Feb. 8, 1955 C. E. ERICKSON ET AL 2,701,421

CLOTHES DRYING MACHINE

Filed Feb. 6, 1951 5 Sheets-Sheet 1

FIG. 1

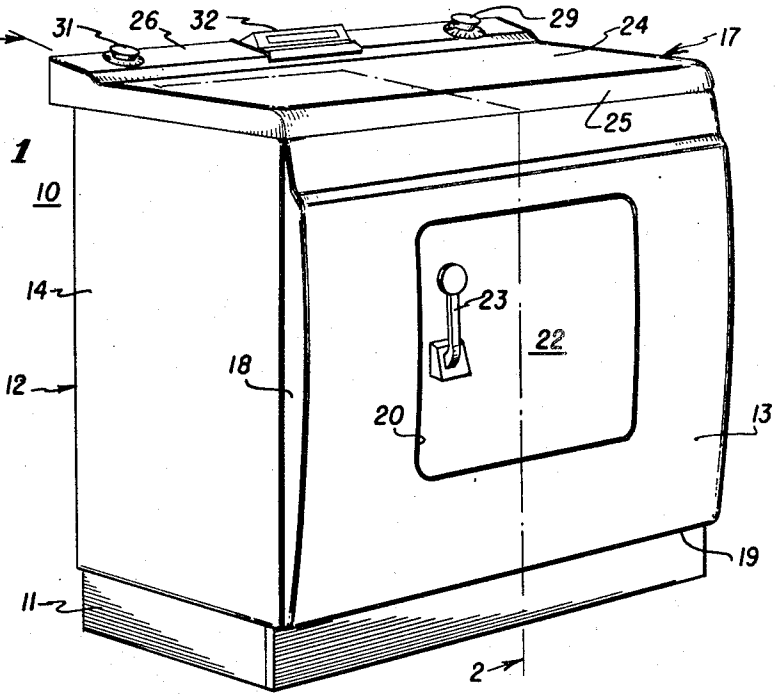
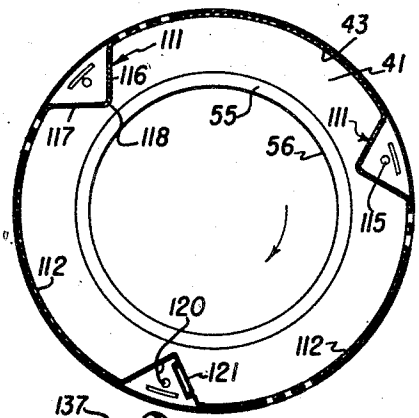



FIG. 6



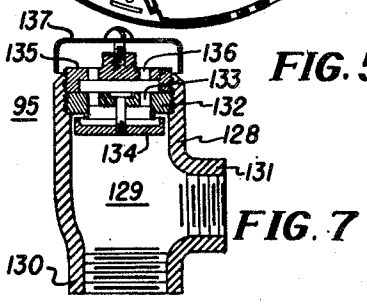
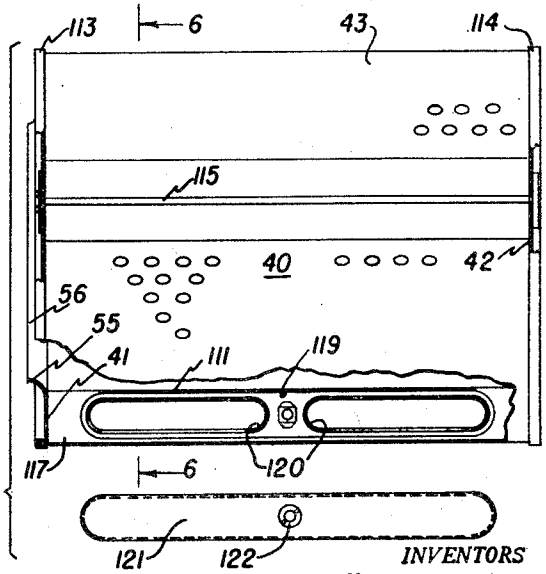




FIG. 7

FIG. 5




INVENTORS
Clifford E. Erickson
Glenn D. Graham
BY
Smith, Olsen & Baird
Attys.

Feb. 8, 1955 C. E. ERICKSON ET AL 2,701,421

CLOTHES DRYING MACHINE

Filed Feb. 6, 1951 5 Sheets-Sheet 2

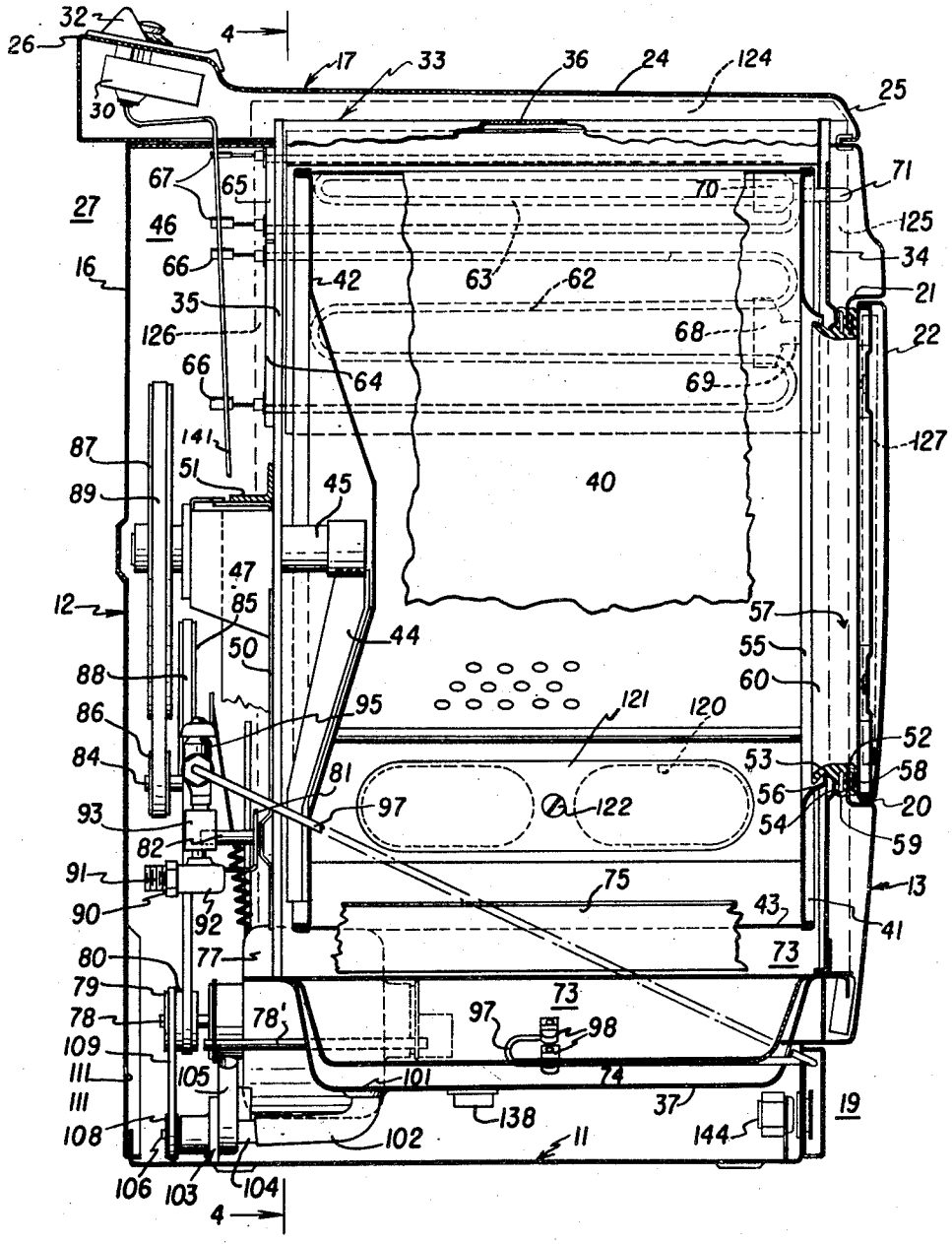



FIG. 2

INVENTORS
Clifford E. Erickson
Glenn D. Graham

BY Smith, Olsen & Baird
Attys.

