United States Patent [19]

Condit

[11] **3,859,004**

[45] **Jan. 7, 1975**

[54] **CONDENSER APPARATUS**

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[52] **U.S. Cl.** **34/75,** 34/131, 55/230, 261/90, 34/133

[51] **Int. Cl.** **F26b 13/00**

[58] **Field of Search** ..... 34/72–78, 130, 34/131, 133, 139; 68/18 C; 55/230; 261/90

[56] **References Cited**

UNITED STATES PATENTS

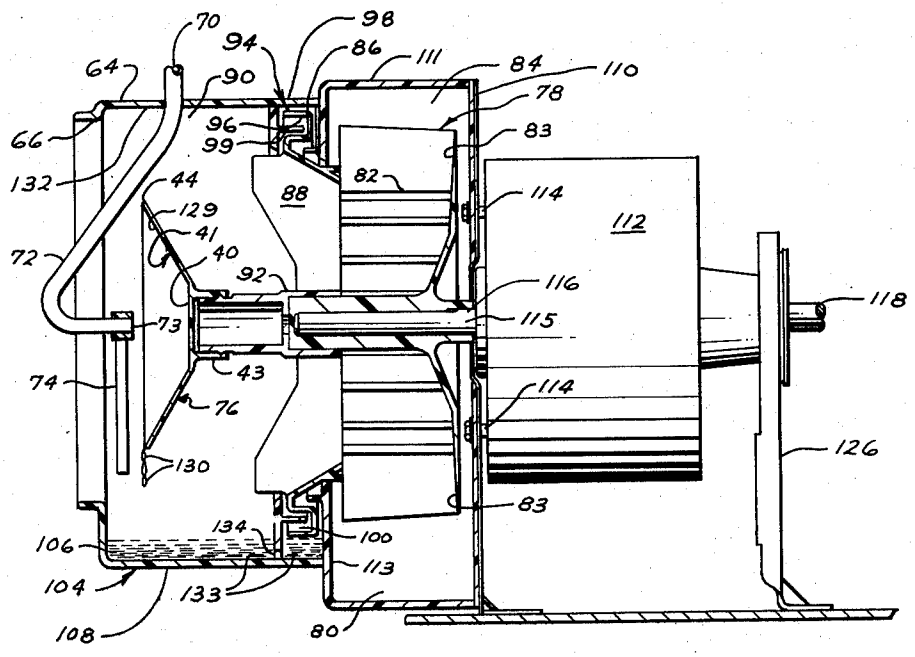
1,730,866	10/1929	Sternberg	261/90
3,022,581	2/1962	Smith	34/75
3,121,000	2/1964	Hubbard	34/75

Primary Examiner—Kenneth W. Sprague
Assistant Examiner—James C. Yeung
Attorney, Agent, or Firm—Frederick P. Weidner; Francis H. Boos

[57] **ABSTRACT**

Condenser apparatus for removing moisture from the air including a housing for the condenser apparatus, which housing has both a cooling liquid inlet and an air inlet at one end. Within the housing is a single rotatable disc that has a central relatively flat radial area surrounded and integrally formed with a continuous wall. The disc is spaced inwardly from the liquid inlet so that when the disc is rotated and liquid is impinged upon the disc a cooling liquid droplet cloud is produced. At the opposite end of the condenser housing from the inlet is an air outlet and a concentrically positioned rotatable blower. Located between the blower and the rotatable disc is a rotatable water wheel for collecting entrained liquid droplets before they pass into the blower. Circumferentially around the rotatable water wheel is a tangential turbine liquid pump that removes liquid from the condenser apparatus. An electric motor is utilized for rotatably driving all of the rotating elements. The condenser apparatus is utilized particularly in an automatic clothes dryer wherein hot moisture-laden air that has been passed over the fabrics to be dried is introduced into the condenser apparatus which reduces the temperature of the air to condense moisture therefrom and then recirculates the air again through the clothes dryer.

