-entraining baffles 167 gives up the entrained condensate and the entrained water spray, whereby the air returned through the passage 125 into the first or preheating chamber 150 carries no substantial entrained condensate or water and has a temperature of 120 degrees F. and is approximately 100 per cent saturated as previously noted.

Thus it will be understood that the relative humidity of the hot air in the drum 90 is increased in order to effect drying of the clothes tumbled therein and that this moisture is transported from the drum 90 into the second or condensing chamber 162, whereby this moisture in the air is given up in the second or condensing chamber 162 by condensation as a consequence of the cooling of the air in the second or condensing chamber 162. Of course, it will be understood that the condensate or water removed from the circulated air by the de-entraining baffles 167 runs back down the lower side wall 63 of the casing 60 into the sump 72, and that substantially all of the water sprayed into the condensing chamber 162 from the nozzle 163 falls directly into the sump 72. While the temperature of the water sprayed from the nozzle 163 into the second or condensing chamber 162 has been assumed to have a temperature of about 60 degrees F. it will be appreciated that cooling water at a lower temperature is desirable in order to increase the rate at which the moisture in the air in the second or condensing chamber 162 is precipitated out, and that cooling water at a temperature of the order of 50 degrees F. or lower is employed when it is available; however, the machine 20 operates entirely satisfactorily employing cooling water having a temperature as high as 90 degrees F.

During the operation of the machine 20 it will be appreciated that as the wet clothes contained in the drum 90 are dried, loose lint contained therein is picked up by the circulated air passing through the drum 90 into the fan chamber 161, whereby the air passing from the fan chamber 161 into the second or condensing chamber 162 carries with it the loose lint mentioned. However, since the air moving through the second or condensing chamber 162 is thoroughly scrubbed with the finely divided spray of cool water, the carried lint is effectively trapped and washed

along with the water into the sump 72. In fact, all of the lint is trapped and washed into the sump 72 before the air passes from the second or condensing chamber 162 into the de-entraining baffles 167 so that the lint is not deposited upon the de-entraining baffles 167. Of course, it follows that the air returned through the passage 125 into the first or preheating chamber 150 is free of lint. Accordingly, during the operation of the machine 20, not only is the water removed from the wet clothes tumbling in the drum 90, but also the loose lint is removed therefrom, whereby both the water contained in the clothes, as well as the loose lint contained therein, are ultimately washed into the sump 72. In passing it is noted that a number of longitudinally spaced-apart openings 121a are provided in the lower portion of the arcuate shaped baffle 121 in order that any water dripping from the wet clothes placed in the drum 90 and falling upon the baffle 121 may be conducted through the openings 121a directly into the sump 72. The water, condensate and lint washed into the sump 72 passes through the fixture 73 into the elbow 74 and is ultimately conducted to the exterior of the cabinet 21 as explained more fully hereinafter.

In view of the foregoing description of the general operation of the machine 20, it will be understood that since a closed circulating system is employed that hot air is not discharged into the laundry room, whereby the operation of the machine 20 does not effect any substantial heating of the laundry room, the relative humidity of the air in the laundry room is not increased, and no lint is discharged into the laundry room. This operation of the machine 20 not only eliminates many of the criticisms of prior clothes drying machines, but it materially increases the over-all efficiency of operation thereof.

Since the air circulated in the casing 60 is heated adjacent to the upper portion thereof in the first or preheating chamber 150 and is cooled adjacent to the lower portion thereof in the second or condensing chamber 162, the exterior surface of the casing 60 is selectively insulated. More particularly, the upper portion of the exterior surface of the casing 60 is provided with an insulating jacket 170 in order to retard heat transfer therefrom, while the lower portion of the casing 60 is exposed in order to facilitate heat transfer therefrom. Further, the lower portion of the casing 60 adjacent to the second or condensing chamber 162 is additionally cooled by the upward circulation of air through the cabinet 21 between the louver 32 disposed in the front wall 24 adjacent to the base 22 within the recess 31 and the holes 33 provided in the rear edge of the top wall 23 as previously explained. The insulating jacket 170 may comprise a plurality of sections or bats of glass wool, or other suitable insulating material, removably secured to the associated upper portion of the exterior surface of the casing 62 in any suitable manner.