Feb. 8, 1955 C. E. ERICKSON ET AL 2,701,421

CLOTHES DRYING MACHINE

Filed Feb. 6, 1951 5 Sheets-Sheet 3

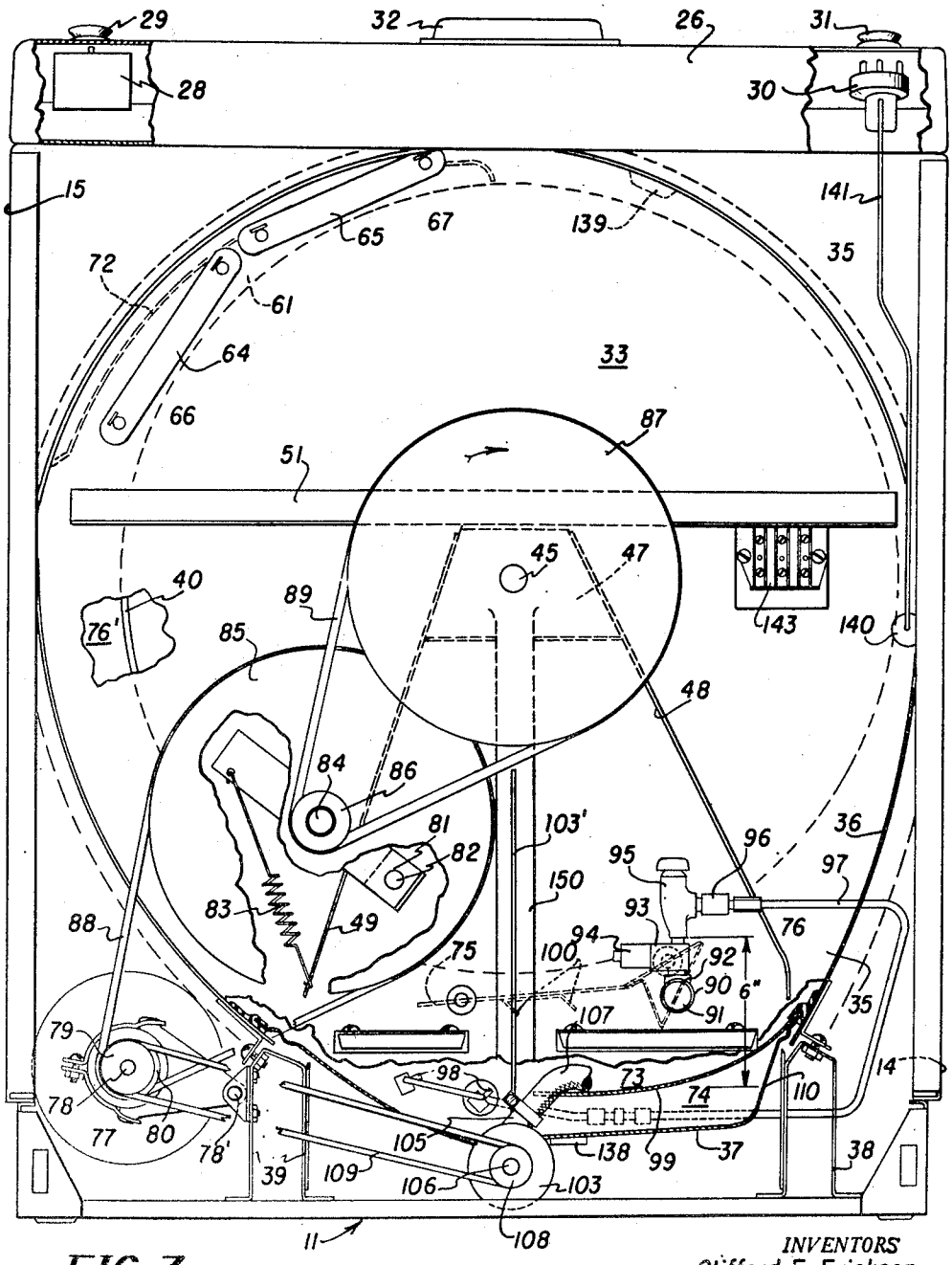



FIG. 3

INVENTORS
Clifford E. Erickson
Glenn D. Graham

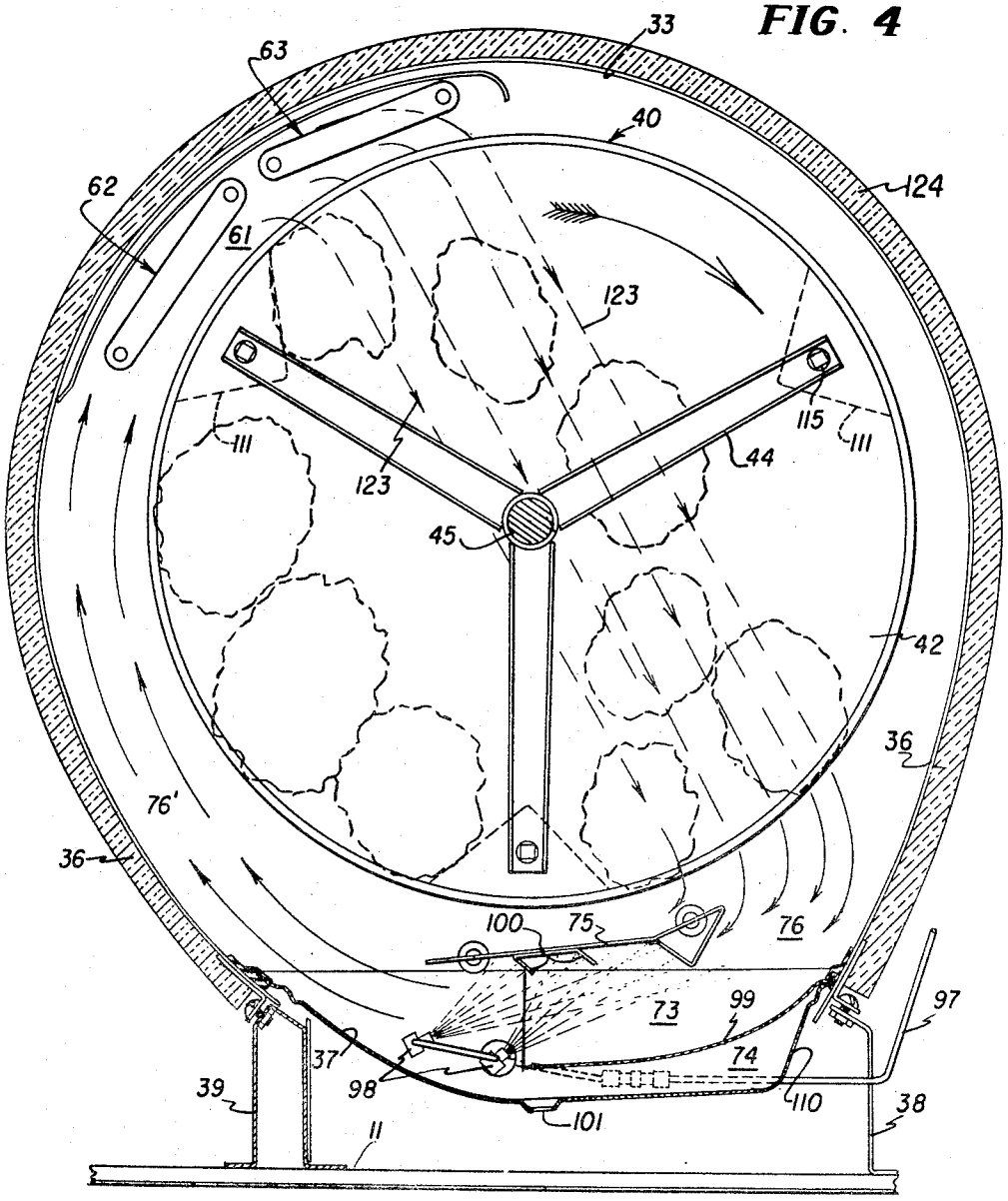
BY Smith, Olsen & Baird
Attys.

Feb. 8, 1955 C. E. ERICKSON ET AL. 2,701,421

CLOTHES DRYING MACHINE

Filed Feb. 6, 1951 5 Sheets-Sheet 4

FIG. 4




INVENTORS
Clifford E. Erickson
Glenn D. Graham
BY
Smith, Olsen & Baird
Attys.

Feb. 8, 1955 C. E. ERICKSON ET AL 2,701,421

CLOTHES DRYING MACHINE

Filed Feb. 6, 1951 5 Sheets-Sheet 5

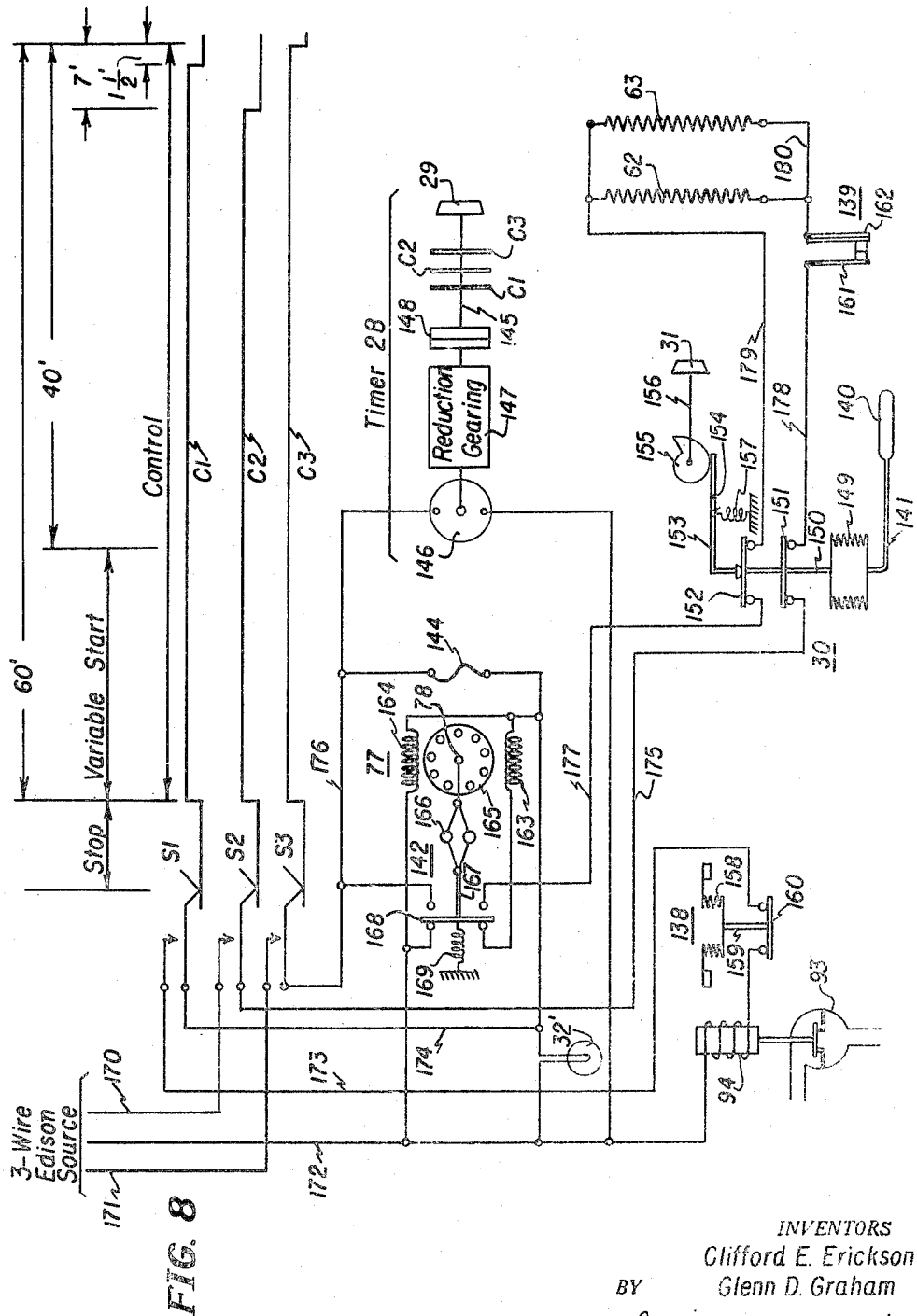



FIG. 8

INVENTORS
Clifford E. Erickson
Glenn D. Graham

BY Smith, Olsen & Baird
Attys.

United States Patent Office 2,701,421 Patented Feb. 8, 1955



2,701,421

# CLOTHES DRYING MACHINE

Clifford E. Erickson and Glenn D. Graham, Chicago, Ill., assignors to General Electric Company, a corporation of New York

Application February 6, 1951, Serial No. 209,657

11 Claims. (Cl. 34—45)

The present invention relates to clothes drying machines of the portable home laundry type and more particularly to improved clothes drying machines of the general character disclosed in the copending application of Kemper M. Hammell and Clifford E. Erickson, Serial No. 75,606, filed February 10, 1949, now Patent No. 2,644,245.