12 Claims, 6 Drawing Figures



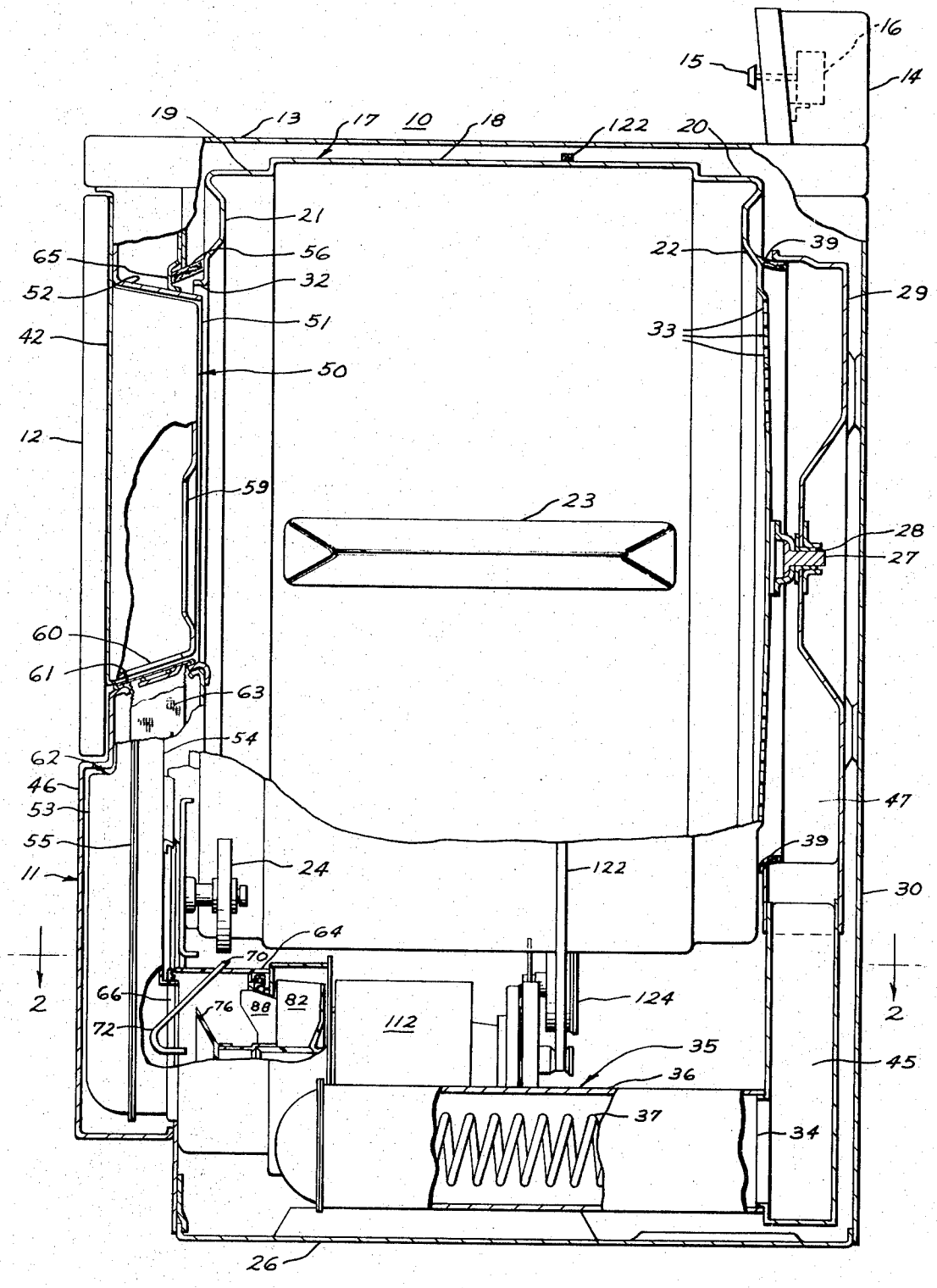

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FIG. 1

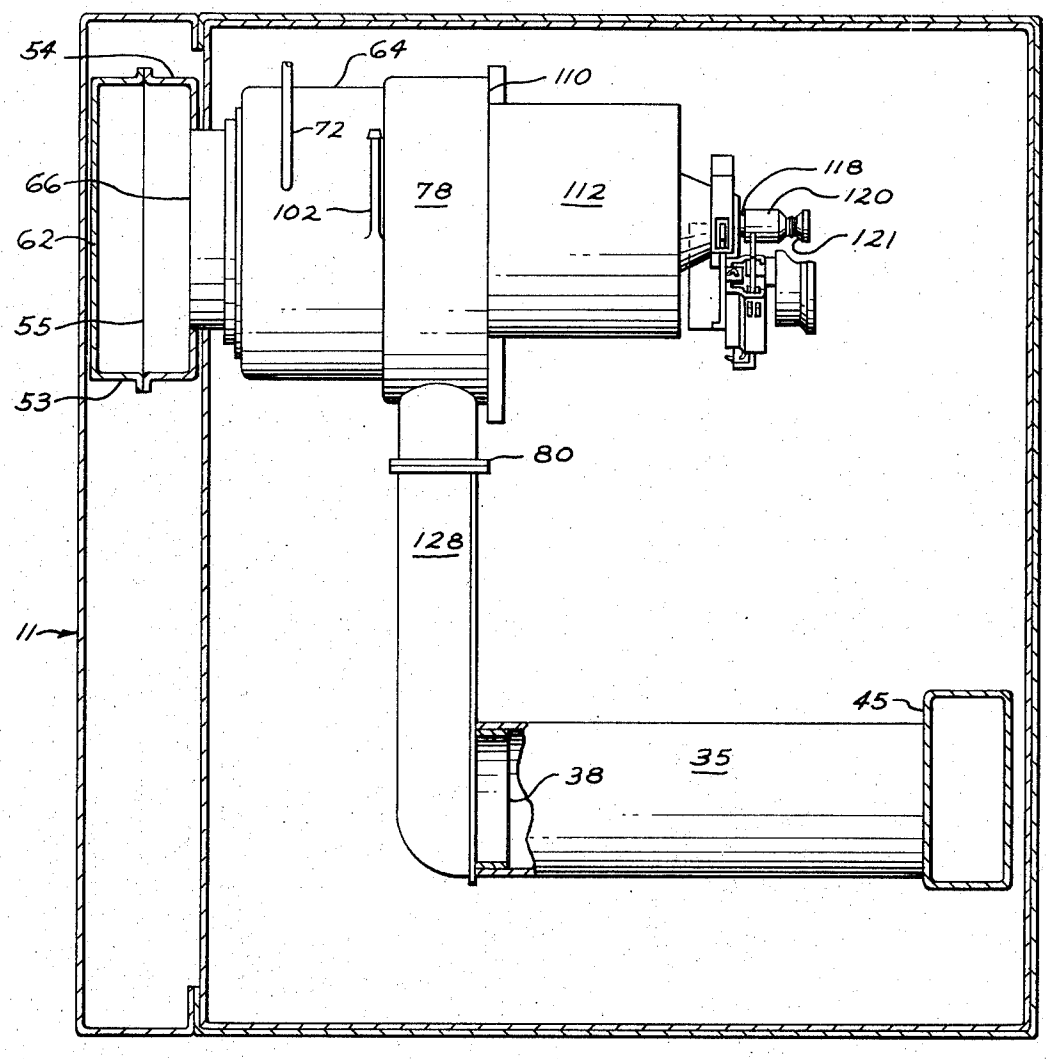

FIG. 2