Continuing now with the construction of the machine 20 the cabinet 21 also houses an electric drive motor 171 in the lower right-hand corner thereof that is carried by a bracket 172, the bracket 172 being pivotally mounted by a pair of aligned bolts 173 upon a base 174 that is directly secured to the upper surface of the bottom wall 22. The pivotal mounting of the bracket 172 upon the base 174 accommodates initial adjustment of the drive motor 171 for the purpose of setting tight associated drive belting, as best shown in Fig. 2. Also the cabinet 21 houses idler mechanism 175 including a pair of brackets 176

pivotally mounted upon the base 22 and rotatably supporting an idler shaft 177 carrying a small sheath pulley 178 and a large sheath pulley 179, the pulleys 178 and 179 being rigidly secured to the idler shaft 177. The pair of brackets 176 are secured to a spring 180 that is, in turn, secured to a bracket 181 that is pivotally mounted upon the base 22 adjacent to the rear left-hand corner thereof as shown in Fig. 2. The small pulley 178 is belted by a substantially V-shaped belt 184 to the relatively large pulley 109 secured to the operating shaft 107; and the relatively large pulley 179 is belted by a substantially V-shaped belt 185 to a relatively small sheath pulley 186 rigidly secured to an operating shaft 187 of the drive motor 171. As clearly shown in Fig. 2, the spring 180 urges the pair of brackets 176 and the supported idler shaft 177 at an angle both towards the bottom wall 22 and toward the left-hand side wall 26, whereby both of the belts 184 and 185 are retained in tight condition. Accordingly, it will be understood that when the drive motor 171 is operated to rotate the operating shaft 187 thereof in the clockwise direction, as viewed in Fig. 2, the small pulley 186 rotating in the clockwise direction rotates the large pulley 179 through the belt 185 at a reduced speed in the clockwise direction, whereby the idler shaft 177 and the small pulley 178 are rotated at the reduced speed in the clockwise direction. The small pulley 178 rotating in the clockwise direction rotates the large pulley 109 through the belt 184 at a further reduced speed in the clockwise direction, whereby the drum 90 is rotated at the required speed of approximately 50 R. P. M. in the counterclockwise direction, as viewed in Fig. 6. The arrangement pivotally mounting the bracket 172 carrying the drive motor 171 permits initial adjustment of the tension in the belts 184 and 185, and the spring arrangement in the mechanism 180 maintains this initial tension in the belts 184 and 185 during operation of the machine 20.

Also the casing of the drive motor 171 carries a pump 190 provided with a casing 191 having threaded intake and discharge fixtures 192 and 193, respectively. The casing 191 of the pump 190 is rigidly secured to the casing of the drive motor 171 and is movable therewith upon the brackets 172; while the operating shaft 187 of the drive motor 171 extends into the casing 191 for the purpose of operating the rotor, not shown, of the pump 190. Accordingly, when the drive motor 171 is operated to rotate the drum 90 in the manner explained above the pump 190 is operated, whereby liquid may be drawn into the intake fixture 192 and pumped through the discharge fixture 193. The outer end of the elbow 74 that is secured to the fixture 73 communicating with the sump 72 is threaded in order to receive a cooperating threaded fixture 194. The threaded fixtures 192 and 194 are detachably secured in communicating relation with each other by a flexible section of hose 195 formed of rubber, or the like, and carrying detachable connectors 196 and 197 at the opposite ends thereof, the detachable connectors 196 and 197 being respectively secured to the threaded fixtures 194 and 192. Accordingly, when the pump 190 is operated the water, condensate and lint washed into the sump 72 are conducted through the fixture 73, the elbow 74, the fixture 194 and the connector 196 into the hose 195 and is thence drawn through the connector 197 and the fixture 192 into the casing 191 of the pump 190,

this material being ultimately discharged through the fixture 193.

As best shown in Fig. 12, the discharge fixture 193 is detachably connected to the drain fixture 44 by a communicating section of flexible hose 198 formed of rubber, or the like, and carrying detachable connectors 199 and 200 at the opposite ends thereof, the detachable connectors 199 and 200 being respectively threaded upon the fixtures 193 and 44. Accordingly, the material discharged from the casing 191 of the pump 190 through the discharge fixture 193 is forced through the connector 199, the hose 198 and the connector 200 and thence through the drain fixture 44 to the exterior of the cabinet 21. The flexible hoses 195 and 198 permit relative movement of the pump 190 with the drive motor 171 without disturbing the water connections described above.

