United States Patent

Schaeffer et al.

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[54] EVAPORATIVE CONDENSER

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[21] Appl. No.: **94,708**

[52] **U.S. Cl.**.....**62/305,** 62/428

[51] **Int. Cl.**.....**F28d 5/00**

[58] **Field of Search**.....62/305, 181, 183, 184, 171

[56] **References Cited**

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[57] **ABSTRACT**

An evaporative condenser of the push-through type has the blower located directly beneath the coils and its horizontal discharge directed upwardly at an angle from the horizontal. An arrangement of roofs and shielding prevent the introduction of water into the fan and the air direction means; drainage is provided for any water that may inadvertently enter the fan housing or air directing means.

9 Claims, 3 Drawing Figures

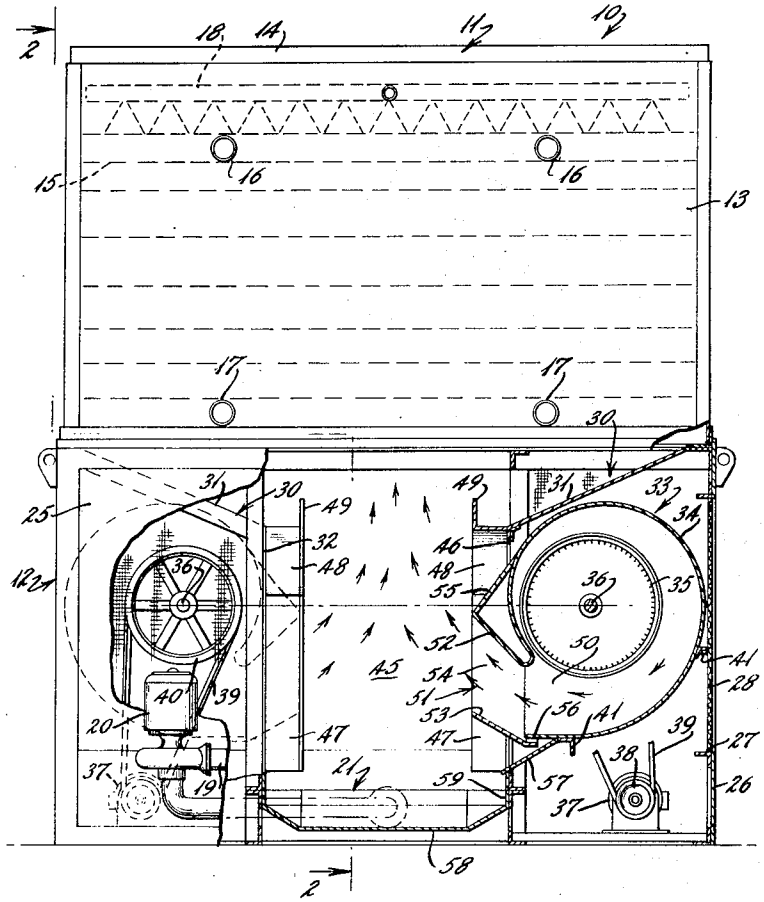

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Fig. 1

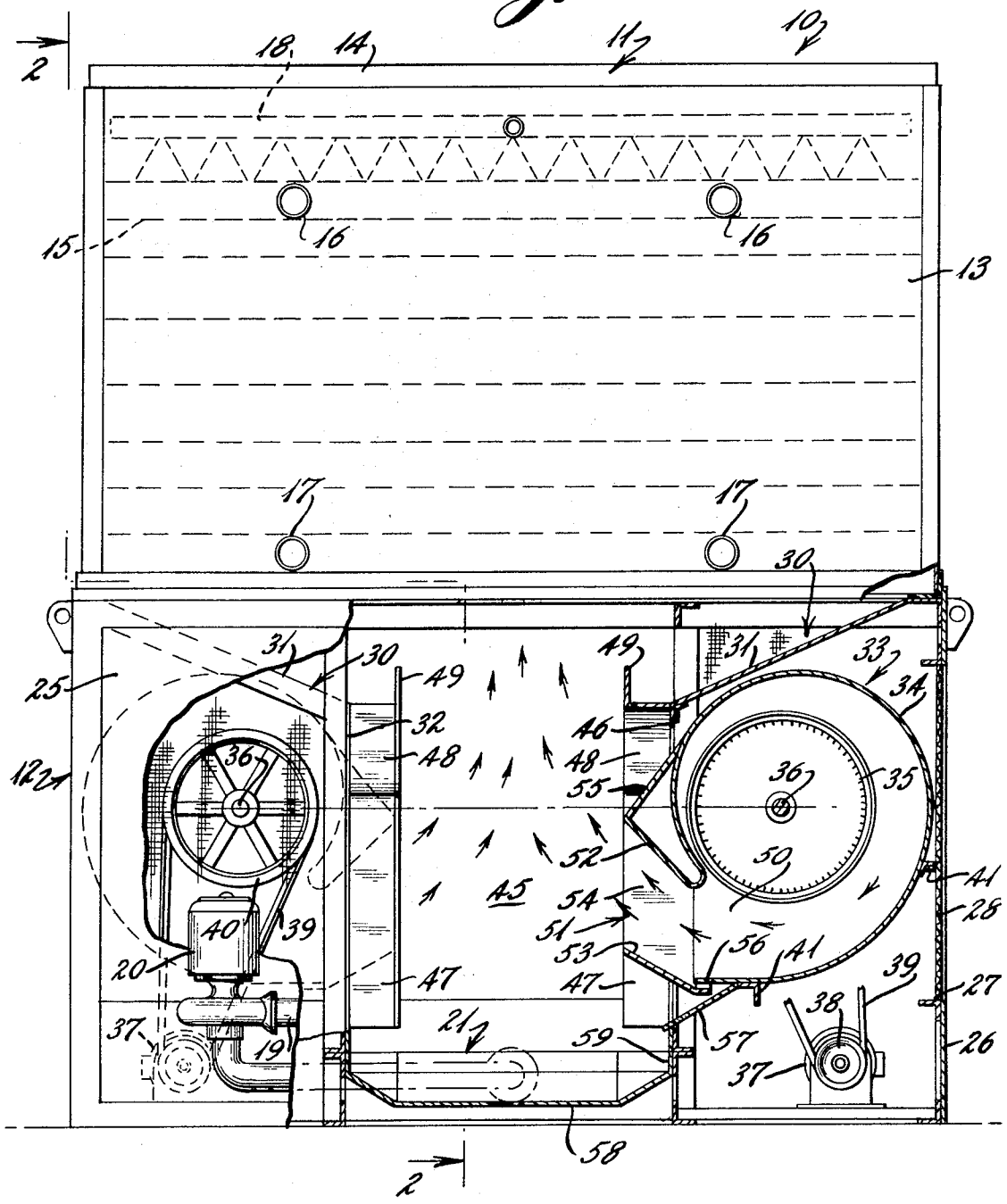

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Fig. 2

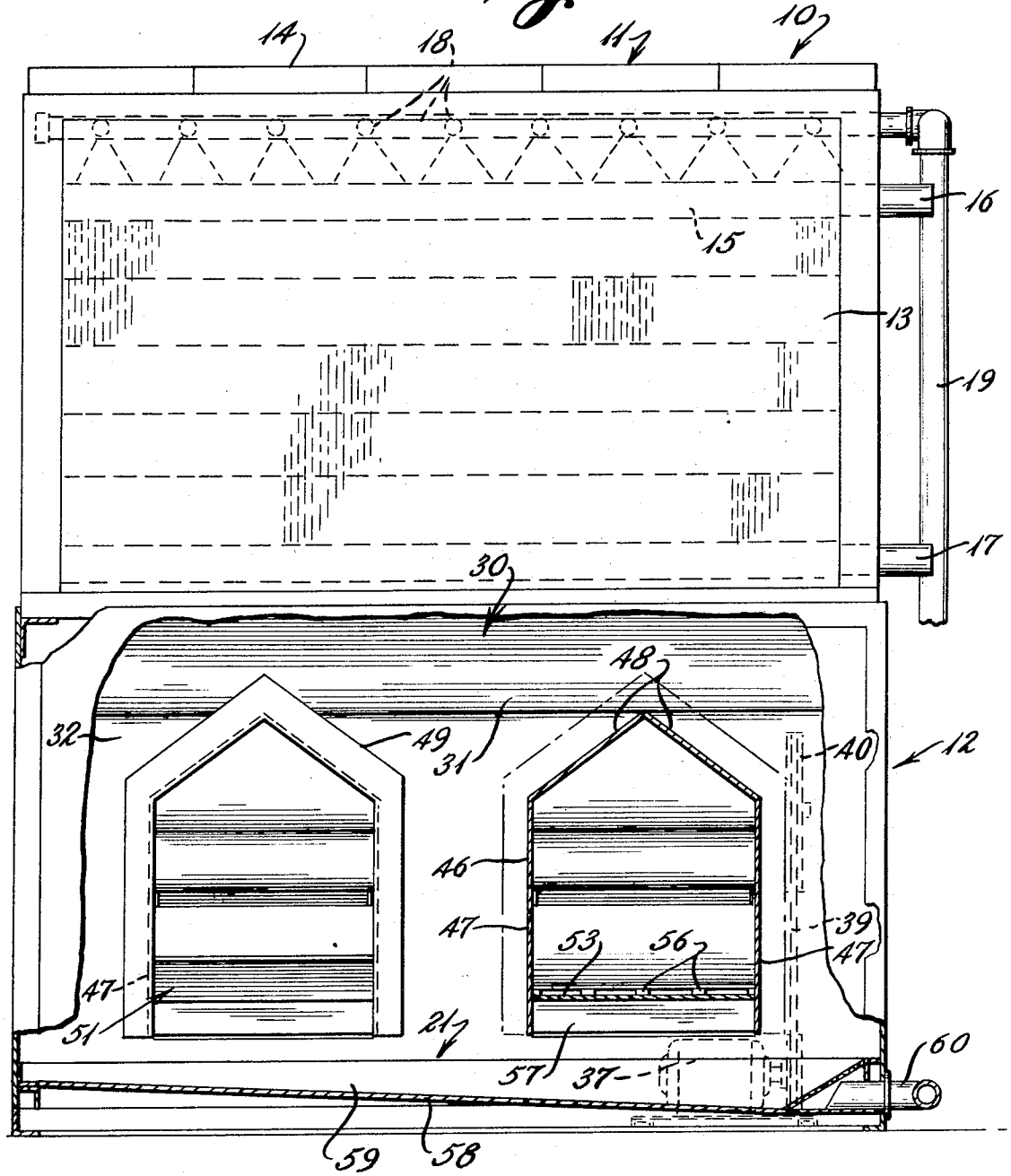

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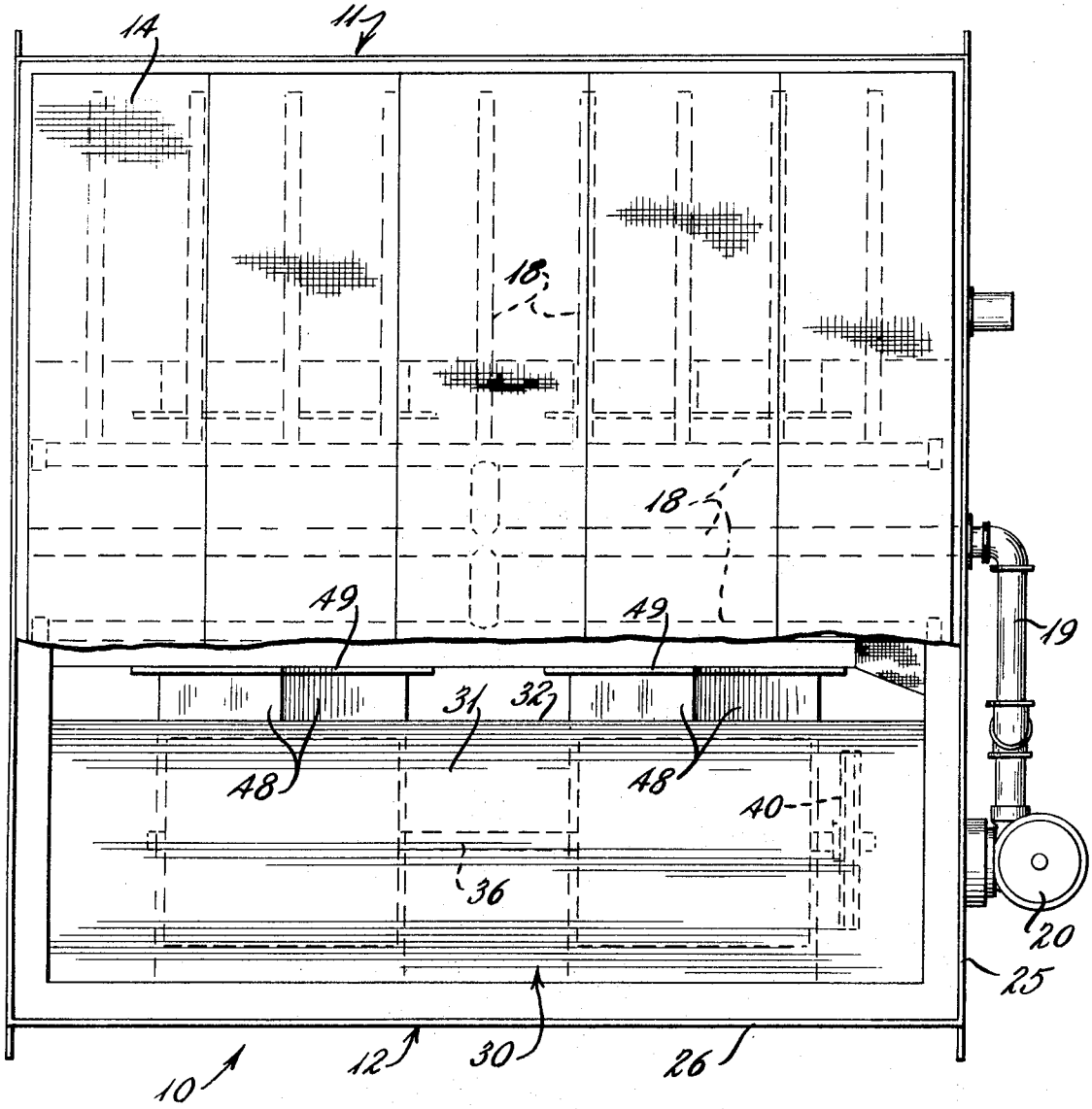
Fig. 3