The clothes drying machine disclosed in the Hammell and Erickson application mentioned is of the portable home laundry type and comprises a rotatably mounted drum having a perforated wall and adapted to receive clothes to be dried, a casing enclosing the drum and cooperating therewith to define first and second chambers therebetween respectively disposed adjacent to the top of the drum and adjacent to the bottom of the drum, and an electric motor for rotating the drum in order to tumble the contained clothes and for producing circulation of a current of air from the first chamber through the drum into contact with the contained clothes and thence into the second chamber and back into the first chamber. An electric heating element is arranged in the first chamber in order to heat the current of air passing therethrough; and a spray nozzle is arranged in the second chamber in order to cool and to scrub with a finely divided spray of cool water the current of air passing therethrough. A sump is formed in the bottom of the casing below the second chamber in order to accumulate the water, as well as condensate and lint that are condensed and scrubbed from the current of air as it is passed through the second chamber. A drain opening is formed in the bottom of the sump; and a pump is provided that communicates between the drain opening and the exterior, the pump being operated by the motor for the purpose of discharging to the exterior the water and the condensate and the lint accumulating in the sump. Further an inlet conduit is provided that is normally supplied with cool water under gauge pressure from the city water main; and a plumbing connection is arranged between the inlet conduit and the spray nozzle. The plumbing connection mentioned includes a solenoid controlled valve that is selectively operative between closed and open positions in order to govern the supply of the cool water from the inlet conduit to the spray nozzle.

While this machine is quite satisfactory under ordinary operating conditions, the cool water supply system thereof is entirely inadequate under certain abnormal operating conditions that are occasionally encountered in particular installations and also fails to satisfy the plumbing code requirements of certain cities in the absence of auxiliary apparatus. More particularly, satisfactory operation of the machine is dependent upon the supply to the spray nozzle of cool water at a gauge pressure within a relatively narrow range, which condition is not satisfied in certain installations due to variation of the gauge pressure of the cool water in the city water mains. Also there is encountered occasionally in an installation the abnormal condition of a subatmospheric pressure of the cool water in the connected city water mains, whereby there is the possibility that water in the sump formed in the bottom of the casing of the machine might be back-siphoned therefrom into the city water main. In any case in this machine, no arrangement is incorporated in the plumbing connection between the inlet conduit and the spray nozzle for positively preventing the possibility of back-siphoning, whereby the plumbing codes of certain cities require the installation of auxiliary anti-back-siphoning apparatus between the city water main and the inlet conduit of the machine.



Accordingly it is a general object of the invention to provide a clothes drying machine of the character described that incorporates an improved arrangement of the sump and connected pump, whereby the water accumulating in the sump may be overflowed to the exterior of the casing in the event operation of the pump is arrested for any unusual time interval, and whereby any possibility of an air lock in the pump is prevented during operation thereof.

Another object of the invention is to provide in a clothes drying machine of the character described, a circuit control network of improved and simplified connection and arrangement.

A further object of the invention is to provide a clothes drying machine of the character described that embodies a timer arrangement for selectively controlling the sequence of operation of the different operating elements thereof in an improved and efficient cycle.

A further object of the invention is to provide a circuit network for a clothes drying machine of the character described, that embodies an improved thermal arrangement for governing the electric heating element disposed in the first chamber thereof and an improved hydrostatic arrangement for governing the solenoid controlled valve incorporated in the plumbing connection between the inlet conduit and the spray nozzle thereof.

A still further object of the invention is to provide a circuit network for a clothes drying machine of the character described, that embodies an improved speed responsive switching arrangement for selectively controlling both starting and running of the electric motor thereof, as well as selective energization of the electric heating element thereof.

Further features of the invention pertain to the particular arrangement of the elements of the clothes drying machine and of the plumbing connection thereto and of the circuit control network thereof, 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 clothes drying machine of the portable home laundry type embodying the present invention; Fig. 2 is an enlarged longitudinal sectional view, partly broken away, of the machine, taken in the direction of the arrows along the offset line 2—2 in Fig. 1; Fig. 3 is an enlarged rear elevational view, partly broken away, of the machine; Fig. 4 is an enlarged lateral sectional view of the machine, taken in the direction of the arrows along the line 4—4 in Fig. 2; Fig. 5 is a somewhat enlarged exploded side elevational view, partly broken away, of the clothes receiving drum incorporated in the machine; Fig. 6 is a somewhat enlarged lateral sectional view of the drum, taken in the direction of the arrows along the line 6—6 in Fig. 5; Fig. 7 is a greatly enlarged vertical sectional view of the vacuum breaker incorporated in the plumbing connection of the cool water supply system of the machine; and Fig. 8 is a diagrammatic illustration of the circuit control network for the machine.

Referring now to Figs. 1 to 3, inclusive, of the drawings, the clothes drying machine **10** there illustrated is of the portable home laundry type and is of the general character of that disclosed in the previously mentioned Hammell and Erickson application, and embodies the features of the present invention. Specifically the machine **10** comprises a substantially rectangular base **11** carrying an upstanding detachable cabinet **12**; the cabinet **12** includes a front wall **13** and a pair of opposed side walls **14** and **15** defining both a rear opening and a front opening. The rear opening provided in the cabinet **12** is closed by a removable rear wall **16**; and the top opening provided in the cabinet **12** is closed by a removable top wall **17**. The front wall **13** is provided with a rearwardly directed rim or boundary flange **18** having side portions disposed substantially flush with the side walls **14** and **15**, and a bottom portion disposed forwardly of the front of the

base 11 and cooperating therewith to define an upstanding toe-receiving recess 19 arranged adjacent to the lower front of the cabinet 12. Also the central portion of the front wall 13 has a substantially rectangular depression 20 formed therein that is surrounded by a rearwardly directed boundary throat 21. Preferably the hollow front wall 13 is formed of one-piece die pressed construction and carries a substantially rectangular fabricated front door 22 suitably hinged thereto and arranged within the boundary throat 21 and movable between open and closed positions with respect to the depression 20, the front door 22 carrying a suitable handle and latch mechanism 23.

The top wall 17 includes a substantially horizontally disposed work surface 24 provided with a downwardly turned rim or boundary flange 25 that includes front and side portions disposed substantially flush with the upper portions of the respective front wall 13 and side walls 14 and 15. Also the rear portion of the top wall 17 terminates in a laterally extending and upwardly directed backsplash 26 that projects rearwardly of the rear wall 16 to define an upstanding space 27 disposed both below the backsplash 26 and behind the rear wall 16 and employed for a purpose more fully explained hereinafter. The side portions of the rim 25 of the top wall 17 merge into the ends of the backsplash 26 to form a smooth continuous construction. Preferably the hollow top wall 17 is formed of one-piece die pressed construction. A timer switch 28 is housed within the hollow backsplash 26 adjacent to the right-hand end thereof and provided with an operating shaft extending through an opening formed therein and carrying a manual control dial 29 that is readily accessible from the exterior; and a thermostatic switch 30 is housed within the hollow backsplash 26 adjacent to the left-hand end thereof and provided with an operating shaft extending through an opening formed therein and carrying a manual control dial 31 that is readily accessible from the exterior. Finally the central portion of the backsplash 26 carries a combination ornamental trim and lamp hood 32 that is adapted to be illuminated by an electric lamp housed in the backsplash 26 for the purpose of indicating operation of the machine 10 and of providing some illumination of the work surface 24 of the top wall 17, the lamp being dagrammatically illustrated at 32' in Fig. 3.

An upstanding substantially tubular casing 33 is housed in the front portion of the cabinet 12 and provided with front and rear walls 34 and 35 and a tubular side wall including complementary upper and lower sections 36 and 37. The casing 33 is directly supported upon the base 11 by an arrangement including two upstanding and laterally spaced-apart pillars 38 and 39 carried by the base 11. A substantially cylindrical drum 40 is enclosed by the casing 33 and provided with front and rear end walls 41 and 42 and a perforated side wall 43. The drum 40 is mounted for rotation in the casing 33 about its longitudinal axis disposed in a substantially horizontal position by an arrangement including a spider 44 secured to the rear surface of the rear wall 42 and carrying a rearwardly projecting drive shaft 45. The drive shaft 45 is disposed along the longitudinal center line of the drum 40 and projects through an opening provided in the rear wall 35 into an upstanding space 46 defined between the rear wall 35 and the rear wall 16. More particularly the drive shaft 45 is supported for rotation in bearing structure carried by a bolster 47, that is, in turn, carried by the rear wall 35 and arranged in the upstanding space 46. The bolster 47 is further supported by two laterally spaced-apart upstanding elements 48 and 49 respectively carried by the pillars 38 and 39. Moreover the rear wall 35 is provided with an upstanding centrally disposed stiffening ridge 50 embossed therein and extending to the bolster 47, as well as a laterally extending stiffening angle member 51.

The boundary throat 21 surrounding the rectangular depression 20 formed in the front wall 13 extends inwardly and terminates in an annular opening 52; the front wall 34 of the casing 33 has a substantially annular opening 53 formed therein that is surrounded by an associated stiffening ridge 54; and the front end wall 41 of the drum 40 is provided with a centrally disposed forwardly flared annular flange 55 terminating in an annular opening 56. The annular openings 52 and 53 and 56 are arranged in longitudinal alignment with each other and carry a cooperating annular throat member 57 formed of rubber, or the like. The throat member 57 comprises first and second compressible annular gasket sections 58 and 59, as well as a rearwardly and outwardly flared annular lip 60 extending into the annular flange 55. The gasket section 59 is compressed between the adjacent annular portion of the boundary throat 21 and the adjacent annular stiffening ridge 54 in order to seal the front wall 13 of the cabinet 12 to the front wall 34 of the casing 33; while the gasket section 58 is arranged between the adjacent annular portion of the boundary throat 21 and the adjacent inner surface of the front door 22 in order to seal the front opening 52 when the front door 22 occupies its closed position. Finally the extension of the annular lip 60 into the annular flange 55 presents a smooth continuous throat into the interior of the drum 40 in order to facilitate ready placement and removal of the clothes with respect thereto. The construction and arrangement of the throat member 57 and its cooperation with the front door 22, the front wall 13 of the cabinet 12, the front wall 34 of the casing 33, and the front end wall 41 of the drum 40 are disclosed and claimed in the copending application of Clifford E. Erickson, Serial No. 218,427, filed March 30, 1951, now Patent No. 2,657,475.