The inlet fixture 43 is connected by a section of pipe 201 to the casing of an inlet valve 202, which casing is also connected to the conduit 164 that supports the nozzle 163. The inlet valve 202 comprises a rotor or valve element 203 that is normally biased to close the communication between the conduits 201 and 164; the inlet valve 202 being of the solenoid-controlled type. As best illustrated in Fig. 12, the rotor 203 of the valve 202 is normally biased in the counterclockwise direction by a coil spring 204 connected between the left-hand side wall 26 and a link 205 that is pivoted to the valve element 203. The link 205 is also pivoted to a link 206 that is supported upon a stationary pivot 207, which link 206 is further pivoted to an armature 208 of a solenoid 209. As previously noted the valve element 203 of the inlet valve 202 is biased in the counterclockwise direction, as viewed in Fig. 12, closing the communication between the conduits 201 and 164; however, when the solenoid 209 is energized the armature 208 is attracted rotating the link 206 in the clockwise direction about the pivot pin 207 against the bias of the spring 204 and rotating the valve element 203 through the link 205 into its open position, whereby the conduits 201 and 164 are placed in communication with each other. Subsequently, when the solenoid 209 is de-energized the spring 204 returns the valve element 203 in the counterclockwise direction, as viewed in Fig. 12, back into its closed position in order to cut off the supply of cooling water through the conduit 201 into the conduit 164.

Also two thermostatic control bulbs 210 and 211 are arranged in the fan chamber 161 in longitudinally spaced-apart relation and responsive to the temperature of the air passing into the fan chamber 161 from the rotating tumbling drum 90; which thermal responsive bulbs 210 and 211 are employed in the control circuit of the machine 20 in a manner more fully explained in conjunction with Fig. 12.

Referring now to Fig. 12, it is assumed that the machine 20 is arranged in the laundry room of a home that is provided with the usual plumbing facilities including a water tap or faucet 220 connected to a source of cool water, not shown, and a laundry tray or tub 221 provided with a drain discharging into the home plumbing system, not shown. The water tap 220 may be detachably connected to the inlet fixture 43 by an appropriate section of inlet conduit 222 carried by the cabinet 21, the inlet conduit 222 comprising a convenient section of flexible hose formed of rubber, or the like. The hose 222 carried detachable connectors 223 and 224 at the opposite ends thereof which are respectively threaded upon the end

of the water tap 220 and upon the inlet fixture 43. The laundry tray 221 may be detachably connected to the drain fixture 44 by an appropriate section of drain conduit 225 carried by the cabinet 21, the drain conduit 225 comprising a convenient section of flexible hose formed of rubber, or the like, as well as a hook-shaped pipe 226. The hook-shaped pipe 226 comprises a handle that is hooked over the wall of the laundry tray 221 for drain purposes. The hose 225 carries detachable connectors 227 and 228 at the opposite ends thereof which are respectively threaded upon an associated end of the pipe handle 226 and upon the drain fixture 44. Thus it will be understood that when the tap 220 is opened cool water under pressure from the plumbing system in the home is supplied through the inlet conduit 222 to the inlet valve 202, which cooling water is supplied to the nozzle 163 when the inlet valve 202 is operated to its open position by the associated solenoid 209, when the machine 20 is operating. Also when the machine is operating the pump 190 is operated, whereby the material washed into the sump 72 is pumped by the pump 190 through the drain conduit 225 into the laundry tray 221 and thence into the drain plumbing system incorporated in the home.

Also it is assumed that the laundry room in the home comprises a convenient source of current supply of the three-wire Edison type that may be of 230 volts and including two line conductors and a grounded neutral conductor. This three-wire Edison source of current supply is connected by the home wiring system to a socket, not shown, which is adapted to be engaged by a cooperating detachable electric plug 230 carried upon the end of a cable 231 that is, in turn, carried by the cabinet 21 of the machine 20 and appropriately wired into the control system of the machine 20, the cable 231 comprising two line conductors 232 and 233 and a grounded neutral conductor 234.

Considering now the connection and arrangement of the control system of the machine 20 as illustrated in Fig. 12, the control equipment housed within the cabinet 21 further comprises a synchronous timer motor 235 that may be of the "Telechron" type that is provided with speed reduction and friction clutch mechanism 236 operatively connected to the operating shaft 237 that carries the operating control knob 41. The operating shaft 237 also carries two timing wipers 238 and 239 respectively associated with two timing cams 240 and 241. The thermostatic bulb 210 is operatively connected to a thermostatic bellows 242 that is provided with a plunger 243 that controls an associated switch 244; and the thermostatic bulb 211 is operatively connected to a thermostatic bellows 245 that is provided with a plunger 246 that controls an associated switch 247. The switch 244 is normally closed but may be opened by the plunger 243 under the control of the bellows 242 that is governed by the thermostatic bulb 210, the temperature control of the bellows 242 being adjustable through an adjustable screw 248 that is operatively connected to the operating shaft 249 upon which the temperature control knob 42 is carried. The switch 247 is normally opened but may be closed by the plunger 246 under the control of the bellows 245 that is governed by the thermostatic bulb 211, the temperature control of the bellows 245 being adjustable through a manually adjustable screw 250. One terminal of the timer motor 235 is connected to the neutral conductor 234, and

