United States Patent [19]

Burgett et al.

[11] **3,857,253**

[45] **Dec. 31, 1974**

[54] **UNITARY AIR COOLED CENTRIFUGAL REFRIGERATION WATER CHILLER**

[75] Inventors: **Lee W. Burgett; Chester D. Ware; Duane F. Sanborn,** all of La Crosse, Wis.

[73] Assignee: **The Trane Company,** La Crosse, Wis.

[22] Filed: **Feb. 11, 1974**

[21] Appl. No.: **441,633**

Related U.S. Application Data

[63] Continuation of Ser. No. 292,051, Sept. 25, 1972.

[52] **U.S. Cl.** **62/289,** 62/389, 62/507

[51] **Int. Cl.** **F25b 39/04**

[58] **Field of Search** 62/183, 201, 288, 289, 62/389, 498, 507, 508

[56] **References Cited**

UNITED STATES PATENTS

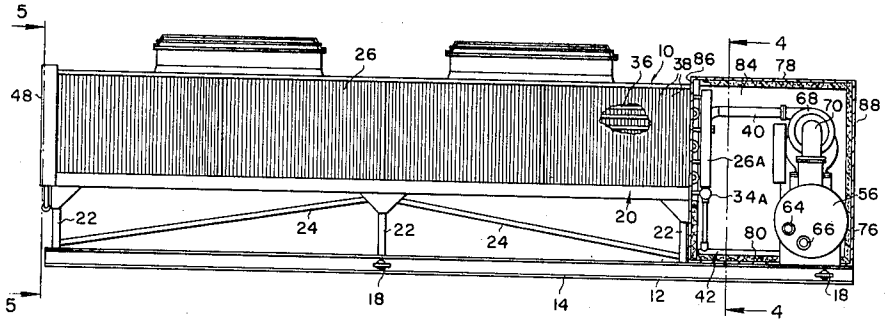
3,306,066	2/1967	Takada	62/507
3,508,417	4/1970	Kimura	62/508
3,524,331	8/1970	Osborne	62/498
3,714,795	2/1973	Fowell	62/508

Primary Examiner—Meyer Perlin

[57] **ABSTRACT**

A unitary air cooled centrifugal refrigeration water chiller is disclosed. The longitudinal extent of the water chiller heat exchanger extends transversely to the longitudinal extent of the condenser and unit sub-frame thereof.