The upper section 36 of the tubular side wall of the casing 33 cooperates with the associated cylindrical side wall 43 of the drum 40 to define a longitudinally extending first or heating chamber 61 therebetween disposed adjacent to the top of the drum 40, in which there are arranged two circumferentially spaced-apart substantially serpentine electric heating elements 62 and 63 that are preferably of the sheathed resistance conductor type. The heating element 62 comprises a supporting plate 64 that is removably secured to the rear wall 35 of the casing 33 in covering relation with respect to an associated opening through which the heating element 62 is projected into the heating chamber 61; and likewise the heating element 63 comprises a supporting plate 65 that is removably secured to the rear wall 35 of the casing 33 in covering relation with respect to an associated opening through which the heating element 63 is projected into the heating chamber 61. The terminals of the heating element 62 project through the plate 64 into the space 46, as indicated at 66; and likewise the terminals of the heating element 63 project through the plate 64 into the space 46, as indicated at 67. The front end of the heating element 62 is anchored in place by an arrangement including a fixture 68 that is provided with a forwardly extending tab 69 that projects through a cooperating slot, not shown, formed in the front wall 34 of the casing 33; and likewise the front end of the heating element 63 is anchored in place by an arrangement including a fixture 70 that is provided with a forwardly extending tab 71 that projects through a cooperating slot, not shown, formed in the front wall 34 of the casing 33. Thus it will be understood that the heating elements 62 and 63 may be readily removed from the heating chamber 61 rearwardly through the upstanding space 46 after the removal of the rear wall 16 from the cabinet 12. Arranged between the heating elements 62 and 63 and the adjacent portion of the upper casing section 36 is a longitudinally extending and substantially arcuate-shaped reflector 72 that is provided for the purpose of reflecting radiant heat toward the perforated side wall 43 of the drum 40.

The lower section 37 of the tubular side wall of the casing 33 cooperates with the associated cylindrical side wall 43 of the drum 40 to define a longitudinally extending second or condensing chamber 73 therebetween disposed adjacent to the bottom of the drum 40. Also the lower section 37 of the tubular side wall of the casing 33 comprises a downwardly extending or dished wall defining a sump 74 in the bottom thereof, the sump 74 being disposed below the condensing chamber 73 and constituting the bottom thereof. The top of the condensing chamber 73 is defined by a longitudinally extending baffle 75 that is arranged just below the bottom of the cylindrical side wall 43 of the drum 40. As best shown in Figs. 3 and 4 and as viewed from the rear of the cabinet 12, the lower end of the upper section 36 of the tubular side wall of the casing 33 disposed on the right-hand side thereof extends downwardly and away from the adjacent portion of the cylindrical side wall 43 of the drum 40 in order to provide a scroll-shaped section that cooperates with the adjacent portion of the cylindrical side wall 43 of the drum 40 to define a com-

pression chamber **76** therebetween that opens into the adjacent end of the condensing chamber **73** below the baffle **75**; on the other hand, the lower end of the upper section **36** of the tubular side wall of the casing **33** disposed on the left-hand side thereof extends upwardly and toward the adjacent portion of the cylindrical side wall **43** of the drum **40** to provide an arcuate-shaped passage **76'** between the adjacent open end of the condensing chamber **73** and the adjacent open end of the heating chamber **61**. The drum **40** is rotated in the counterclockwise direction as viewed from the front of the machine **10** or in the clockwise direction as viewed from the rear of the machine **10** in Figs. 3 and 4. Still referring to Figs. 3 and 4, it will be understood that when the drum **40** is rotated in the clockwise direction, the clothes contained therein are tumbled and circulation of a current of air is produced from the heating chamber **61** into the drum **40** through the perforated cylindrical side wall **43** thereof and into contact with the contained clothes. The air current is then circulated from the drum **40** through the perforated cylindrical side wall **43** thereof into the compression chamber **76**, wherein the air is compressed and forced into the adjacent end of the condensing chamber **73**. The air passes through the condensing chamber **73** between the sump **74** and the baffle **75** and thence out of the other end thereof and through the passage **76'** and again into the heating chamber **61**. Moreover it is pointed out that this forced circulation of the current of air described above is produced solely by the rotation of the drum **40** in the clockwise direction, as viewed in Figs. 3 and 4, at a speed of approximately 50 R. P. M., together with the tumbling of the clothes contained in the drum **40**, all without the usual external blower or fan.

Also the machine **10** comprises an electric motor **77** that is pivotally mounted upon the pillar **39** by an arrangement including a pivot pin **78'**, the motor **77** being disposed in the lower right-hand portion of the cabinet **12** below the casing **33**, as viewed from the front of the machine **10**. The motor **77** comprises an operating shaft **78** having two pulleys **79** and **80** rigidly secured thereto. Also an arm **81** is pivotally mounted upon a pivot pin **82** carried by the rear wall **35** of the casing **33**, which arm **81** is normally biased in the counterclockwise direction about the pivot pin **82**, as viewed in Fig. 3, by an arrangement including a coil spring **83** extending between the supporting element **49** and the outer end of the arm **81**. The intermediate portion of the arm **81** carries a stub shaft **84** upon which there are rotatably mounted two pulleys **85** and **86** that are rigidly secured together. Finally the rear end of the drive shaft **45** carries a pulley **87** rigidly secured thereto. The pulley **80** carried by the operating shaft **78** of the motor **77** is belted to the pulley **85** rotatably mounted upon the stub shaft **84** by an arrangement including a flexible V-belt **88**; and likewise the pulley **86** rotatably mounted on the stub shaft **84** is belted to the pulley **87** carried by the drive shaft **45** by an arrangement including a flexible V-belt **89**. The pulley **80** is considerably smaller than the pulley **85**; and the pulley **86** is considerably smaller than both of the pulleys **85** and **87**; whereby a suitable speed reduction is obtained between the operating shaft **78** of the motor **77** and the drive shaft **45** of the drum **40**. It will be understood that the weight of the motor **77** tends to pivot it in the counterclockwise direction about the pivot pin **78'**, as viewed in Fig. 3, in order to tighten the belt **88** extending between the pulleys **80** and **85**, whereby the tension of the belt **88** assists the coil spring **83** in pivoting the arm **81** in the counterclockwise direction about the pivot pin **82**, as viewed in this figure, in order to tighten the belt **89** extending between the pulleys **86** and **87**. Not only are the belts **88** and **89** tightened by virtue of the disposition of weights and by the coil spring **83** as explained above, but a substantially aligned drive is obtained through the axes of the operating shaft **78**, the stub shaft **84** and the drive shaft **45**, as clearly illustrated in Fig. 3. Finally it will be observed in Fig. 2 that the pulleys **80**, **85**, **86** and **87** are arranged in the upstanding space **46** disposed between the rear wall **35** of the casing **33** and the rear wall **16** of the cabinet **12**, whereby the pulleys noted are readily accessible from the exterior after the removal of the rear wall **16** from the associated side walls **14** and **15** of the cabinet **12**.

Also the machine **10** comprises a cooling water supply system including an inlet conduit **90** that is adapted to be supplied with cool water under gauge pressure, the rear end of the inlet conduit **90** being provided with a threaded nipple **91** that is adapted detachably to receive a flexible rubber cool water supply hose, not shown. The front end of the inlet conduit **90** communicates with a fixture **92**, the fixture **92** housing a strainer, not shown. The upper portion of the fixture **92** communicates with a valve **93**; the valve **93** is of the solenoid controlled type and is normally biased into its closed position and provided with a solenoid **94** energizable to operate it into its open position. The upper portion of the valve **93** communicates with a vacuum breaker **95**, that, in turn, communicates with a flow control regulator **96**. Preferably the flow control regulator **96** is of the flexible diaphragm compression aperture or throat type that is designed to maintain a substantially constant flow of the cool water therethrough, when the valve **93** occupies its open position, notwithstanding considerable variation of the gauge pressure of the cool water supplied to the inlet conduit **90**. Specifically the flow control regulator **96** is designed to maintain a substantially constant flow of approximately 0.4 gallon per minute of the cool water therethrough. Finally the flow control regulator **96** communicates with a tube **97** that terminates in two spray nozzles **98** arranged in the lower portion of the condensing chamber **73**.

More particularly, the longitudinally extending baffle **75** is arranged immediately below the bottom of the cylindrical side wall **43** of the drum **40**; and a longitudinally extending arcuate-shaped baffle **99** is arranged in spaced relation below the baffle **75** and above the bottom wall of the sump **74** and joining the right-hand junction between the upper and lower casing sections **36** and **37**, as viewed in Figs. 3 and 4. Thus the condensing chamber **73** has a generally arcuate-shape and is disposed between the baffles **75** and **99**. The spray nozzles **98** are arranged substantially centrally of the lower casing section **37** adjacent to the end of the baffle **99**. More specifically the spray nozzles **98** are disposed in circumferentially spaced-apart relation and are directed upwardly at an angle toward the baffle **75**, whereby the spray nozzles **98** project a finely divided spray of cool water upwardly at an angle between the baffles **75** and **99** when the valve **93** occupies its open position. Since the spray nozzles **98** are directed upwardly at an angle with respect to the baffle **75**, a component of the direction of the spray of cool water is in counterflow relation with respect to the direction of circulation of the current of air through the condensing chamber **73**. This arrangement is very advantageous in view of the fact that the counterflow relation between the upwardly directed spray of cool water and the current of air passing through the condensing chamber **73** effects a thorough scrubbing of the current of air as it is passed through the condensing chamber **73**.

Further a plurality of longitudinally extending angularly disposed fins or deflectors **100** project downwardly from the lower surface of the baffle **75** for the purpose of redirecting the finely divided spray of cool water downwardly into the space between the baffles **75** and **99** in the condensing chamber **73**. It will be understood that the water accumulating upon the lower baffle **99** drains readily from the end thereof into the sump **74** disposed therebelow. The bottom of the sump **74** has a drain opening **101** formed in the lowermost portion thereof that receives the adjacent end of a drain conduit **102** formed of molded rubber, or the like. Also a pump **103** is suitably supported by the base **11** below the sump **74** and provided with a casing having an inlet port **104** and a discharge port **105**, as well as a rotatable pump element housed in the casing and provided with an operating shaft **106**. The inlet port **104** is connected to the adjacent end of the drain conduit **102**; and the discharge port **105** is connected to the adjacent end of a flexible rubber drain hose **107**. The operating shaft **106** has a pulley **108** rigidly secured thereto which is belted by a V-belt **109** to the pulley **79** carried by the operating shaft **78** of the motor **77**. Thus it will be understood that when the motor **77** is operated, the pump **103** is operated in order to draw water, condensate and lint accumulating in the sump **74** through the drain conduit **102** and to discharge the water, condensate and lint through the flexible drain hose **107**. An upstanding vent conduit **103'** is arranged in the space **46**, the lower end of the vent conduit **103'** communicating

with the casing of the pump 103 and the upper end of the vent conduit 103' communicating with the atmosphere. The arrangement of the vent conduit 103' positively prevents the possibility of a gas lock in the casing of the pump 103 when upstanding columns of water are present both in the drain conduit 102 and in the drain hose 107.