the other terminal thereof is connected to a control conductor 251. Also the terminals of the pilot lamp 40 are connected between the neutral conductor 234 and the control conductor 251. The electric heating elements 134, 135 and 136 are connected in multiple respectively to the control conductor 251 and to a control conductor 252. The line conductor 232 is connected to the timer cam 240, and the wiper 238 is connected to the control conductor 251. The line conductor 233 is connected to one terminal of the switch 244, and the other terminal of the switch 244 is connected to the timer cam 241, and the wiper 239 is connected to the control conductor 252. Also the neutral conductor 234 is connected to one terminal of the switch 247, while the other terminal of the switch 247 is connected to one terminal of the solenoid 209, and the other terminal of the solenoid 209 is connected to the control conductor 251. One terminal of the drive motor 171 is connected to the control conductor 251, and the other terminal of the drive motor 171 is connected to the neutral conductor 234.

Considering now the operation of the machine 20, it may be assumed that the top 220 has been opened and that the electric plug 230 has been inserted into the associated electric socket, not shown. Further, it may be assumed that the bellows 245 is adjusted by the screw 250 to operate the switch 247 when the air contacting the thermal bulb 211 in the fan chamber 161 reaches a temperature of approximately 130 degrees F. At this time the person places the wet clothes to be dried into the drum 90 through the front opening 34 when the door 36 occupies its open position. It may be assumed that approximately 9 lbs. of clothes carrying 9 lbs. of water are thus placed in the drum 90, and the door 36 is then closed. The person then determines the temperature he desires in the drum 90 and then appropriately rotates the temperature control knob 42 into its high position or its low position or some intermediate position in order correspondingly to adjust the screw 248 and consequently the control of the bellows 242 upon the switch 244, the bellows 242 being governed by the thermal bulb 210 also disposed in the fan chamber 161 as previously noted. The person then determines whether he wishes the clothes finished to a complete dry condition, or to an iron-dry condition containing some residual moisture to facilitate ironing of the clothes. Upon making this determination he appropriately operates the control knob 41 in the clockwise direction from its off position into its iron-dry or dry positions.

Assuming that the clothes placed in the drum 90 are to be dried to the iron-dry condition, the operating control knob 41 is rotated in the clockwise direction from its off position into its iron-dry position. This rotation of the operating control knob 41 effects a corresponding rotation of the operating shaft 237 and the wipers 238 and 239 carried thereby, the mechanism 236 permitting the required slippage between the operating shaft 237 and the timer motor 235. More particularly, the wiper 238 is first moved off of the associated insulating section of the timer cam 240 connecting the line conductor 232 to the control conductor 251; and the wiper 239 is then moved off of the associated insulating section of the timer cam 241 connecting the line conductor 233 through the closed switch 244 to the control conductor 252. When the line conductor 232 is thus connected by the wiper 238 and the timer cam 240 to the control conductor 251, an obvious

circuit is completed for operating the timer motor 235 and obvious multiple circuits are completed for illuminating the pilot lamp 40 and for operating the drive motor 171. Thus the timer motor 235 is operated across the line conductor 232 and the neutral conductor 234 at 115 volts in order to produce a timing operation, the timer motor 235 operating at a constant timing rate. More particularly, the timer motor 235 returns the operating shaft 237 through the mechanism 236 in the counterclockwise direction back toward its off position, whereby the operating control knob 41 is rotated at the timed rate back towards its off position. Thus the operating control knob 41 not only initiates operation of the machine 20 but it also serves as an indicator of the particular operating condition thereof. Also the pilot lamp 40 is illuminated across the line conductor 232 and the neutral conductor 234 at 115 volts indicating that the machine 20 is operating at this time.

Further, the drive motor 171 is operated across the line conductor 232 and the neutral conductor 234 at 115 volts, whereby operation of the pump 190 is initiated and the drum 90 is rotated in the counterclockwise direction, as viewed in Fig. 12, through the drive mechanism including the idler shaft 177 previously described. When the line conductor 233 is thus connected to the control conductor 252 the electric heating elements 134, 135 and 136 are supplied in multiple with heating current across the line conductors 232 and 233 at 230 volts; whereby the heating elements 134, 135 and 136 are soon heated to red heat.