8 Claims, 6 Drawing Figures



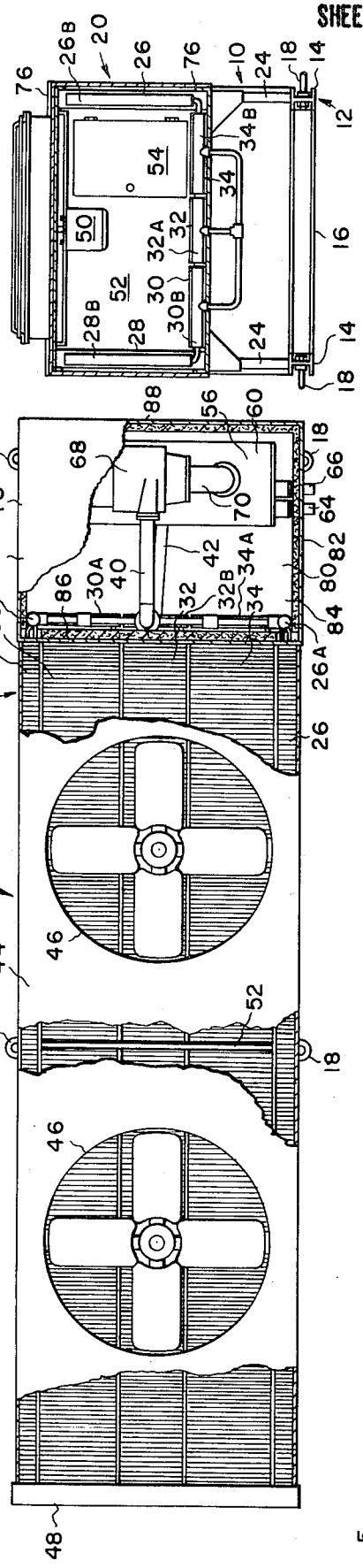


FIG. 5

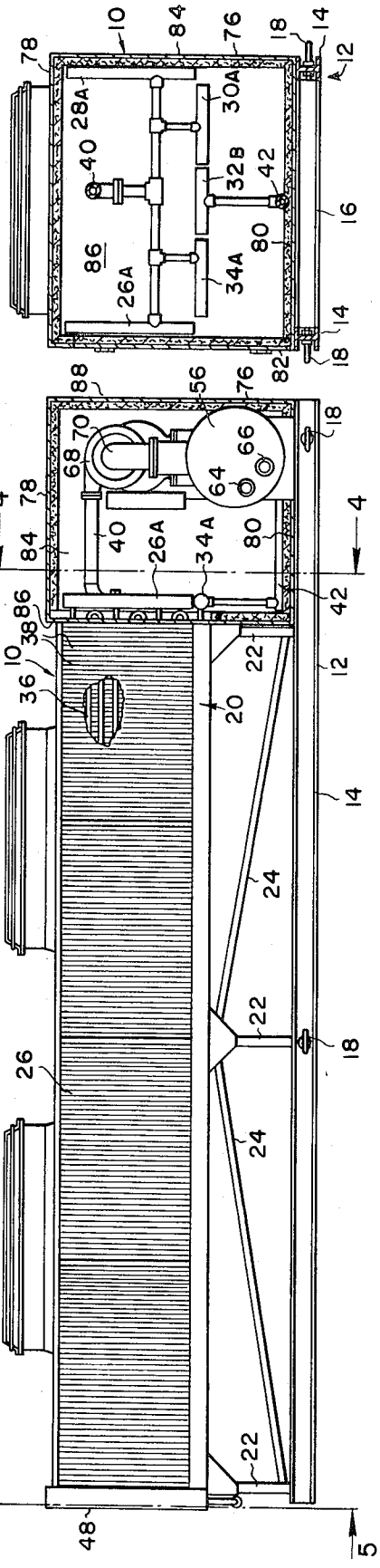


FIG. 4

FIG. 6

FIG. 3

FIG. 1

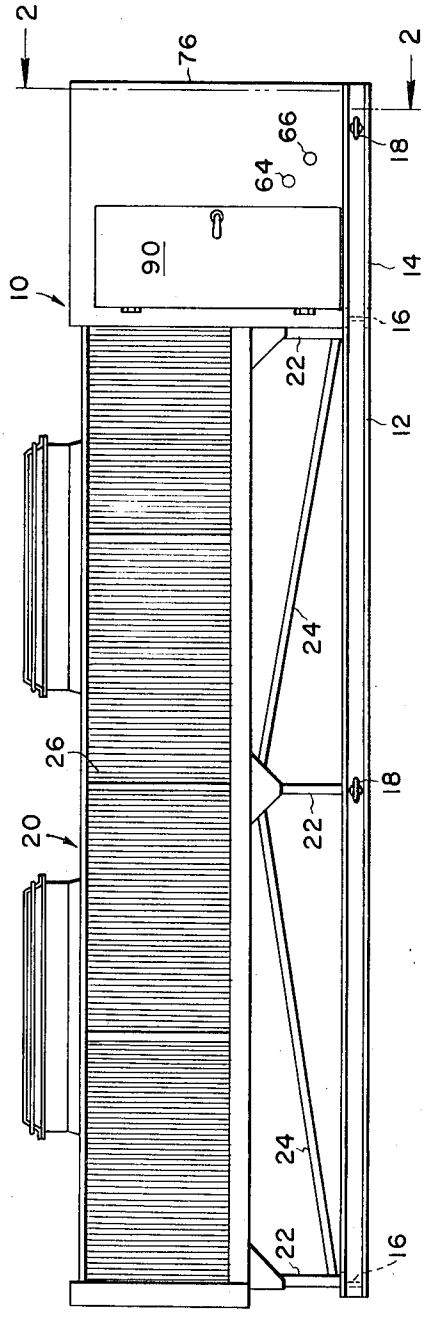
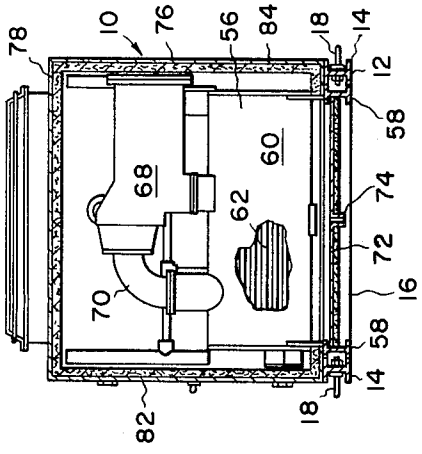

2
76
2
66
64
18
90
14
10
16
22
12
24
26
18
20
22
24
22
16

FIG. 2


78
10
76
56
84
18
14
12
58
60
68
62
74
72
70
16
58
14
82
18

UNITARY AIR COOLED CENTRIFUGAL REFRIGERATION WATER CHILLER

This is a continuation, of application Ser. No. 292,051, filed Sept. 25, 1972.