Also a longitudinally extending overflow opening 110 is formed in the end wall of the sump 74 well above the drain opening 101 formed in the bottom wall thereof and below the baffle 99. The arrangement of the overflow opening 110 in the end wall of the sump 74 prevents the accumulation of an excess head of the water in the sump 74 should operation of the pump 103 be arrested for an unusual time interval since the water thus accumulated in the sump may overflow from the sump 74 through the overflow opening 110 to the exterior of the casing 33. Moreover the bottom of the overflow opening 110 is disposed below the spray nozzles 98 in order positively to prevent an accumulation of water in the sump 74 submerging the spray nozzles 98; which arrangement is employed for a purpose more fully explained hereinafter. Further it is noted that the disposition of the baffle 99 projecting over the overflow opening 110 formed in the end wall of the sump 74 provides an adjacent low pressure area in the sump 74 tending to cause air to drain through the overflow opening 110 into the sump 74, thereby positively preventing the escape of any appreciable amount of water vapor from the condensing chamber 73 and the sump 74 to the exterior through the overflow opening 110.

As viewed from the front of the machine 10, the lower left-hand portion of the rear wall 16 has an opening 111 formed therein through which the cool water supply hose, not shown, and the drain hose 107 project from the upstanding space 46 disposed interiorly of the cabinet 12 into the upstanding space 27 disposed exteriorly of the cabinet 12. Of course the cool water supply hose, not shown, is suitably connected to the source of cool water in the laundry room and consequently to the city water main; while the drain hose 107 is suitably associated with a laundry tray or other drain plumbing in the laundry room. The arrangement of the upstanding space 27 disposed rearwardly of the rear wall 16 and below the top wall 17 not only conceals the cool water supply hose, not shown, and the drain hose 107, but it also affords adequate space for these hoses, as well as the electrical connections, when the rear of the backsplash 26 is arranged in abutting relation with respect to the wall of the laundry room.

As best shown in Figs. 5 and 6, the cylindrical side wall 43 of the drum 40 carries three substantially equally circumferentially spaced-apart longitudinally extending and inwardly projecting vanes 111 that are formed integrally therewith. More particularly, the cylindrical side wall 43 is interrupted by the three vanes 111 to provide the cylindrical side wall 43 with three perforated segmental sections 112 disposed between the vanes 111. Also the front end wall 41 is provided with an annular flange 113 that frictionally engages the adjacent end of the cylindrical side wall 43; and the rear end wall 42 is provided with an annular flange 114 that frictionally engages the adjacent end of the cylindrical side wall 43. Finally the end walls 41 and 42 are retained in assembled relation with respect to the ends of the cylindrical side wall 43 by an arrangement including three longitudinally extending belts 115 arranged within the respective vanes 111. Each of the vanes 111 comprise a substantially flat imperforate leading face 116, a substantially flat imperforate trailing face 117, and a connecting smooth curved crest 118, with respect to the direction of rotation thereof. More particularly the leading face 116 slopes forwardly at an angle of approximately 45° with respect to a reference plane passed through the longitudinal axis of the drum 40 and the crest 118; while the trailing face 117 slopes rearwardly at an angle of approximately 45° with respect to the reference plane noted; whereby the faces 116 and 117 are disposed at an angle of approximately 90° with respect to each other. Moreover the crest 118 of each vane 111 projects inwardly a distance of substantially 20% of the radial distance between the longitudinal axis of the drum 40 and the segments 112 of the cylindrical side wall 43 thereof. This construction of the vanes 111 is very advantageous as it avoids the usual slapping and jamming of the clothes and the consequent balling thereof in the drum 40. Specifically as a vane 111 approaches the top of its travel the clothes carried thereby are unfolded and fall back toward the bottom of the drum 40, so that they are again gently gathered and propelled by one of the vanes 111, whereby the clothes travel in a continuous path during the rotation of the drum 40.

Finally at least one of the vanes 111 has a longitudinally extending depression 119 formed in the trailing face 117 thereof through which a pair of longitudinally spaced-apart elongated access openings 120 are formed. The access openings 120 are normally covered by an elongated removable cover plate 121 arranged in the depression 119 and secured in place by a suitable screw 122. This arrangement accommodates ready access through the openings 120, after removal of the cover plate 121, into the space between the cylindrical side wall 43 of the drum 40 and the tubular side wall of the casing 33 to permit cleaning and inspection of the heating elements 62 and 63, and for other purposes.

The construction and arrangement of the drum 40 described above are disclosed and claimed in the copending divisional application of Clifford E. Erickson and Glenn D. Graham, Serial No. 348,082, filed March 9, 1953.

Referring now to Fig. 4, as a constructional example, it has been discovered that by utilizing the drum 40 having a length of substantially 18" and a diameter of substantially 27", and provided with the three inwardly directed vanes 111 projecting toward the longitudinal axis of the drum 40 by a distance of substantially 20% of the radial distance between the longitudinal axis of the drum 40 and the cylindrical side wall 43 thereof, a circulation of air between 50 and 75 cubic feet per minute is obtained in the casing 33 through the drum 40, depending upon the load of clothes being tumbled, when the drum 40 is rotated at approximately 50 R. P. M. Specifically when the drum 40 contains approximately 9# of clothes in a wet condition, the circulation of air therethrough is about 75 cubic feet per minute. This circulation of the current of air in the casing 33 through the drum 40 is obtained not only by the fanning action of the rotating drum 40 and the vanes 111 upon the air, but also by the action of the clothes falling or cascading through the space in the drum 40, as indicated by the lines 123, as the clothes are tumbled in the drum 40. The rate of circulation of air is substantially decreased when a smaller weight of clothes is tumbled in the drum 40; and also the rate of circulation is decreased noticeably as the load of clothes is dried. Under normal initial conditions, the rate of circulation mentioned is obtained employing the load of 9# of clothes carrying 9# of water.

In the operation of the machine 10, in the initial portion of the cycle thereof, it may be assumed that cool water at a temperature of approximately 60° F. is supplied to the inlet conduit 90 under gauge pressure and that the flow regulator 96 effects the supply of about 0.4 gallon per minute of cool water to the spray nozzles 98 when the valve 93 occupies its open position. Also it may be assumed that the heating elements 62 and 63 are energized to develop 4500 watts. Under these initial operating conditions, the air entering the heating chamber 61 may have a temperature of approximately 130° F. and may be substantially 100% saturated. In passing through the heating chamber 61, the air may be heated to a temperature of approximately 400° F. in order to effect a corresponding reduction in the relative humidity thereof. The air is cooled somewhat in passing into the drum 40 and may have a temperature of about 375° F. upon contacting the clothes tumbling therein, as well as a low relative humidity. Due to the radiant heat projected into the drum 40 by the heating elements 62 and 63 through the perforations formed in the side wall 43 thereof, and the hot dry air passing through the drum 40, the wet clothes contained therein are heated to a temperature of approximately 175° F. and dried, whereby the temperature of the air in the drum 40 is considerably reduced and the relative humidity thereof is increased to substantially 100% saturation. After passing through the drum 40, the air enters the compression chamber 76 and may have a temperature of approximately 245° F. and may be substantially 100% saturated. The air is compressed in the compression chamber 76 and swept into the condensing chamber 73, where

it is thoroughly scrubbed with the finely divided spray of cool water at the temperature of approximately 60° F. Accordingly the temperature of the air is appreciably reduced in the condensing chamber 73 in order to effect the condensation of moisture therefrom, whereby the air may have a temperature of approximately 130° F. and may be substantially 100% saturated as it passes out of the condensing chamber 73 into the passage 76' and again toward the heating chamber 61. Thus it will be understood that the relative humidity of the hot air in the drum 40 is increased as it is passed therethrough into contact with the contained clothes tumbling therein effecting drying of the clothes and that this moisture is transported from the drum 40 into the condensing chamber 73. This moisture in the air is given up in the condensing chamber 73 by condensation as a consequence of cooling of the air therein. Of course, the condensate removed from the circulated air together with the cool water that is sprayed into the condensing chamber 73 is collected in the sump 74. While the temperature of water sprayed from the spray nozzles 98 into the condensing chamber 73 has been assumed to be about 60° F., it will be appreciated that cool water at a lower temperature is desirable in order to increase the rate at which the moisture in the air in the condensing chamber 73 is precipitated out and that cool water at a temperature of 50° F. or lower is employed when it is available; however, the machine 10 operates entirely satisfactorily when employing a finely divided spray of cool water having a temperature as high as 90° F.

During the operation of the machine 10, it will be appreciated that as the wet clothes contained in the drum 40 are dried, loose lint contained therein is picked up by the circulated current of air passing through the drum 40, whereby this loose lint is thoroughly scrubbed out of the circulated air in the condensing chamber 73 and accumulates along with the water and the condensate in the sump 74. Thus in the operation of the machine 10, not only is the water removed from the wet clothes tumbling in the drum 40, but also the loose lint is removed therefrom. The water, the condensate, and the lint accumulating in the sump 74 are removed to the exterior through the drain conduit 102 by the pump 103, in the manner previously explained. In view of the foregoing description of the general operation of the machine 10, it will be understood that since a closed air circulating system is employed, no hot air is discharged into the laundry room so that there is no substantial heating of the laundry room. Furthermore the relative humidity of the air in the laundry room is not increased and no lint is blown thereinto from the machine 10.

Since the air circulated in the casing 33 is heated adjacent to the upper portion thereof in the heating chamber 61 and is cooled adjacent to the lower portion thereof in the condensing chamber 73, the exterior surface of the casing 33 is selectively insulated. More particularly, as best shown in Fig. 2, the exterior surface of the upper casing section 36 is provided with a blanket of insulating material, indicated at 124. Likewise the exterior surface of the upper portion of the front wall 34 is provided with a blanket of insulating material, indicated at 125; and the exterior surface of the upper portion of the rear wall 35 is provided with a blanket of insulating material, indicated at 126. Similarly a blanket of insulating material, indicated at 127, is arranged between the inner and outer sheets or walls of the fabricated front door 22. On the other hand, the exterior surface of the lower casing section 37 and the exterior surfaces of the lower portions of the front wall 34 and the rear wall 35 are exposed to the atmosphere within the cabinet 12 since the current of air circulated in the casing 33 is cooled in the lower portion thereof within the condensing chamber 73, as previously explained.