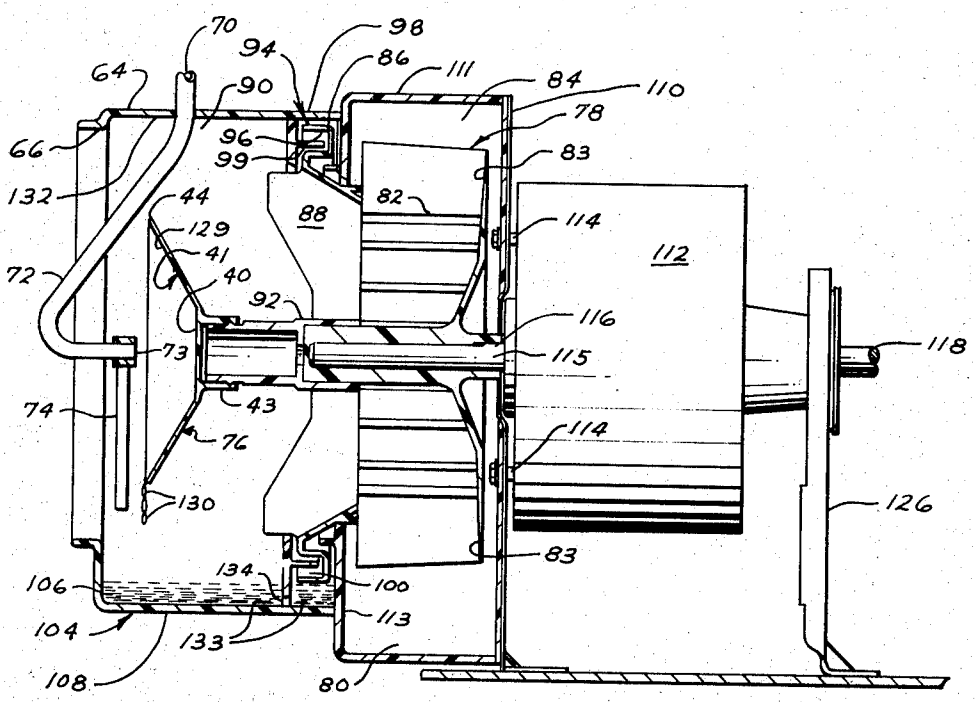
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FIG. 3

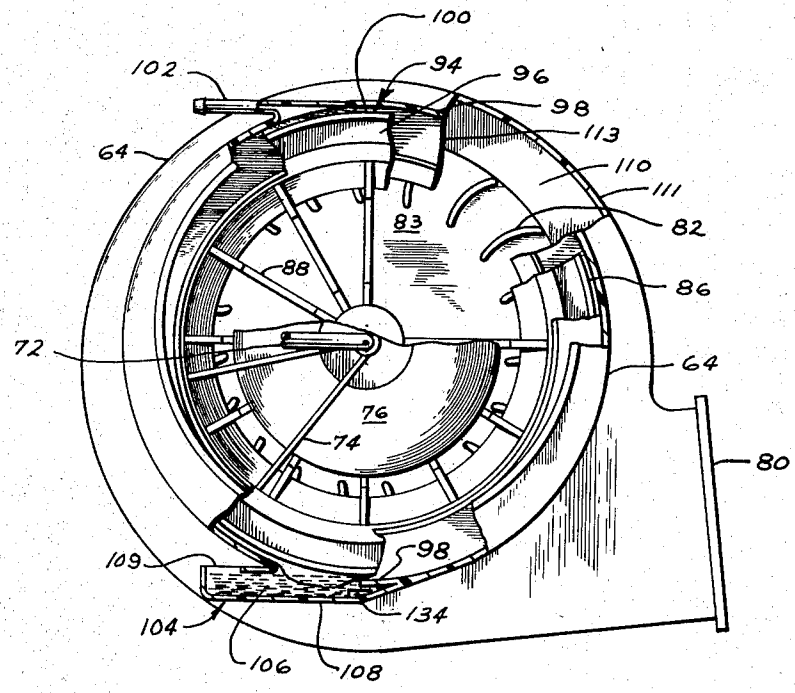
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FIG. 4