Rotation of the drum 90 in the counterclockwise direction not only tumbles the contained clothes, but it also establishes the circulation of air through the casing 60, all in the manner previously explained; whereby the temperature of the air entering the fan chamber 161 rises rapidly heating the thermal bulbs 210 and 211. When the temperature of the air entering the fan chamber 161 reaches a temperature of approximately 130 degrees F. the thermal bulb 211 is heated sufficiently to govern the bellows 245, whereby the plunger 246 operates the switch 247 from its open position into its closed position. When the switch 247 is thus operated into its closed position, a circuit, including the control conductor 251, the wiper 238 and the timer cam 240, is completed between the neutral conductor 234 and the line conductor 232 for energizing the solenoid 209, whereby the solenoid 209 operates the inlet valve 202 from its closed position into its open position in the manner previously explained. At this time cool water is supplied from the water tap 220 via the inlet valve 202 to the nozzle 163, whereby the air circulated in the casing 60 is scrubbed in the condensing chamber 162 with the finely divided spray of cool water, all in the manner previously explained. The water, condensate and lint that is washed into the sump 72 is pumped by the pump 190 into the laundry tray 221 and drained to the exterior of the laundry room.

At this time the machine 20 is operating to effect drying of the clothes as they are being tumbled in the drum 90, and in the event the temperature of the air passing into the fan chamber 161 exceeds the normal temperature of 145 degrees F. by a suitable increment, the thermal bulb 210 is controlled to effect operation of the bellows 242, whereby the plunger 243 operates the switch 244 from its closed position into its open position. When the switch 244 is

thus operated to its open position the previously traced circuit for supplying current to the heating elements 134, 135 and 136 is interrupted, whereby the temperature of the air circulated in the casing 60 is reduced. Shortly thereafter the temperature of the air entering the fan chamber 161 again falls to the normal temperature of approximately 145 degrees F., whereby the thermal bulb 210 is appropriately cooled to control the bellows 242 in order to cause the plunger 243 to operate the switch 244 from its open position back into its closed position again completing the circuit for supplying current to the heating elements 134, 135 and 136. Thus it will be understood that during normal operation of the machine 20 the switch 244 under the control of the thermal bulb 210 regulates the temperature of the air circulated in the casing 60 in accordance with the setting of the temperature control knob 42. This arrangement prevents overheating of the air circulated in the drum 90 and also regulates the supply of radiant heat directed into the drum 90 and onto the clothes as they are tumbled therein.

After the expiration of approximately 45 minutes the timer motor 235 has returned the operating shaft 237 sufficiently in the counterclockwise direction to cause the wiper 239 to disengage the conducting portion and to engage the insulating portion of the timer cam 241, while the wiper 238 remains in engagement with the conducting portion of the timer cam 240. When the wiper 239 disengages the conducting portion of the timer cam 241, the circuit for supplying heating current to the heating elements 134, 135 and 136 is interrupted, while operation of the drive motor 171 continues. Also the supply of cooling water to the nozzle 163 continues, whereby the air circulated in the casing 60 is gradually cooled in order to effect corresponding cooling of the clothes being tumbled in the drum 90. After the expiration of an additional time interval of approximately 5 minutes the timer motor 235 drives the operating shaft 237 further in the counterclockwise direction in order to restore the operating control knob 41 into its off position. Thus at the expiration of approximately 50 minutes the operating control knob 41 has been restored from its iron-dry position back into its off position. At this time the wiper 238 disengages the conducting portion of the timer cam 240 interrupting the circuits for operating the timer motor 235 and the drive motor 171, interrupting the circuit for illuminating the pilot lamp 40, and interrupting the circuit for energizing the solenoid 209. Thus operation of the timer motor 235 is arrested and the pilot lamp 40 is extinguished in order to indicate that the machine 20 has completed its operating cycle. Further operation of the drive motor 171 is arrested in order to arrest rotation of the drum 90 and operation of the pump 190. Finally when the solenoid 209 is deenergized the inlet valve 202 is returned to its closed position in order to cut off the supply of cooling water to the nozzle 163. At this time the cycle of operation of the machine 20 has been completed and the clothes contained in the drum 90 have been sufficiently cooled so that they may be immediately removed by the person after opening the door 36.

The operation of the machine 20 to effect drying of the clothes to the dry condition is substantially identical to that described above except that the operating knob 41 is initially rotated in the clockwise direction to its dry posi-

tion, whereby the timer motor 235 effects operation of the machine 20 for an additional time interval of approximately 10 minutes before effecting the interruption of the circuit for supplying current to the heating elements 134, 135 and 136. In this case, the machine is operated through its cycle in approximately 60 minutes. Thus the iron-dry and dry cycles of the machine 20 respectively consume approximately 50 and 60 minutes, the last 5 minutes of each of these cycles being effective to cause cooling of the clothes contained in the tumbling drum 90 so that the clothes may be immediately removed in a reasonably cool condition from the tumbling drum 90 at the conclusion of either of the cycles of operation. When the machine 20 is operated through the iron-dry cycle, approximately 8 lbs. of the original 9 lbs. of water contained in the 9 lbs. of clothes is removed; and when the machine 20 is operated through its dry cycle, virtually all of the original 9 lbs. of water contained in the 9 lbs. of clothes is removed.