During the operation of the machine 10, should the abnormal condition appear of a subatmospheric pressure of the water in the connected city water main, air is admitted into the plumbing connection by the vacuum breaker 95 and thence via the inlet conduit 90 and the connected cool water supply hose, not shown, into the city water main, since the valve 93 occupies its open position at this time. However there can be absolutely no back-siphoning of water from the sump 74 under the abnormal condition noted by virtue of the arrangement of the vacuum breaker 95 at least 6" above the bottom of the overflow opening 110 disposed in the end wall of the sump 74, as indicated in Fig. 3. Thus there is no possibility of back-siphoning from the sump 74 into the city water main under the abnormal condition noted even though operation of the pump 113 is arrested for a considerable time interval and even though a considerable amount of water accumulates in the sump 74.

Referring now to Fig. 7, the vacuum breaker 95 may comprise a casing 128 providing a chamber 129 communicating via an inlet connection 130 with the valve 93 and an outlet connection 131 communicating with the flow regulator 96. Arranged in the upper end of the casing 128 is a removable lower plug 132 having a plurality of vent ports 133 formed therein and carrying a movable valve element 134, the valve element 134 being movable between open and closed positions with respect to the vent ports 133 formed in the lower plug 132. Also an upper plug 135 having a plurality of vent ports 136 formed therein is arranged in the upper end of the casing 128 above the lower plug 132. The upper plug 136 carries a removable cover 137 arranged to protect the vent ports 136 against the entry of large foreign objects thereinto but permits ready passage of air from the atmosphere through the vent ports 136 and 133 when the valve element 134 occupies its open position. More particularly when cool water under gauge pressure is supplied into the chamber 129 through the inlet connection 130, the valve element 134 is moved into its closed position with respect to the lower plug 132, whereby the cool water proceeds through the outlet connection 131. On the other hand, in the event of a subatmospheric pressure in the chamber 129, the valve element 134 is moved into its open position with respect to the lower plug 132 so that air is drawn into the chamber 129 through the vent ports 136 and 133 and then passes from the chamber 129 through the inlet connection 130 so as to prevent back-siphoning into the chamber 129 through the outlet connection 131.

Further the machine 10 includes various instrumentalities that are employed in the electric control circuit therein, and including a hydrostatic switch 138 carried by the bottom wall of the lower casing section 37 and communicating with the sump 74, as indicated in Fig. 2. Also a cutout switch 139 of the thermostatic type is carried by the upper portion of the upper casing section 36 and responsive to the temperature of the current of air in the general region where it leaves the heating chamber 61 and enters the drum 40, as indicated in Fig. 3. Further the thermostatic switch 30 is provided with a thermal responsive element 140 that is supported in position between the central portion of the left-hand side of the upper casing section 36 of the casing 33 and the associated side wall 43 of the drum 40, as viewed from the front of the machine 10, and responsive to the temperature of air in the general region where it leaves the drum 40 and enters the compression chamber 76 preceding the beginning of the condensing chamber 73, as indicated in Fig. 3. Also, as indicated in Fig. 3, the thermal responsive element 140 is connected to the casing of the thermostatic switch 30 by a capillary tube 141 extending therebetween. Further the electric motor 77 is provided with the usual start and run controller switch, indicated at 142 in Fig. 8, that is incorporated in the end bell thereof in a conventional manner. Further the rear wall 35 supports a terminal block, indicated at 143, in Fig. 3, that is adapted to terminate a flexible cable, not shown, that extends to a suitable 3-wire Edison A. C. source providing 230 volts between the outside lines thereof and 115 volts between either outside line thereof and the grounded neutral line thereof; and a fuse device 144 is carried by the lower right-hand front of the base 11, as indicated in Fig. 2.

Referring now more particularly to Fig. 8, the timer 28 comprises a rotatable operating shaft 145 that carries the control dial 29 on the outer upper end thereof and that also carries three insulating control cams C1, C2, and C3. Also the timer 28 comprises an electric synchronous drive motor 146 that is preferably of the "Telechron" type, reduction gearing 147, and a slip clutch 148. The rotatable armature of the timer motor 146 is directly connected to the drive shaft of the reduction gearing 147; the driven shaft of the reduction gearing 147 is directly connected to one plate of the slip clutch 148; and the other plate of the slip clutch 148 is directly connected to the inner lower end of the operating shaft 145. Also three sets of switch springs S1, S2 and S3 are respectively

operatively associated with the control cams C1, C2 and C3. The cooperation between the control cams C1, C2 and C3 and their respective sets of switch springs S1, S2 and S3 has been illustrated on a time basis in Fig. 8, as more fully explained hereinafter.

Further the thermostatic switch 30 comprises an expansible bellows 149 that is operatively connected to the capillary tube 141 and cooperates with a push rod 150 carrying two contact bridging members 151 and 152. Also as diagrammatically illustrated in Fig. 8, a control lever 153 is provided that is pivotally mounted at 154 and has an inner end that cooperates with the push rod 150, the outer end of the control lever 153 cooperating with a cam 155 that is carried by the inner lower end of an operating shaft 156, the control dial 31 being mounted on the outer upper end of the operating shaft 156. The control lever 153 is biased in the counterclockwise direction about the pivot 154 by a coil spring 157, whereby the inner end of the control lever 153 normally biases the push rod 150 downwardly to cause the bridging members 151 and 152 to bridge the associated pairs of contacts. The bias that the control lever 153 exerts upon the push rod 150 may be selectively adjusted by rotation of the cam 155 as a consequence of manipulation of the control dial 31 carried by the operating shaft 156. On the other hand, the projection of fluid into the expansible bellows 149 exerts an upward force upon the push rod 150 tending to move the bridging members 151 and 152 to open the associated pairs of constacts.

The hydrostatic switch 138 comprises an expansible bellows 158 that communicates with the lower portion of the sump 74 and is responsive to the head of the water accumulating therein, the expansible bellows 158 cooperating with a push rod 159 that carries a contact bridging member 160. As previously noted, the cutout switch 139 may be of the thermostatic type and as illustrated comprises a stationary contact supporting element 161 and a movable contact supporting element 162 of the bimetallic thermal responsive type.

The electric motor 77 is of the split-phase type including a start winding 163, a run winding 164, and an inductively coupled armature 165 supporting the operating shaft 78. As previously noted, the start and run control switch 142 is operatively connected to the operating shaft 78 and comprises a speed responsive or centrifugal device 166 that is also connected to a pull rod 167 that carries a contact bridging member 168 of the double throw type. The bridging member 168 is normally biased toward the left by a coil spring 169 and is movable by the speed responsive device 166 against the bias of the coil spring 169 toward the right. In its left-hand position, the bridging member 168 closes its left-hand pair of contacts and opens its right-hand pair of contacts; and in its right-hand position, the bridging member 168 closes its right-hand pair of contacts and opens its left-hand pair of contacts. When the armature 165 occupies its normal rest position, the bridging member 168 occupies its left-hand position; and when rotation of the armature 165 is initiated and approximately 50% of the normal operating speed thereof is attained, the speed responsive or centrifugal device 166 operates the bridging member 168 from its left-hand position into its right-hand position. Of course when rotation of the armature 165 is arrested, the coil spring 169 again returns the bridging member 168 from its right-hand position back into its left-hand position.

Also in Fig. 8, there is diagrammatically illustrated the valve 93, the solenoid 94, the heating elements 62 and 63, and the three-wire Edison source of current supply, including the outside conductors 170 and 171 and the grounded neutral conductor 172.

In the circuit control network, the set of switch springs S1 comprises upper and lower springs respectively connected to two conductors 173 and 174; the set of switch springs S2 comprises upper and lower springs respectively connected to the outside conductor 170 and to a conductor 175; and the set of switch springs S3 comprises upper and lower springs respectively connected to the outside conductor 171 and to a conductor 176. One terminal of the start winding 163 is connected to one of the left-hand contacts controlled by the bridging member 168; and the other terminal of the start winding 163 is connected to the conductor 174. One terminal of the run winding 164 is connected to the neutral conductor 172; and the other terminal of the run winding 164 is connected to the conductor 174. The other left-hand contact controlled by the bridging member 168 is connected to the neutral conductor 172; one of the right-hand contacts controlled by the bridging member 168 is connected to a conductor 177; and the other right-hand contact controlled by the bridging member 168 is connected to the conductor 176. The fuse device 144 is connected between the conductors 176 and 174; and the lamp 32' is bridged between the conductor 174 and the neutral conductor 172. The conductor 173 is connected to one of the contacts controlled by the bridging member 160; the other contact controlled by the bridging member 160 is connected to one terminal of the solenoid 94; and the other terminal of the solenoid 94 is connected to the neutral conductor 172. The terminals of the timer motor 146 are respectively connected to the conductor 176 and to the neutral conductor 172. The conductor 175 is connected to one of the contacts controlled by the bridging member 151; the other contact controlled by the bridging member 151 is connected to a conductor 178; the conductor 177 is connected to one of the contacts controlled by the bridging member 152; and the other contact controlled by the bridging member 152 is connected to a conductor 179. The stationary contact element 161 of the cutout switch 139 is connected to the conductor 178; and the movable contact element 162 of the cutout switch 139 is connected to a conductor 180. Finally the heating elements 62 and 63 are bridged in parallel circuit relation between the conductors 179 and 180.

When the machine 10 is at rest, the control dial 29 occupies its stop position so that the control cams C1, C2 and C3 carried by the operating shaft 145 actuate the sets of switch springs S1, S2 and S3 into their open circuit positions. The electric motor 77 is normally at rest, whereby the contact bridging member 168 normally occupies its left-hand position; the lamp 32' is extinguished; the timer motor 146 is at rest; the cutout switch 139 occupies its closed position; the hydrostatic switch 138 occupies its closed position; and the solenoid 94 is deenergized so that the valve 93 occupies its closed position.