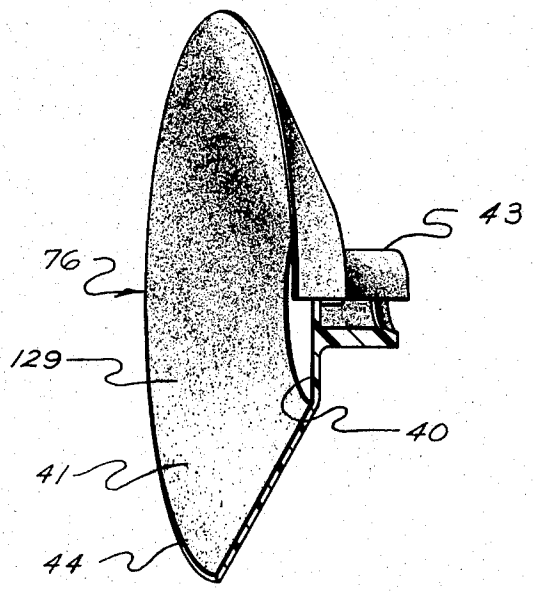

FIG. 5

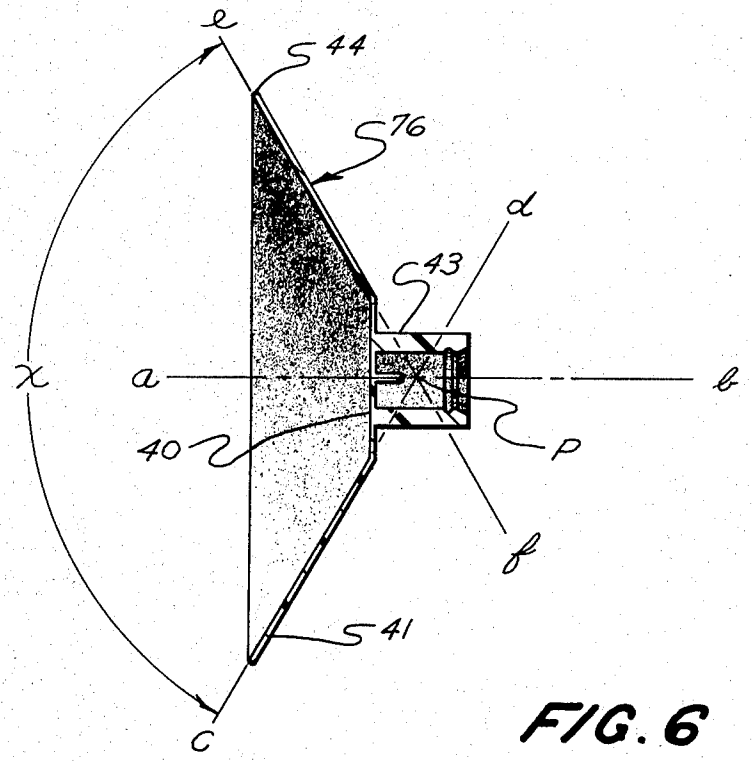

FIG. 6

CONDENSER APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to condenser apparatus, and more particularly to condenser apparatus for utilization in an automatic clothes dryer so that warm moisture-laden air from the clothes dryer is cooled and moisture removed therefrom.

2. Description of the Prior Art

In automatic clothes dryers it is common to vent the warm moisture-laden exhaust air or vapor outside the machine and preferably even outside the house or building while air is constantly being introduced into the clothes dryer, heated and passed over the fabrics to be dried. It is not, however, always possible and, in fact, it may not be desirable to provide such a venting system for automatic clothes dryers in apartments or other high rise housing establishments. In drying fabrics in a clothes dryer it is highly desirable to be able to heat the air, pass the heated air over the fabrics to be dried and withdraw moisture therefrom, remove the hot moisture-laden air from the fabrics and introduce it into an apparatus that lowers the temperature of the moisture-laden air thereby condensing out moisture from the air, then recirculate the air through the clothes dryer.

Condensing apparatus has been utilized in laundry machines, both combination clothes washers and dryers and automatic clothes dryers, for many years. One such condensing apparatus is shown in U.S. Pat. No. 2,451,692 wherein moist air is passed through a water spray from a nozzle that is also used to effect movement of the air; the free water from the spray is to be removed by a stationary screen. Another type of condensing apparatus is disclosed in U.S. Pat. No. 2,785,557 wherein only a controlled portion of the moist air is passed through a dehumidifier. U.S. Pat. No. 2,921,384 shows apparatus that uses an impeller to circulate air that also has the cooling water discharged directly against the impeller, however, there is no free water collection means provided. U.S. Pat. No. 3,121,000 utilizes a condensing arrangement that produces a coherent film of water on a channel wall to avoid entrainment of water droplets.

Condenser apparatus for automatic clothes dryers must be efficient in operation, low in manufacturing cost, and economical to operate in order to make it desirable. Moreover, it should be compact and of a size such that it can be easily installed in present standard size clothes dryers.

To accomplish the above-mentioned desirable characteristics in a condenser apparatus, one of the main areas that has needed improvement is a means for producing a highly effective liquid droplet cloud through which the hot moisture-laden air from the dryer is passed. Such a droplet producing means must be capable of forming a high concentration of discreet relatively large liquid droplets to lower the temperature of the moisture-laden air as quickly as possible while it is passing through the droplet cloud. If the droplets are too small in size they are readily entrained by the air. Entrainment of free liquid is particularly troublesome when the blower that induces the air flow through the condenser apparatus is downstream from the liquid droplet cloud. Too much air entrainment of free liquid can detrimentally affect the efficiency of the entire condenser apparatus. Also, since the condenser apparatus may be utilized in an automatic clothes dryer it is desirable to minimize expelling free liquid from the condenser apparatus into the clothes dryer system. Moreover, since the condenser dryer may be adapted for installation into present standard size clothes dryers, the condensing chamber containing the liquid droplet cloud must necessarily be limited in axial length. Therefore, to accomplish the necessary air cooling over the limited axial length, the liquid droplet dispersion means directly affects the efficiency of the entire condenser apparatus and the clothes dryer wherein it is utilized.

Rotating discs for producing liquid droplets have been used in apparatus for humidifying air. See, for example, U.S. Pat. No. 1,730,866 where atomized water impinges upon the disc downstream of the fan to be further broken up into a fine mist or vapor. U.S. Pat. No. 1,914,812 also uses a disc downstream of the fan to spread finely divided water particles throughout the atmosphere of a room. The arrangements shown in those patents, however, are specifically to provide for increasing the amount of moisture by producing finely divided water particles and expelling them from a humidifier into a room for humidification.

SUMMARY OF THE INVENTION

There is provided condenser apparatus for removing moisture from the air and particularly a condenser apparatus that is utilized in connection with an automatic clothes dryer and includes a housing for the condenser apparatus, which housing has both a cooling liquid inlet and an air inlet at one end, an air outlet at the opposite end of the housing, and a condensing chamber therebetween. This invention relates to utilizing in such a condenser apparatus a single improved rotatable disc axially spaced inwardly from the liquid inlet and positioned within the condenser housing. The disc has a central relatively flat radial area surrounded and integrally formed with a continuous wall slanting upwardly and outwardly relative to the central area and in the direction of the liquid inlet means and terminating at a circular periphery. The liquid introduced through the liquid inlet impinges upon the central relatively flat radial area of the disc which is rotated and the centrifugal force acting on the liquid causes the liquid to form a sheet or film and move up the continuous wall and be radially thrown from the periphery of the disc in the form of droplets in a plane normal to the axis of rotation of the disc. The droplets are intercepted by the inside of the condenser housing and deflected and form a cooling liquid droplet cloud in the condensing chamber.