In view of the foregoing it is apparent that there has been provided an improved portable clothes drying machine that is especially adapted for use in a home laundry, which machine transports no substantial heat or moisture or lint into the associated laundry or other room during operation thereof, the undesired heat and moisture and lint being carried by the cooling water supplied to the machine into the plumbing system incorporated in the home laundry.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a substantially cylindrical perforated wall and adapted to receive clothes to be dried, a casing enclosing said drum and having a substantially tubular wall disposed in spaced relation to said drum wall, said casing wall including a substantially scroll-shaped section disposed somewhat above the bottom thereof and an adjacent substantially arcuate-shaped section disposed at the bottom thereof, said scroll section being directed downwardly away from the adjacent portion of said drum wall and cooperating therewith to define a downwardly diverging chamber therebetween, a baffle disposed between the bottom of said drum wall and said arcuate section in spaced relation thereto, said baffle cooperating with said arcuate section to define a substantially arcuate-shaped passage therebetween, one end of said passage communicating with said chamber and the other end of said passage communicating with said drum wall, means for rotating said drum in the direction from said chamber toward said passage in order to tumble the contained clothes, the clothes tumbling in said drum cascading from a position disposed adjacent to the top thereof to a position disposed somewhat above the bottom thereof and located over said chamber, and means essentially consisting of only said rotating drum wall cooperating with said casing wall and with said baffle and the contained clothes cascading in said drum for pumping air in said drum into said chamber and for compressing said air in said chamber in order to circulate said air in a cur-

rent therefrom through said passage and back into said drum, said current of air passing out of and into said drum through the perforations in said drum wall at locations respectively disposed adjacent to said chamber and beyond said other end of said passage.

2. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a substantially cylindrical perforated wall and adapted to receive clothes to be dried, a casing enclosing said drum and having a substantially tubular wall disposed in spaced relation to said drum wall, said casing wall including a substantially scroll-shaped section disposed somewhat above the bottom thereof and an adjacent substantially arcuate-shaped section disposed at the bottom thereof, said scroll section being directed downwardly away from the adjacent portion of said drum wall and cooperating therewith to define a downwardly diverging chamber therebetween, a baffle disposed between the bottom of said drum wall and said arcuate section in spaced relation thereto, said baffle cooperating with said arcuate section to define a substantially arcuate-shaped passage therebetween, one end of said passage communicating with said chamber and the other end of said passage communicating with said drum wall, means for rotating said drum in the direction from said chamber toward said passage in order to tumble the contained clothes, the clothes tumbling in said drum cascading from a position disposed adjacent to the top thereof to a position disposed somewhat above the bottom thereof and located over said chamber, means essentially consisting of only said rotating drum wall cooperating with said casing wall and with said baffle and the contained clothes cascading in said drum for pumping air in said drum into said chamber and for compressing said air in said chamber in order to circulate said air in a current therefrom through said passage and back into said drum, said current of air passing out of and into said drum through the perforations in said drum wall at locations respectively disposed adjacent to said fan chamber and beyond said other end of said passage, means for heating said current of air beyond said other end of said passage in order to reduce the relative humidity thereof, means for scrubbing said current of air with a finely divided spray of cool water in said passage below said baffle in order to condense out moisture contained therein and to trap lint carried thereby, means including a sump formed in the bottom of said casing wall for collecting said water and condensate and lint, and means including a pump for discharging to the exterior of said casing said water and condensate and lint collecting in said sump.

3. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a perforated wall and adapted to receive clothes to be dried, means including an electric motor for rotating said drum in order to tumble the contained clothes, means including a casing cooperating with said drum wall for defining a chamber therebetween, rotation of said drum in said casing forcing air into and out of said drum through the perforations in said wall at spaced-apart locations and into contact with the contained clothes and thence into said chamber, means including an electric heating unit for subjecting said air and the contained clothes to radiant heat in said drum, means including a spray device for cooling and scrubbing

said air with a finely divided spray of cooling water in said chamber in order to condense moisture contained therein, a source of cooling water, means including an electro-responsive valve for controlling the connection of said spray device to said source of cooling water, means for draining said cooling water and condensate from said chamber to the exterior of said casing, a source of current supply, an electro-responsive cyclic operative timer, means for initiating a cycle of operation of said timer and for connecting said motor and said heating unit to said source of current supply, thermal responsive means governed in response to a predetermined temperature of said air passing into said chamber for controlling operation of said valve into its open position, means governed by said timer after a predetermined time interval for disconnecting said heating unit from said source of current supply, and means governed by said timer after an additional predetermined time interval for disconnecting said motor from said source of current supply and for controlling operation of said valve into its closed position.

4. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a perforated wall and adapted to receive clothes to be dried, means including an electric motor for rotating said drum in order to tumble the contained clothes, means including a casing cooperating with said drum wall for defining spaced-apart first and second chambers therebetween, rotation of said drum in said casing producing circulation of air from said first chamber into and out of said drum through the perforations in said wall at spaced-apart locations and into contact with the contained clothes and thence through said second chamber and back into said first chamber, an electric heating element operatively associated with said first chamber, a source of electric current, a cooler operatively associated with said second chamber, a source of coolant, a valve selectively operative to control the supply of coolant from said source of coolant to said cooler, a cyclic operative timer, means for producing a cycle of operation of said timer, means governed by said timer in its operative cycle for selectively operating said motor and for selectively connecting said heating element to said source of electric current and for selectively operating said valve, means for draining condensate from said second chamber and said coolant from said cooler to the exterior of said casing, and additional means including a thermal responsive device operatively associated with said second chamber and governed in response to the temperature of said air passing into said second chamber for selectively connecting said heating element to said source of electric current.

5. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a substantially cylindrical perforated wall and adapted to receive clothes to be dried, a plurality of vanes arranged within said drum wall, a casing enclosing said drum and having a substantially tubular wall disposed in spaced relation to said drum wall, said casing wall including a substantially scroll-shaped section disposed somewhat above the bottom thereof and an adjacent substantially arcuate-shaped section disposed at the bottom thereof, said scroll section being directed downwardly away from the adjacent portion of said drum wall and

cooperating therewith to define a downwardly diverging chamber therebetween, a baffle disposed between the bottom of said drum wall and said arcuate section in spaced relation thereto and cooperating therewith to define a substantially arcuate-shaped passage therebetween, one end of said passage communicating with said chamber and the other end of said passage communicating with said drum wall, means for rotating said drum in the direction from said chamber toward said passage in order to cause said vanes to tumble the contained clothes, the clothes tumbling in said drum cascading from a position disposed adjacent to the top thereof to a position disposed somewhat above the bottom thereof and located over said chamber, and means essentially consisting of only said vanes and said rotating drum wall cooperating with said casing wall and with said baffle and the contained clothes cascading in said drum for pumping air in said drum into said chamber and for compressing said air in said chamber in order to circulate said air in a current therefrom through said passage and back into said drum, said current of air passing out of and into said drum through the perforations in said drum wall at locations respectively disposed adjacent to said chamber and beyond said other end of said passage.

6. The clothes drying machine set forth in claim 2, wherein said heating means is in the form of an electric heating element disposed between the adjacent portions of said drum wall and said casing wall and in spaced relation thereto, and further comprising a reflector disposed between said heating element and the adjacent portion of said casing wall in order to project radiant heat from said heating element onto said drum wall.

7. The clothes drying machine set forth in claim 4, wherein said timer effects the disconnection of said heating element from said source of electric current preceding the end of its operating cycle and while said motor is operating and while said coolant is being supplied from said source of coolant to said cooler.

8. A clothes drying machine comprising a substantially horizontally disposed and rotatably mounted drum having a substantially cylindrical perforated wall and adapted to receive clothes to be dried, a casing enclosing said drum and having a substantially tubular wall disposed in spaced relation to said drum wall, said casing wall including a substantially scroll-shaped section and a curved-shaped section and an intermediate arcuate-shaped section, said arcuate section being disposed at the bottom of said casing and said scroll section being disposed somewhat above and on one side of the bottom of said casing and said curved section being disposed well above and on the other side of the bottom of said casing, said scroll section being directed downwardly and away from the adjacent portion of said drum wall and cooperating therewith to define a downwardly diverging first chamber therebetween, said curved section being directed upwardly and toward the adjacent portion of said drum wall and cooperating therewith to define an upwardly converging second chamber therebetween, a baffle disposed between the bottom of said drum wall and said arcuate section and cooperating with said arcuate section to define a third chamber therebetween, said first chamber communicating with the interior of said drum through the perforations in the adjacent portion of said drum wall, said second chamber communicating