Considering now the operation of the machine 10 in conjunction with the circuit control network therefor, the operator places a load of clothes to be dried into the drum 40 and closes the front door 22. She then adjusts the control dial 31 of the thermostatic switch 30 in accordance with the character of the fabrics to be dried. Specifically, the control dial 31 governs the cam 155 through the operating shaft 156 to establish the bias that is exerted by the control lever 153 upon the push rod 150, and consequently the temperature at which the influence exerted by the thermal responsive element 140 upon the bellows 149 will operate the push rod 150 to open the bridging members 151 and 152 with respect to the associated pairs of contacts. Also the control dial 129 of the timer 28 is set to the desired time interval in accordance with whether the load of clothes is to be dried to a damp-dry condition or to a bone-dry condition. Specifically, the control dial 29 is rotated out of its stop position into its variable start position in order to set the time interval or operating cycle of the timer 28 in the zone between a time interval of 60 minutes and a timer interval of 40 minutes, as indicated in the chart associated with the control cams C1, C2 and C3. For example, it may be assumed that the load of clothes is to be dried to the bone-dry condition, whereby the control dial 29 is set to the initial portion of the variable start position establishing an overall time interval of 60 minutes of operation of the cycle of the machine 10.

Specifically, the control dial 29 is rotated in the clockwise direction out of its stop position, the slip clutch 148 accommodating rotation of the operating shaft 145 with respect to the reduction gearing 147, whereby the control cams C1, C2 and C3 respectively close the sets of switch springs S1, S2 and S3. When the set of switch springs S3 is thus closed, the outside conductor 171 is connected to the conductor 176, thereby completing a direct circuit, including the neutral conductor 172, for operating the timer motor 146, whereby the timer motor 146 drives the operating shaft 145 further in the clockwise direction through the reduction gearing 147 and the slip clutch 148. Also the conductor 176 is connected through the fuse device 144 to the conductor 174, thereby to complete a circuit, including the left-hand pair of contacts controlled by the bridging member 168 and the neutral conductor 172, for energizing the start winding 163, as well as a direct circuit between the conductor 174 and the neutral conductor 172 for energizing the run winding 164.

When the start winding 163 and the run winding 164 of the electric motor 77 are thus energized, rotation of the armature 165 is initiated. Further the lamp 32' is illuminated between the conductor 174, and the neutral conductor 172. When the set of switch springs S1 is thus closed, the conductor 174 is connected to the conductor 173 to complete a circuit, including the contacts controlled by the bridging member 160 and the neutral conductor 172 for energizing the solenoid 94, whereby the valve 93 is operated into its open position. Thus the current supplied between the outside conductor 171 and the neutral conductor 172 to the start winding 163 and to the run winding 164 of the electric motor 77 passes through the fuse device 144. Moreover the currents supplied between the outside conductor 171 and the neutral conductor 172 to the lamp 32' and to the solenoid 94 pass through the fuse device 144. However the current between the outside conductor 171 and the neutral conductor 172 that is supplied to the timer motor 146 bypasses the fuse device 144, whereby the fuse device 144 provides overload protection only to the electric motor 77, to the lamp 32', and to the solenoid 94.

When the set of switch springs S2 is thus closed, the outside conductor 170 is connected to the conductor 175; however, the circuit for energizing the heating elements 62 and 63 is open at this time at the right-hand contacts controlled by the bridging member 168, although the contacts controlled by the bridging members 151 and 152 are closed and the contacts of the cutout switch 139 are closed. Accordingly energization of the heating elements 62 and 63 is dependent upon operation of the electric motor 77. More particularly, when the armature 165 of the electric motor 77 reaches approximately 50% of its normal operating speed, the centrifugal device 166 operates the bridging member 168 from its left-hand position into its right-hand position, interrupting at the left-hand contacts controlled by the bridging member 168, the circuit for energizing the start winding 163, and completing at the right-hand contacts controlled by the bridging member 168, the circuit mentioned for energizing the heating elements 62 and 63. After the start winding 163 of the electric motor 77 is thus deenergized the armature 165 continues to accelerate on into its normal operating speed in a conventional manner. The circuit for energizing the heating elements 62 and 63 extends from the outside conductor 170 via the set of switch springs S2, the conductor 175, the contacts controlled by the bridging member 151, the conductor 178 and the cutout switch 139 to the conductor 180, and from the outside conductor 171 via the set of switch springs S3, the conductor 176, the right-hand contacts controlled by the bridging member 168, the conductor 177, and the contacts controlled by the bridging member 152 to the conductor 179; the heating elements 62 and 63 being bridged in parallel circuit relation between the conductors 179 and 180. Accordingly, at this time, the heating elements 62 and 63 are supplied with electric current between the outside conductors 170 and 171 at the 230 volts A. C. and consequently become heated to effect heating of the air in the heating chamber 61, in the manner previously explained. Also the valve 93 occupying its open position effects the supply of cool water to the spray nozzles 98 in the condensing chamber 73, in the manner previously explained.

As the cycle of the machine 10 proceeds, the timer motor 146 drives the operating shaft 145 and consequently the cams C1, C2 and C3 further in the clockwise direction back toward the stop position of the control dial 29, as previously explained. Also during the course of the cycle when the circulated air reaches a predetermined temperature, the influence exerted upon the thermal responsive element 140 effects operation of the bellows 149 sufficiently to effect operation of the push rod 150 so as to move the bridging members 151 and 152 into open circuit position, depending upon the initial adjustment of the thermostatic switch 30, as brought about by the manipulation of the control dial 31. When the bridging members 151 and 152 are thus operated into their open circuit positions, the heating elements 62 and 63 are deenergized, whereby the temperature of the circulated air soon subsides so that the thermal responsive device 140 exercises a contrary influence upon the bellows 149 effecting reclosure of the bridging members 151 and 152 and the consequent reenergization of the heating elements 62 and 63. Thus the thermostatic switch 30 operates to hold the temperature of the circulated air to that previously set by manipulation of the control dial 31.

During the operation of the machine 10, should the temperature of the circulated air become excessive, the cutout switch 139 is operated independently of the thermal switch 30 in order positively to open a further point in the circuit for energizing the heating elements 62 and 63. Of course in the operation of the cutout switch 139, the movable bimetallic element 162 moves away from the stationary element 161 opening the contacts respectively carried thereby. When this abnormally high temperature subsides, the cutout switch 139 is again operated into its closed position. Of course, it will be understood that the temperature at which the cutout switch 139 is adjusted to be operated into its open circuit position is somewhat higher than the normal range of the thermostatic device 30 and really comprises a safety switch operative in the event of failure of operation of the normally operated thermal switch 30.

Also in the operating cycle of the machine 10, should operation of the pump 103 be arrested, such for example as the result of the breakage of the belt 109, water begins to accumulate in the sump 74 and when the head thereof reaches a predetermined head disposed below the bottom of the overflow opening 110 formed in the end wall of the sump 74, the bellows 158 is expanded sufficiently to cause the push rod 159 to move the bridging member 160 into its open circuit position effecting deenergization of the solenoid 94 and the consequent operation of the valve 93 back into its closed position. Thus it will be understood that the hydrostatic switch 138 comprises an additional safety device for positively preventing the accumulation of an excess head of water in the sump 74 should operation of the pump 103 be arrested, whereby the hydrostatic switch 138 further insures that there is no back-siphoning of water from the sump 74 into the connected city water main in the event of the abnormal condition of a subatmospheric pressure in the city water main.

The electric lamp 32' not only serves as a pilot light indicating that the machine 10 is operating in its cycle, but it also projects light through the ornamental trim and lamp hood 32 effecting some illumination of the work surface 24 of the top wall 17.

Furthermore in the operating cycle of the machine 10, should an electrical fault develop in the electric motor 77, in the solenoid 94 or in the electric lamp 32', the fuse device 144 would be operated as a consequence of the overload current so that operation of the motor 77 would be arrested, the solenoid 94 would be deenergized and the electric lamp 32' would be extinguished. In this event, when operation of the electric motor 77 is arrested, the coil spring 169 returns the bridging member 168 from its right-hand position into its left-hand position opening the circuit for energizing the heating elements 62 and 63. Thus it will be understood that the start and run control switch 142 associated with the electric motor 77 comprises an additional safety device for effecting energization of the heating elements 62 and 63 only when the electric motor 77 is operating.

Continuing now with the cycle of operation of the machine 10, after the expiration of all but 7 minutes of the time interval previously set by the control dial 29 of the timer 28, the control cam C2 operates the set of switch springs S2 into its open circuit position effecting deenergization of the heating elements 62 and 63. Subsequently after the expiration of all but 1½ minutes of the time interval previously set by the control dial 29 of the timer 28, the control cam C1 operates the set of switch springs S1 into its open position effecting deenergization of the solenoid 94 and the consequent return of the valve 93 into its closed position. Accordingly it will be understood that in the operating cycle of the machine 10, cool water is supplied to the spray nozzles 98 for a time interval of approximately 5½ minutes after the heating elements 62 and 63 are deenergized immediately adjacent to the end of the operating cycle. Thereafter and at the expiration of an additional time interval of 1½ minutes the operating shaft 145 of the timer 28 is returned back into its stop position, whereby the control cam C3 operates the set of switch springs S3 into its open circuit position to arrest operation of the electric motor 77, to arrest operation of the timer motor 146 and to extinguish the electric lamp 32'. At this time, the cycle of operation of the machine 10 has been completed and the timer 28 has been returned back

into its normal stop position opening all of the electric circuits.

In view of the foregoing, it is apparent that there has been provided in a clothes drying machine of the portable home laundry type including a closed air circulating system involving a heating chamber and a spaced-apart spray condensing chamber, an improved cabinet construction, an improved cool water supply system, and an improved circuit control network therefor.

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 including complementary upper and lower casing sections secured together and enclosing said drum, said upper casing section cooperating with said drum to define a first chamber therebetween disposed adjacent to the top of said drum, a first baffle disposed between the bottom of said drum and the bottom of said lower casing section and cooperating with the bottom of said lower casing section to define a second chamber therebetween disposed adjacent to the bottom of said drum, means for rotating said drum in order to tumble the contained clothes and to produce circulation of a current of air from said first chamber through said drum into contact with the contained clothes and thence into said second chamber and back into said first chamber, means for heating said current of air as it is passed through said first chamber, means for producing a finely divided spray of cool water in said second chamber below said baffle in order to cool and to scrub said current of air as it is passed therethrough, the bottom of said lower casing having a drain opening formed therein, means including a pump communicating between said drain opening and the exterior for discharging from said second chamber water accumulating therein, said lower casing having an overflow opening formed therein and disposed above said drain opening and communicating with the exterior, and means including a second baffle operatively associated with said overflow opening for preventing the escape of any substantial amount of water vapor from said second chamber through said overflow opening to the exterior.