Near the air outlet of the condenser apparatus in which this disc improvement invention is utilized there is positioned a rotatable blower for inducing an air flow through the condenser apparatus from the air inlet to the air outlet passing through the liquid droplet cloud. Located between the blower and the disc, also positioned within the condenser housing, is a means, such as a rotatable water wheel, for collecting entrained liquid droplets before they can pass into the blower. Circumferentially around the liquid droplet collecting means is a tangential turbine liquid pump that removes both the introduced cooling liquid and the moisture condensed from the air from the condenser apparatus to a drain external of the condenser apparatus. Means

for rotatably driving all of the rotating elements is also provided.

It is an object of this invention to provide an improved rotatable disc for producing liquid droplets for use in condenser apparatus.

It is another object of this invention to provide an improved single rotatable disc for producing liquid droplets for use in condenser apparatus which in turn is used in an automatic clothes dryer.

It is also an object of this invention to provide a condenser apparatus which is simple in construction, efficient in operation, and compact in size to enable its incorporation into standard size automatic clothes dryers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an automatic clothes dryer suitable for incorporation of the condenser apparatus utilizing the present invention, the view being partly broken away and partly in section to illustrate details.

FIG. 2 is a view taken along the lines 2—2 of FIG. 1 showing the condenser apparatus installed in the automatic clothes dryer.

FIG. 3 is a side elevational, cross-sectional view of the condenser apparatus utilizing the invention.

FIG. 4 is a front elevational view of the condenser apparatus shown in FIG. 3 taken along lines 4—4 and partially broken away to illustrate details.

FIG. 5 is a partially cut away perspective view of the disc.

FIG. 6 is a cross-sectional view of the disc taken in a vertical plane through the central longitudinal axis of the disc.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and initially to FIG. 1 thereof, there is illustrated a domestic automatic clothes dryer **10** including an appearance and protective outer cabinet **11** having a door or closure **12** to provide access into the interior of the cabinet for loading and unloading fabrics. Provided on the top **13** of cabinet **11** is a control housing **14** which may, in a conventional way, include a suitable manual control **15** connected to a control assembly **16** mounted in the control housing **14.** By manual setting of control **15,** the machine may be caused to start and automatically proceed through a cycle operation.

Within cabinet **11,** there is provided a clothes tumbling container or drum **17** mounted for rotation on a substantially horizontal axis. Drum **17** is substantially cylindrical in shape, having a central cylindrical wall portion **18,** and outer cylindrical wall portions **19** and **20,** located respectively adjacent an annular front wall **21** and a circular rear wall **22** of the drum. Wall portions **18, 19** and **20** are imperforate while rear wall **22** has a plurality of perforations **33.** On the interior surface of wall portion **18** there is a plurality of clothes tumbling ribs **23** so that clothes are lifted up when the drum rotates, and then permitted to tumble back down to the bottom of the drum. The front of the drum **17** may be rotatably supported within outer cabinet **11** by suitable slide members or idler wheels, one of the latter of which is indicated by the numeral **24.**

The rear end of drum **17** receives its support by means of a stub shaft **27** extending from the center of wall **22.** Shaft **27** is secured within a bearing **28** mounted in a baffle-like structure **29** which, in turn, is rigidly secured to the back wall **30** of the cabinet **11.**

In order to provide for the flow of drying air through the clothes drum, it is provided with a central aperture **32** in the front wall **21** and a plurality of perforations **33** in the rear wall **22.** The air provided to the drum is heated as by an electrical resistance heating element **37,** the element being the form shown in the drawings, which issues from the outlet **34** of the heating unit **35.** Heating unit **35** includes a heater housing **36** and the electrical resistance heating element **37.** In the conventional way, air is drawn into the heating unit **35** through an inlet opening **38** (FIG. **2**) and is warmed as it passes over and through the electrical resistance heating element **37** and then out the heater outlet **34.**

The outlet end **34** of the heating unit communicates with an upwardly extending duct **45,** which enters a generally circular heat diffuser chamber **47** formed between the structure **29** and the rear wall **22** of drum **17.** A flexible circumferential seal **39** is interposed between member **29** and rear wall **22** of the drum to provide a rear drum airseal and is secured to member **29** and contacts the rear wall of the rotating drum. The heated air flows from the chamber **47** through the perforations **33** into the interior of the drum **17.**

The front opening **32** of the drum is substantially closed by means of a bulkhead generally indicated by the numeral **50.** Bulkhead **50** is made up of a number of adjacent members including the inner surface **51** of the access door **12,** a stationary frame **52** formed as a flange on front wall **46** of the cabinet and a front door liner **42.**

A transition duct **62** is formed by joining together cavity member **54** and cavity member **53** at an annular flange **55.** It will be noted that a suitable clearance is provided between the inner edge of aperture **32** and the edge of frame **52** so that there is no rubbing between the drum and the frame during rotation of the drum. In order to prevent substantial air leakage through the aperture **32,** a suitable front drum ring seal **56** is secured to the flange **65** in sealing relationship with the exterior surface of the drum wall **21.**

Door **12** is mounted on cabinet **11** so that when the door is opened fabrics may be inserted into and removed from the drum through the door frame **52.**

The air outlet from the drum is provided by a perforated opening **59** formed in the inner wall **51** of the hollow door. The bottom wall section of door **12** and the adjacent wall of door frame **52** are provided with aligned openings **60** and **61,** opening **61** providing an entrance to the duct **62.** A lint trap **63** may be positioned in the duct **62** within opening **61** and supported by the door frame **52.** Duct **62** leads downwardly and communicates with condenser housing **64.** It is within the condenser housing that the hot moisture-laden air is cooled which causes moisture to be removed from the air prior to reintroducing the air into the heating unit **35** and then recirculated through the clothes dryer.