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EVAPORATIVE CONDENSER

BACKGROUND OF THE INVENTION

This invention relates to evaporative condenser construction of the blow-through type in which air is directed upwardly through the coils as the liquid flows downwardly over the coils.

In this type of heat exchanger provision must be made for preventing the passage of water into the fan elements. This has been done in some cases by positioning the fan outside of the vertical projection of the coils. However, this arrangement requires separate packaging or handling of the fan unit since additional space outside the coil housing is required. Even if the fan unit is mounted at the factory on a framework with the coils, it still protrudes from what would otherwise be a substantially rectangular package.

Attempts have been made to position the fan unit within the vertical projection of the coils by employing air discharge ducts from the fan which are inclined downwardly in order to avoid admission of water thereinto, as, for example, in the patent to Engalitcheff, Jr. et al., U.S. Pat. No. 3,442,494. Such arrangement, however, creates air turbulence since the air must change direction through an angle of more than 90° within a confined space in order to flow upwardly through the coils. In this patent the arrangement results in the use of a sump having a cross-sectional area which is smaller at the bottom than at the top.

SUMMARY OF THE INVENTION AND OBJECTS

The present invention is an evaporative condenser including a housing having refrigerant receiving coils in the upper portion over which a liquid is sprayed in indirect heat exchange relationship with the refrigerant within the coils. One or more blowers are located directly below the coils and are adapted to blow air upwardly through the coils and the liquid being sprayed. An air flow directional duct is provided for causing air to be discharged into the plenum chamber below the coils in a direction not less than 30° from the horizontal. Also drainage means is provided for reducing the amount of water which flows past the blower discharge area, as well as to prevent water from entering the blower housing.

It is an object of the invention to provide an evaporative condenser of the push-through type in which the blower is located inside of the vertical projection of the side walls of the coil area and in which the air is directed substantially upwardly from the blower, thereby creating conditions for relatively smooth air flow, and in which provision is made for preventing the liquid from falling into the blower housing. The arrangement provides other advantages, including permitting the use of a large proportion of the space beneath the coils for the fan structure.

These and other objects of the invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation with portions broken away illustrating one embodiment of the invention in which blowers are arranged on opposite sides of the center line of the housing.

FIG. 2 is a section on the line 2—2 of FIG. 1.