with the interior of said drum through the perforations in the adjacent portion of said drum wall, said third chamber communicating with both said first chamber and said second chamber, means for rotating said drum in the direction from said first chamber toward said third chamber and then toward said second chamber in order to tumble the contained clothes, the clothes tumbling in said drum cascading from a position disposed adjacent to the top thereof to a position disposed somewhat above the bottom thereof and located over said first chamber, means essentially consisting of only said rotating drum wall cooperating with said casing wall and with said baffle and the contained clothes cascading in said drum for pumping air in said drum into said first chamber and for compressing said air in said first chamber in order to circulate said air in a current therefrom through said third chamber and then through said second chamber and back into said drum into contact with the contained clothes tumbling therein, means for heating said current of air as it is passed through said second chamber, means for cooling and scrubbing said current of air with a finely divided spray of cool water as it is passed through said third chamber, means including a sump formed in the bottom of said casing wall for collecting said water and condensate and lint, and means including a pump for discharging to the exterior of said casing said water and condensate and lint collecting in said sump.

9. The clothes drying machine set forth in claim 4, wherein said cooler is in the form of mechanism productive of a finely divided spray of coolant in said second chamber, and said source of coolant is in the form of a source of cool water.

10. The clothes drying machine set forth in claim 2, and further comprising an upstanding cabinet housing said casing, the front of said cabinet and the front of said casing and the front end of said drum having substantially registering front openings respectively formed therein in order to afford access from the exterior into said drum, and a front door carried by said cabinet and movable between open and closed positions with respect to said front openings.

11. A portable clothes drying machine comprising an upstanding cabinet housing a casing enclosing a substantially horizontally disposed and rotatably mounted drum having a perforated wall and adapted to receive clothes to be dried, substantially registering openings respectively formed in said cabinet and in said casing and in one end of said drum in order to afford access from the exterior into said drum, a door carried by said cabinet and movable between open and closed positions with respect to said openings, an electric motor housed within said cabinet for rotating said drum in order to tumble the contained clothes, rotation of said drum in said casing circulating a current of air within said casing into and out of said drum through the perforations in said wall at spaced-apart locations and into contact with the contained clothes, means for heating said current of air adjacent to the top portion of said casing, means for cooling said current of air adjacent to the bottom portion of said casing, means including heat-insulating material associated with said top portion of said casing for reducing heat transfer therefrom, said bottom portion of said casing being exposed to promote heat transfer therefrom, said cabinet including front and rear walls, said front wall having a rearwardly offset

toe-receiving recess formed in the lower portion thereof, means including a first opening formed in the lower portion of said front wall within said recess and a second opening formed in the upper portion of said rear wall for producing a flow of cooling air upwardly through said cabinet and over said casing in order selectively to cool said bottom portion of said casing, and means for draining condensate from the bottom portion of said casing to the exterior thereof.

12. The clothes drying machine set forth in claim 10, and further comprising a first seal disposed between said front door and said cabinet about said front opening in said cabinet, and a second seal disposed between said cabinet and said casing about said front opening in said casing.

13. The clothes drying machine set forth in claim 10, wherein said front openings are substantially annular, and further comprising a first seal disposed between said front door and said cabinet about said front opening in said cabinet, a second seal disposed between said cabinet and said casing about said front opening in said casing, and an annular flange carried by said cabinet and projecting through said front opening in said casing and said front opening in said

front end of said drum to provide a smooth throat from the exterior into said drum when said front door occupies its open position.

KEMPER M. HAMMELL.
CLIFFORD E. ERICKSON.

References Cited in the file of this patent
UNITED STATES PATENTS

	Number	Name	Date
10	1,301,055	Humberger	Apr. 15, 1919
	1,442,179	Schneible	Jan. 16, 1923
	1,908,559	Roser	May 9, 1933
	1,942,758	Jessup	Jan. 9, 1934
	1,968,910	Poole	Aug. 7, 1934
15	2,249,202	Glenn	July 15, 1941
	2,310,680	Dinley	Feb. 9, 1943
	2,328,256	Breckenbridge	Aug. 31, 1943
	2,398,880	Brogie	Apr. 23, 1946
	2,434,476	Wales	Jan. 13, 1948
20	2,451,692	Pugh	Oct. 19, 1948
	2,453,859	Pugh	Nov. 16, 1948
	2,463,934	Allen	Mar. 8, 1949
	2,503,330	Geldhof	Apr. 11, 1950
	2,540,955	Moore	Feb. 6, 1951
25	2,543,579	Kauffmann II	Feb. 27, 1951
	2,590,295	Constantine	Mar. 25, 1952