With reference to FIGS. **1, 3** and **4** in particular, the operation and construction of the condenser apparatus will now be explained. The condenser apparatus includes a housing **64** which is cylindrical or drum shaped and has an air inlet **66** located at the front of the condenser unit which is also near the front of the clothes dryer. Hot moisture-laden air from the drum is introduced into the condenser unit through the air inlet **66**

by a transition duct **62** (FIG. **1**) between the drum and the air inlet. Also located at the same end of the condenser housing **64** is a liquid inlet means **70** which may conveniently be a hose or tubular conduit **72** supported by structure **74** secured in a suitable fashion to the condenser housing. The structure **74** secures and positions the tubular conduit **72** substantially on the longitudinal axis of the condenser housing **64** with the end **73** of the conduit **72** directed into the condenser apparatus. The liquid introduced into the condenser apparatus by means of the tubular conduit **72** passes through a solenoid operated control valve (not shown) and is in the form of a stream. The liquid is furnished from a source external of the clothes dryer such as a household faucet. Spaced axially from the liquid inlet means **70** is a single rotatable disc **76.** The details of disc **76** can be clearly seen in FIGS. **5** and **6.** The disc **76** has a central relatively flat radial area **40,** a hub **43,** and a continuous wall **41** slanting upwardly and outwardly relative to the central area **40.** The continuous wall **41** terminates at a circular lip or periphery **44.** This disc can be manufactured by molding from a variety of synthetic plastic compositions, such as polypropylene, or some other suitable moldable material. The material or composition from which it is made should, of course, be compatible with the environmental conditions involved.

With reference to FIG. **6,** the profile of the disc, as viewed in a vertical plane through the longitudinal central axis of the disc can be readily seen. The longitudinal central axis is designated in FIG. **6** as line *a–b*. The continuous wall **41** diverges from the central axis line *a–b* in a direction away from the flat area **40** and hub **43.** Line *c–d* represents one side of continuous wall **41** and line *e–f* represents the opposite side thereof. The continuous wall **41** is straight and, if extended, toward the hub **43,** would intersect at point P, as shown by the intersection of lines *c–d* and *e–f*. The included angle formed by intersecting lines *c–d* and *e–f* is designated X in FIG. **6** and is the angle referred to herein as the included angle formed by the diverging opposite continuous wall sections as viewed when a plane is passed vertically through the central longitudinal axis of the disc. The intersection of lines *c–d* and *e–f* at point P is on the central axis line *a–b;* therefore, the central axis line *a–b* bisects the included angle X. The included angle X formed by the opposite continuous wall **41** is substantially bisected by the central longitudinal axis and the included angle X is from about 110 degrees to about 130 degrees.

At the opposite end of the condenser housing **64** from the liquid inlet means **70** is a blower **78** for inducing air to flow from the air inlet **66** to an air outlet **80.** The blower **78** not only induces air flow through the condenser apparatus but causes the air to flow through the entire clothes dryer so that only a single blower is needed. The blower in this embodiment consists of rotatable blower wheel having a plurality of blades **82** secured as by molding to circular plate **83** and a confining air space **84** surrounding the blower wheel for developing sufficient air pressure within the blower to induce the above-mentioned air flow through the entire clothes dryer including the condenser unit. Positioned within the condenser housing **64** and located between the rotatable disc **76** and the blower **78** is a liquid droplet collecting means **86** which in the present preferred embodiment described is in the form of a rotatable water wheel having a plurality of spaced blades **88** which extend radially outward from the axis of rotation of the wheel. The axial depth of blades **88** is such that they extend from the blower wheel **78** into the condensing chamber **90.** The blades **88** are integrally formed with a hub **92** and are spaced so that air flowing through the condenser apparatus may flow through the spaces between the radial blades **88** and into the blower. Surrounding the water droplet collecting means **86** is a tangential turbine pump **94** which consists of a rotatable U-shaped inner wall **96** and a stationary outer pump wall **98** which cooperate with each other to provide a pump cavity **100** therebetween. The outer pump wall **98** may be integrally formed with the condenser housing. Also forming one part of the pump **94** is a circumferential wall member **99** that is stationary and secured to the inside of the condenser housing and inwardly depending therefrom. Rotation of the inner pump wall **96** forces the liquid to be accelerated circumferentially by rotational force and discharged through the pump discharge outlet **102.** The discharge outlet **102** is connected by suitable means to a drain outside of the clothes dryer.

Located at the bottom of the condenser housing **64** is a sump **104** which performs as an axially liquid discharge outlet from the condenser apparatus should the pump **94** fail to operate. The sump **104** consists of a reservoir **106** formed by surrounding a wall area **108** and a liquid discharge outlet **109** which may be formed integrally with the condenser housing **64.** The sump liquid discharge outlet **109** is arranged to be spaced from and located below the liquid inlet means **70** to provide an air gap therebetween. Plumbing codes generally require a sufficient air gap in association with the water inlet, so that if a negative pressure is produced in the water line, only air will be taken in. It can be seen in FIG. **4** that if the condenser pump **94** fails to operate liquid accumulates in the condenser apparatus sump until it overflows, thus providing an air gap in the system between the discharge outlet **109** and liquid inlet end **73.** If desired, means for discontinuing operation of the condenser apparatus responsive to the auxiliary liquid discharge may be provided. One such means could be an externally located float mechanism activated by overflow liquid discharged from the condenser.