FIG. 3 is a top plan view with portions broken away.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With further reference to the drawings, the evaporative condenser includes a generally rectangular housing **10** having upper and lower portions **11** and **12** respectively. The upper portion **11** has substantially imperforate side walls **13** and an open-work grid **14** serving as a top wall. Within the upper portion **11** a series of refrigerant carrying coils **15** are provided having inlets **16** and outlets **17** extending through the side walls **13**. A liquid, such as water or the like, is sprayed over the coils **15** in heat exchange relationship by headers **18** from a supply pipe **19** connected to a pump **20** which draws liquid from a sump **21** in the lower portion **12** of the housing.

The lower portion **12** of the housing **10** is enclosed by side walls **25** and end walls **26** with the side walls **25** having openings **27** with screening **28** therein to permit ingress of air. Within the lower portion **12** of the housing **10** a pair of opposed blower compartments **30** are provided each of which is defined by a sloping roof **31** connected to the side walls **25** and extending inwardly and downwardly to a generally vertical partition **32** extending from end to end of the lower portion **12**. Within each one of the blower compartments **30** is at least one blower **33** having a shroud or scroll **34** within which a cage **35** is fixed to a shaft **36**. Such shaft is adapted to be driven by a motor **37** having a drive pulley **38** which drives a belt **39** and the belt in turn drives a driven pulley **40** carried by the shaft **36**.

As illustrated a pair of blowers **33** are mounted within each of the compartments **30** and the shaft **36** is common to both blowers so that both blowers will be driven by the same motor **37**. It is noted that if desired each blower could be provided with an independent drive. The blowers **33** are supported within the compartments **30** in any conventional manner, as by supports **41**.

The blower compartments **30** define a plenum chamber **45** in the lower portion **12** directly below the coils **15**. In order for the blowers **33** to discharge air into the plenum chamber **45**, the partitions **32** are provided with openings **46** with an opening being in alignment with each of the blowers **33**. As illustrated in FIGS. **1** and **2**, a shroud is connected to the partitions **32** and extends around the openings **46**. Each shroud includes inwardly extending generally parallel side walls **47** connected at their upper ends to angularly disposed roof plates **48** forming a peaked roof for the shroud. Each of the side walls and roof plates **47** and **48** is provided with a right angle flange **49** to prevent water draining from the sloping roof **31** from entering the openings **46**.

Each of the blowers **33** is provided with a substantially horizontally disposed outlet **50** generally in alignment with the openings **46**. It is desirable to direct a stream of air from each blower upwardly and outwardly at an angle which is preferably no less than 30° from the horizontal. In order to do this, an air duct **51** is provided having upper and lower deflecting plates **52** and **53** respectively connected by side walls **54**, and such air ducts are connected at one end to the blower outlets **50**. The stream of air from each blower is deflected upwardly by the ducts and since the blowers are in opposed relation, such air streams will merge into a single upwardly directed air flow which will spread throughout the plenum chamber **45** and pass upwardly through the coils **15**.

In order to deflect any water which may fall onto the top of the air duct **51**, a baffle plate **55** is connected at one end to the outer end of the upper deflecting plate **52** and connected at the opposite end to the scroll **34** of the blower (FIG. **1**). To prevent water which falls into the air duct from entering the scroll **34**, the lower deflecting plate **53** of the air duct is spaced below the forward edge of the scroll at the blower outlet and is connected thereto by spacers **56**. A drain plate **57** is disposed below the air duct **51** and such drain plate is angled downwardly so that water discharged through the opening between the air duct and the blower outlet will fall by gravity onto the drain plate **57** from which it will gravitate into the sump **21**.

Intermediate the partitions **32**, the sump **21** includes a pan having a generally flat bottom **58** and side walls **59**. As illustrated in FIG. **2**, the sump extends the full length of the housing and preferably is inclined downwardly from end to end. An outlet pipe **60** connects the lower end of the sump with the pump **20** so that the water will be recirculated through the coils **15**.