2. The clothes drying machine set forth in claim 1, wherein said means for producing a finely divided spray of cool water in said second chamber below said first baffle includes a nozzle disposed in the bottom of said second chamber that directs said finely divided spray of cool water upwardly in an inclined position toward said first baffle so that the direction of said spray of cool water has a component that is in counterflow relation with respect to the direction of circulation of said current of air.

3. 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 including complementary upper and lower casing sections secured together and enclosing said drum, said upper casing section cooperating with said drum to define a first chamber therebetween disposed adjacent to the top of said drum, a first baffle disposed between the bottom of said drum and the bottom of said lower casing section, a second baffle disposed between said first baffle and the bottom of said lower casing section, said first and second baffles cooperating to define a second chamber therebetween disposed adjacent to the bottom of said drum, means for rotating said drum in order to tumble the contained clothes and to produce circulation of a current of air from said first chamber through said drum into contact with the contained clothes and thence into said second chamber and back into said first chamber, means for heating said current of air as it is passed through said first chamber, means for producing a finely divided spray of cool water between said baffles in said second chamber in order to cool and to scrub said current of air as it is passed therethrough, the bottom of said lower casing having a drain opening formed therein, and means including a pump communicating between said drain opening and the exterior for discharging from said second chamber water accumulating therein, said lower casing having an overflow opening formed therein and disposed below said second baffle and above said drain opening and communicating with the exterior, said second baffle cooperating with said overflow opening to prevent the escape of any substantial amount of water vapor from said second chamber through said overflow opening to the exterior.

4. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted drum adapted to receive clothes to be dried, wall structure defining a passage communicating at the opposite ends thereof with two spaced-apart portions of said drum, said wall structure also defining spaced-apart and communicating first and second chambers in said passage, an electric heating element adapted to heat a current of air passing through said first chamber, an inlet conduit adapted to supply cool water into said second chamber so as to cool a current of air passing therethrough, a pump operative to discharge to the exterior water accumulating in said second chamber, and an electric motor operative to rotate said drum in order to tumble the contained clothes and to produce circulation of a current of air from said first chamber through said drum into contact with the contained clothes and thence into said second chamber and back into said first chamber and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, means controlled by initial operation of said timer in its operating cycle for initiating operation of said motor and for connecting said heating element to said source of electric current and for operating said valve into its open position, means controlled by subsequent operation of said timer in its operating cycle for disconnecting said heating element from said source of electric current, means controlled by still subsequent operation of said timer in its operating cycle for operating said valve into its closed position, means controlled by final operation of said timer in its operating cycle for arresting operation of said motor, a first thermostatic switch selectively operative to connect and to disconnect said heating element with respect to said source of electric current, said first thermostatic switch being jointly controlled by a first thermal element responsive to the temperature within said casing in the region where said circulated air leaves said drum and enters said second chamber and by a manually settable control device, and a second thermostatic switch selectively operative to connect and to disconnect said heating element with respect to said source of electric current, said second thermostatic switch being controlled by a second thermal element responsive to the temperature within said casing in the region where said circulated air leaves said first chamber and enters said drum.

5. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted perforated drum adapted to receive clothes to be dried, a substantially imperforate casing enclosing said drum and cooperating therewith to define first and second spaced-apart chambers adjacent thereto and communicating therewith, an electric heating element arranged in said first chamber and adapted to heat said drum in order to evaporate moisture from the clothes in said drum, an inlet conduit adapted to supply cool water into said second chamber in order to condense the moisture evaporated from the clothes in said drum, a pump operative to discharge to the exterior water and condensate accumulating in said second chamber, and an electric motor operative to rotate said drum and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, means controlled by said timer in its cycle of operation for selectively initiating and arresting operation of said motor and for selectively operating said valve into its open and closed positions, a circuit for connecting said heating element to said source of electric current, a control device operated in response to operation of said motor, means responsive to operation of said control device for closing a normally open first

point in said circuit, and additional means controlled by said timer in its cycle of operation for selectively closing and opening a second point in said circuit.

6. The clothes drying machine combination set forth in claim 5, wherein said control device is in the form of a centrifugal switch that is operated in response to a predetermined speed of said motor to close its normally open contacts constituting said first point in said circuit.

7. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted perforated drum adapted to receive clothes to be dried, a substantially imperforate casing enclosing said drum and cooperating therewith to define first and second spaced-apart chambers adjacent thereto and communicating therewith, an electric heating element arranged in said first chamber and adapted to heat said drum in order to evaporate moisture from the clothes in said drum, an inlet conduit adapted to supply cool water into said second chamber in order to condense the moisture evaporated from the clothes in said drum, a pump operative to discharge to the exterior water and condensate accumulating in said second chamber, and an electric motor operative to rotate said drum and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, means controlled by said timer in its cycle of operation for selectively initiating and arresting operation of said motor and for selectively connecting and disconnecting said heating element with respect to said source of electric current, means normally biasing said valve into its closed position, a circuit for operating said valve against said bias from its closed position into its open position, a control device operated in response to the accumulation of a predetermined amount of water in said second chamber, means responsive to operation of said control device for opening a normally closed first point in said circuit, and additional means controlled by said timer in its cycle of operation for selectively closing and opening a second point in said circuit.

8. The clothes drying machine combination set forth in claim 7, wherein said control device is in the form of a hydrostatic switch that is operated in response to a predetermined head of the water accumulating in said second chamber to open its contacts constituting said first point in said circuit.

9. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted perforated drum adapted to receive clothes to be dried, a substantially imperforate casing enclosing said drum and cooperating therewith to define first and second spaced-apart chambers adjacent thereto and communicating therewith, an electric heating element arranged in said first chamber and adapted to heat said drum in order to evaporate moisture from the clothes in said drum, an inlet conduit adapted to supply cool water into said second chamber in order to condense the moisture evaporated from the clothes in said drum, a pump operative to discharge to the exterior water and condensate accumulating in said second chamber, and an electric motor operative to rotate said drum and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, means controlled by said timer in its cycle of operation for selectively initiating and arresting operation of said motor, a first circuit for connecting said heating element to said source of electric current, a thermostatic switch responsive to the temperature within said casing for selectively closing and opening a first point in said first circuit, means normally biasing said valve into its closed position, a second circuit for operating said valve against said bias from its closed position into its open position, a control device operated in response to the accumulation of a predetermined amount of water in said second chamber, means responsive to operation of said control device for opening a normally closed first point in said second circuit, and additional means controlled by said timer in its cycle of operation for selectively closing and opening a second point in said first circuit and for selectively closing and opening a second point in said second circuit.

10. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted perforated drum adapted to receive clothes to be dried, a substantially imperforate casing enclosing said drum and cooperating therewith to define first and second spaced-apart chambers adjacent thereto and communicating therewith, an electric heating element arranged in said first chamber and adapted to heat said drum in order to evaporate moisture from the clothes in said drum, an inlet conduit adapted to supply cool water into said second chamber in order to condense the moisture evaporated from the clothes in said drum, a pump operative to discharge to the exterior water and condensate accumulating in said second chamber, and an electric motor operative to rotate said drum and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, means controlled by said timer in its cycle of operation for selectively initiating and arresting operation of said motor, a first circuit for connecting said heating element to said source of electric current, a first control device operated in response to operation of said motor, means responsive to operation of said first control device for closing a normally open first point in said first circuit, means normally biasing said valve into its closed position, a second circuit for operating said valve against said bias from its closed position into its open position, a second control device operated in response to the accumulation of a predetermined amount of water in said second chamber, means responsive to operation of said second control device for opening a normally closed first point in said second circuit, and additional means controlled by said timer in its cycle of operation for selectively closing and opening a second point in said first circuit and for selectively closing and opening a second point in said second circuit.

11. In a clothes drying machine including a substantially horizontally disposed and rotatably mounted perforated drum adapted to receive clothes to be dried, a substantially imperforate casing enclosing said drum and cooperating therewith to define first and second spaced-apart chambers adjacent thereto and communicating therewith, an electric heating element arranged in said first chamber and adapted to heat said drum in order to evaporate moisture from the clothes in said drum, an inlet conduit adapted to supply cool water into said second chamber in order to condense the moisture evaporated from the clothes in said drum, a pump operative to discharge to the exterior water and condensate accumulating in said second chamber, and an electric motor operative to rotate said drum and to operate said pump; the combination comprising a source of electric current, means including a valve selectively operative between open and closed positions to control the supply of cool water from said inlet conduit to said second chamber, a cyclic operative timer, means for producing a cycle of operation of said timer, said motor being of the split-phase type including start and run windings, a first circuit for connecting said start and run windings to said source of electric current, means controlled by said timer in its cycle of operation for selectively opening and closing said first circuit and for selectively operating said valve into its open and closed positions, a second circuit for connecting said heating element to said source of electric current, a speed-responsive switch operated by a predetermined speed of said motor, means responsive to operation of said switch for disconnecting said start winding from said first circuit and for closing a normally open first point in said second circuit, and additional means controlled by said timer in its cycle of operation for selectively closing and opening a second point in said second circuit.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 357,363 | Booraem | Feb. 8, 1887 |
| 1,442,179 | Schneible | Jan. 16, 1923 |

**(Other references on following page)**

UNITED STATES PATENTS


| | | |
|---|---|---|
| 1,705,263 | McIlvane | Mar. 12, 1929 |
| 2,097,124 | Kelsey | Oct. 26, 1937 |
| 2,114,088 | Sagebarth | Apr. 12, 1938 |
| 2,259,984 | Anderson | Oct. 21, 1941 |
| 2,314,748 | White | Mar. 23, 1943 |
| 2,398,880 | Broglie | Apr. 23, 1946 |
| 2,434,476 | Wales | Jan. 13, 1948 |
| 2,451,692 | Pugh | Oct. 19, 1948 |
| 2,453,859 | Pugh | Nov. 16, 1948 |
| 2,463,934 | Allen | Mar. 8, 1949 |
| 2,496,517 | Bradley, Jr. | Feb. 7, 1950 |
| 2,503,329 | Geldhof et al. | Apr. 11, 1950 |
| 2,505,041 | Gorsuch | Apr. 25, 1950 |
| 2,540,955 | Moore | Feb. 6, 1951 |
| 2,555,268 | Chamberlin | May 29, 1951 |
| 2,590,295 | Constantine | Mar. 25, 1952 |
| 2,607,209 | Constantine | Aug. 19, 1952 |
| 2,644,245 | Hammell et al. | July 7, 1953 |