At the rear of the condenser housing **64** is a rear wall **110** which forms part of the condenser housing. The rear wall **110** together with cylindrical wall section **111** of housing **64** and inwardly directed circular flange **113** form the blower chamber **84.** Secured to the rear wall **110** on the opposite side from the blower chamber **84** is an electric motor **112** which may be suitably attached to the rear wall as by bolts **114.** The electric motor has a rotatable shaft extending through an aperture **116** in the rear wall **110** close to the central longitudinal axis of the condenser apparatus. Secured to this motor shaft **115,** which extends into the condenser housing, are the four rotatable elements of the condenser apparatus, namely, the blower **78,** the water droplet collecting means or water wheel **86,** inner wall **96** of the pump **94** and the disc **76.** The single motor **112** rotatably drives all four of these condenser apparatus elements.

The motor shaft **115** also extends rearward of the motor in the opposite direction from the condenser apparatus and is utilized to rotate drum **17.** In order to effect this rotation, motor **112** is provided with a shaft portion **118** having a small pulley **120** secured to the end thereof. Around the pulley **120** and seated in

groove **121** and entirely around the cylindrical wall section **18** of drum **17** is a movable belt **122.** The relative circumference of the pulley **120** and the wall section **18** of the drum **17** causes the drum to be driven by the motor at a speed suitable to effect tumbling of fabrics to be dried in the drum. In order to effect proper tensioning of the belt **122,** a suitable idler assembly **124** is secured to the same support **126** which supports one end of the motor.

The air exiting the condenser apparatus through air outlet **80** passes via duct **128** into the heating unit **35** for heating the air and recirculating it into the clothes dryer drum **17.**

The operation of the condenser and dryer apparatus is as follows: Hot moisture-laden air that has been passed through the clothes dryer drum and picked up moisture from the fabrics tumbled therein is introduced into the condenser unit through the air inlet opening **66** while a stream of cooling liquid is being introduced into the condenser unit through tubular conduit **72.** When the condenser apparatus is operating the electric motor provides for simultaneous rotation of the blower **78,** droplet collecting water wheel **86,** inner wall **96** of pump **94** and disc **76.** As disc **76** is being rotated the stream of liquid being introduced impinges onto the flat center area **40** of the rapidly rotating disc. The liquid striking the rotating surface **40** is acted upon by centrifugal force causing the liquid to spread into a film or sheet and swirl and travel up the inclined inner wall surface **129** of the continuous wall **41** of the disc **76** to the periphery **44** thereof and from there thrown outwardly in the form of liquid droplets **130.** The generally radial flight of the liquid droplets **130** is interrupted by the inner surface **132** of the condenser housing **64** whereupon the liquid droplets are deflected back toward the center of the condenser chamber **90,** this in effect produces a curtain or cloud of liquid droplets within the condensing chamber **90** while the incoming hot moisture-laden air from the dryer drum flows through this resultant liquid droplet cloud. By using a rotatable disc **76** as above-described a single disc may be used in the condenser which affords several advantages. The single disc may be positioned in close proximity to the air inlet **66** so that the liquid droplets **130** leaving the disc periphery **44** are more remote from the rear of the condenser chamber **90** than otherwise for a given condenser chamber **90** axial length. It will be appreciated that the condenser chamber **90** length is restricted or limited in order to be able to incorporate the condenser apparatus in space available in standard size clothes dryers. It is important to have the liquid droplets within the condenser chamber **90** remote from the liquid droplet collecting means **86** and blower **78** in order to minimize air entrainment of the liquid droplets into these components. Moreover, my disc arrangement produces a pattern of discreet liquid droplets to help minimize their entrainment. If the electric motor **112** shaft rotates at approximately 1725 revolutions per minute and the disc **76** having a diameter of 4½ inches also rotates at the same speed the disc periphery would have a rotating velocity of approximately 34 feet per second. Then if the stream of liquid impinging onto the disc has a flow rate of 0.30 to 0.48 gallons per minute good air cooling is achieved with little entrainment of the resultant liquid droplets.

With my disc configuration good liquid droplet dispersion is achieved with minimum droplet entrainment within a restricted condenser chamber length. The hot moisture-laden air in contact with the cooler liquid droplets causes the air temperature to be lowered and the moisture condensed therefrom. Because the air flowing through the condenser chamber **90** may entrain some liquid droplets the water droplet collecting means **86** is positioned upstream of the blower **78** between the disc **76** and blower **78** so that entrained liquid droplets are essentially collected by the rotating blades **88** and deposited in an underlying liquid bath **133** which is in communication with the pump **94** through an opening **134.** It will be understood that simultaneously with the introduction of cooling liquid into the condenser apparatus through the tubular conduit **72** that liquid will also be removed from the condenser apparatus by the pump **94** at a rate such that only a small amount of liquid is in the liquid bath **133** at a given time during operation of the condenser apparatus. The now cooled air reaches the blower **78** which applies air pressure to induce the air flow and force the air out of the condenser apparatus through air outlet **80** for introduction into the heating unit **35** and again recirculate through the clothes dryer.

The foregoing is a description of the preferred embodiment of the invention and variations may be made thereto without departing from the true spirit of the invention, as defined in the appended claims.

What is claimed is:

1. Condenser apparatus for removing moisture from air by passing moisture-laden air through a cloud of cooling liquid droplets having:

a. a housing,

b. liquid inlet means at one end of said housing for introducing a stream of liquid into the housing essentially along the central axis of the housing,

c. air inlet means at said one end of the housing,

d. air outlet means at the end of the housing opposite the air inlet means,

e. a rotatable blower for inducing air to flow from the air inlet means to the air outlet means,

f. means for collecting liquid droplets which is positioned within the housing and located between the disc and blower,

g. means for removing liquid from the condenser apparatus, and

h. means for driving the rotatable components,

the improvement comprising a single rotatable disc positioned within the housing and axially spaced from said liquid inlet means, said disc having a hub, a continuous wall slanting upwardly and outwardly relative to the hub and in the direction of the liquid inlet means and terminates at a circular periphery.