In the operation of the device, the refrigerant which has absorbed heat is introduced into the coils **15** through the outlets **16**. In order to efficiently remove the heat from the refrigerant, water or other liquid is sprayed onto the coils **15**

from the headers **18** in indirect heat exchange relationship with the refrigerant while simultaneously air flows upwardly through the coils in a direction counter to the flow of water. The water in the central portion of the housing will fall directly into the sump **21**, while the water on opposite sides will fall onto the sloping roofs **31** of the blower compartments **30**. From the sloping roofs the water will drain down partitions **32** into the sump. It is important to keep water out of the blowers and therefore a shroud having side walls **47** and roof plates **48** is disposed around each blower opening so that water from the sloping roofs cannot drain into the blowers. An air duct is located within the shroud and such duct deflects the flow of air from the blowers upwardly at an angle of not less than 30° from the horizontal to create a smooth upward flow of air within the plenum chamber of the lower portion of the housing. The lower deflecting plate **53** of the air duct is spaced below the blower outlet so that any water which falls into the air duct will drain into the sump and will not enter the scrolls **34** of the blower. Water which is discharged into the sump will be recirculated by the pump **20** and again will be sprayed over the coils **15** in a continuous process. After the heat has been absorbed from the refrigerant and the refrigerant has changed state from a gas to a liquid, such refrigerant is discharged from the coils through the outlet **17**.

We claim:

1. An evaporative condenser comprising heat exchange apparatus mounted in an enclosure, means to discharge liquid onto the upper portion of said heat exchange apparatus, the liquid flowing downwardly over the lower portion thereof and falling from the lowermost portion, means for blowing air over said heat exchange surfaces in counterflow relation to the path of the liquid, said means comprising blower means mounted beneath the heat exchange means, said blower means so positioned and arranged as to discharge air substantially horizontally from the lower side of the blower means, air directing means mounted at the outlet of said blower means and disposed to direct the air upwardly at an angle to the horizontal, means for shielding the blower means and air directing means from liquid which is falling from the heat exchange means, said shielding means comprising roof means mounted directly above the blower means and having a higher portion adjacent to the wall of the enclosure and a lower portion over the discharge from the blower means, partition means extending from the lower portion of said roof means to the bottom of said enclosure, said partition means having an opening for said blower means, a shroud having flange means disposed about said opening for preventing the discharge of liquid over said opening, said shroud having a higher portion centrally of the blower means whereby liquid falling from the roof portion is deflected away from the blower means and from the air directing means, and sump means positioned to receive liquid which is discharged from the roof means and which falls directly into the sump means from the heat exchange means.

2. The invention of claim **1** in which the blower means is of the centrifugal type and has a scroll housing, in which the roof means is mounted above the scroll housing, and in which the outlet from the scroll housing is positioned on the lower side of the blower means.

3. The invention of claim **1** in which a second blower means is mounted on the opposite side of the enclosure from said first blower means, said second blower means having an outlet which discharges air substantially directly toward the outlet of said first blower means, said second blower means having air directing means which directs the discharge from the blower means upwardly at an angle from the horizontal, whereby the effective path of air from both blower means meets substantially intermediate and above the blower means and in a generally upward and central direction.

4. The invention of claim **1** in which the sump means has one portion lower than the other in order to facilitate drainage from the sump.

5. The invention of claim **1** in which the enclosure is substantially rectangular and in which the blower means is positioned within the vertical extension of the portion of the housing within which the heat exchange means is located.

6. The invention of claim **1** in which said air deflecting means includes a plate member which extends at an angle from the lower wall of the blower outlet and has a portion spaced beneath the outer end of the lower wall in order to permit liquid which falls on the deflected means to drain beneath the blower means.

7. An evaporative condenser comprising a housing having upper and lower portions, condenser coil means located in said upper portion, spray means disposed above said coil means and adapted to discharge liquid thereon, means for supplying liquid under pressure to said spray means, said lower portion including a plenum chamber located below said coil means, at least one blower compartment having side and top walls in said lower portion, blower means mounted within said compartment and adapted to discharge a stream of air through the side walls of said compartment into said plenum chamber, air duct means for directing said stream of air upwardly at an angle greater than 30° to the horizontal, shroud means on at least the side walls of said blower compartment and disposed about said air duct means to prevent water falling on the top wall of said blower compartment from draining in front of said air duct means, the lower portion of said air duct means being located below said blower means to exclude water from said blower means, and sump means in said lower portion for collecting water discharged by said spray means.

8. The structure of claim **7** in which said lower portion includes a blower compartment on opposite sides thereof and said sump means is disposed between said blower compartments.

9. The structure of claim **8** in which each of said blower compartments includes at least one blower located opposite the blower of the other compartment, each of said compartments having an air duct means for directing a stream of air outwardly and upwardly into said plenum chamber to distribute a flow of air over substantially the entire surface area of said coil.

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