2. The condenser apparatus of claim **1** wherein between the hub and continuous wall of the disc is a central, relatively flat, radial area from which the continuous wall departs.

3. The condenser apparatus of claim **2** wherein the liquid inlet is arranged to impinge the liquid stream onto the central, relatively flat, radial area of the disc.

4. The condenser apparatus of claim **1** wherein the opposite sides of the continuous slanting wall of the disc, as viewed in cross-sectional plane through the longitudinal central axis, converge toward each other in the direction of the hub with the included angle formed by said converging side walls is from about 110 degrees to about 130 degrees.

5. The condenser dryer apparatus of claim 1 wherein the rate of liquid flow introduced by the inlet means is in the range of 0.30 to 0.48 gallons per minute and the peripheral velocity of the disc is approximately 34 feet per second.

6. Condenser apparatus for removing moisture from air by passing mositure-laden air through a cloud of cooling liquid droplets having:

a. a housing,

b. liquid inlet means at one end of said housing for introducing a stream of liquid into the housing essentially along the central axis of the housing,

c. air inlet means at said one end of the housing,

d. air outlet means at the end of the housing opposite the air inlet means,

e. a rotatable blower for inducing air to flow from the air inlet means to the air outlet means,

f. a rotatable water wheel for collecting liquid droplets which is positioned within the housing and located between the disc and blower,

g. a pump for removing liquid from the condenser apparatus, and

h. a motor for driving the rotatable components including the pump, the improvement comprising a single rotatable disc positioned within the housing and axially spaced from said liquid inlet means, said disc having a hub, a continuous wall slanting upwardly and outwardly relative to the hub and in the direction of the liquid inlet means and terminates at a circular periphery, a central relatively flat, radial area between the hub and continuous wall, said continuous slanting wall of the disc, as viewed in cross-sectional plane through the longitudinal central axis, converge toward each other in the direction of the hub with the included angle formed by said converging side walls being from about 110 degrees to about 130 degrees, said disc being rotated at a peripheral velocity of approximately 34 feed per second while the liquid flow rate introduced by the inlet means is in the range of 0.30 to 0.48 gallons per minute.

7. In an automatic clothes dryer machine having a cabinet, a drum mounted for rotation within the cabinet to tumble clothes to be dried, means for passing air through the drum and heating means to heat the air, and a condenser apparatus through which the air passes to be cooled and remove moisture, the condenser apparatus having:

a. a housing,

b. liquid inlet means at one end of said housing for introducing a stream of liquid into the housing essentially along the central axis of the housing,

c. air inlet means at said one end of the housing,

d. air outlet means at the end of the housing opposite the air inlet means,

e. a blower for inducing air to flow from the air inlet means to the air outlet means,

f. a rotatable water wheel for collecting liquid droplets which is positioned within the housing and located between the disc and blower,

g. means for removing liquid from the condenser apparatus, and

h. means for driving the rotatable components,

the improvement comprising a single rotatable disc positioned within the housing and axially spaced from said liquid inlet means, said disc having a hub, a continuous wall slanting upwardly and outwardly relative to the hub and in the direction of the liquid inlet means and terminates at a circular periphery.

8. In the automatic clothes dryer of claim 7 wherein between the hub and continuous wall of the disc is a central, relatively flat, radial area from which the continuous wall departs.

9. In the automatic clothes dryer of claim 7 wherein the liquid inlet is arranged to impinge the liquid stream onto the central, relatively flat, radial area of the disc.

10. In th automatic clothes dryer of claim 7 wherein the opposite sides of the continuous slanting wall of the disc, as viewed in cross-sectional plane through the longitudinal central axis, converge toward each other in the direction of the hub with the included angle formed by said converging side walls is from about 110 degrees to about 130 degrees.

11. In the automatic clothes dryer of claim 7 wherein the rate of liquid flow introduced by the inlet means is in the range of 0.30 to 0.48 gallons per minute and the peripheral velocity of the disc is approximately 34 feet per second.

12. In an automatic clothes dryer machine having a cabinet, a drum mounted for rotation within the cabinet to tumble clothes to be dried, means for passing air through the drum and heating means to heat the air, and a condenser apparatus through which the air passes to be cooled and remove moisture, the condenser apparatus having:

a. a housing,

b. liquid inlet means at one end of said housing for introducing a stream of liquid into the housing essentially along the central axis of the housing,

c. air inlet means at said one end of the housing,

d. air outlet means at the end of the housing opposite the air inlet means,

e. a rotatable blower for inducing air to flow from the air inlet means to the air outlet means,

f. a rotatable water wheel for collecting liquid droplets which is positioned within the housing and located between the disc and blower,

g. a pump for removing liquid from the condenser apparatus, and

h. a motor for driving the rotatable components including the pump, the improvement comprising a single rotatable disc positioned within the housing and axially spaced from said liquid inlet means, said disc having a hub, a continuous wall slanting upwardly and outwardly relative to the hub and in the direction of the liquid inlet means and terminates at a circular periphery, a central relatively flat, radial area between the hub and continuous wall, said continuous slanting wall of the disc, as viewed in cross-sectional plane through the longitudinal central axis, converge toward each other in the direction of the hub with the included angle formed by said converging side walls is from about 110 degrees to about 130 degrees, said disc being rotated at a peripheral velocity of approximately 34 feet per second while the liquid flow rate introduced by the inlet means is in the range of 0.30 to 0.48 gallons per minute.

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