BACKGROUND OF THE DISCLOSURE

Prior hereto air cooled water chillers have been constructed to utilize reciprocating compressors. The evaporators have been arranged to extend generally parallel to the longitudinal axis of the air cooled condenser and are longitudinally coextensive with the condenser. This has been considered necessary for the reason of economy and compactness.

However these conventional arrangements have precluded the advent of a practical unitary air cooled water chiller using a centrifugal compressor at refrigeration tonages normally associated with centrifugal compressors, i.e., in excess of 100 tons. Such arrangements become impractical to service as the evaporator and compressor are nested within the close confines of the air cooled condenser, it being understood that economy requires the compressor to be physically proximate to the evaporator.

SUMMARY OF THE INVENTION

The instant invention solves these problems by providing an improved structural relationship of refrigerant machine elements employing an air cooled condenser, a shell-and-tube evaporator, a centrifugal compressor and subframe. This has been accomplished by providing a shell-and-tube evaporator which is generally more stout, that is with a larger number of shorter tubes than normally considered economical, and disposing the heat exchanger in a crosswise relation to the length of the condenser adjacent the end thereof.

The heat exchanger is not directly insulated as is generally practice, but rather the heat exchanger and compressor are contained within a shelter which is in turn thermally insulated from the ambient. A drain pan extends below the shell-and-tube heat exchanger to collect atmospheric condensate formed within the enclosure.

These and other aspects of the invention will be apparent from a reading of the detail description in conjunction with the drawing in which:

FIG. **1** is a side elevation of the unitary air cooled centrifugal water chiller;

FIG. **2** is a vertical section taken at line **2—2** of FIG. **1**;

FIG. **3** is an elevation similar to FIG. **1** but with the front wall of the shelter and a portion of the condenser fins removed for purposes of illustrations;

FIG. **4** is a vertical section taken at line **4—4** of FIG. **3**;

FIG. **5** is a vertical section taken at line **5—5** of FIG. **3** just inside the end closure panel of the condenser; and

FIG. **6** is a plan view of the unit shown in the preceding figures with portions of the top panels and wall removed for purposes of illustration.

DETAILED DESCRIPTION

Now with reference to the accompanying drawing it will be seen that the air cooled centrifugal refrigeration water chiller unit **10** has a subframe **12** which includes a pair of spaced longitudinally extending I beams **14** connected by longitudinally spaced transversely extending I beams **16.** Beams **14** have laterally extending lifting lugs **18** which may be connected to a suitable sky hook for purposes of transferring the machine.

An elongated refrigerant condenser **20** is mounted on subframe **12** in spaced parallel relationship therewith through vertical columns **22.** Appropriate cross braces **24** are also employed to add ridigity to the frame.

The condenser **20** is generally U-shaped in vertical transverse cross-section. The condenser **20** includes first and second vertical heat exchanger coils **26** and **28** respectively defining the legs of the U-shape. The base of the U-shape is formed by first, second and third horizontal heat exchanger coils **30, 32,** and **34** respectively. Each of coils **26, 28, 30, 32,** and **34** is of the fin-and-tube type having a plurality of longitudinally extending tubes **36** extending through a stack of generally rectangular fins **38.** The tubes of each coil are interconnected at their ends to provide an odd number of passes so that the inlet header is at the opposite end of the coil from the discharge header. Condenser refrigerant gas supply conduit **40** is connected to inlet headers **26A, 28A, 30A** and **34A** of coils **26, 28, 30,** and **34** respectively as seen in FIG. **4.** The outlet headers **26B** and **28B** at the opposite ends of coils **26** and **28** respectively are connected to discharge refrigerant into outlet headers **34B** and **30B** respectively of coils **34** and **30** respectively as seen in FIG. **5.** Outlet headers **30B** and **34B** are connected to pass condensed refrigerant into inlet header **32A** of condenser subcooler coil **32** as seen in FIG. **5.** The condensed and subcooled refrigerant is discharged from condenser **20** through discharge header **32B** of coil **32** and condensed refrigerant discharge conduit **42** as seen in FIG. **4.**

The top side of the condenser is closed with a top panel **44** which is provided with two large longitudinally spaced apertures **46.** A motor driven propeller fan is disposed at each aperture for drawing ambient cooling air over the fins of each of coils **26, 28, 30, 32,** and **34** and discharging such air upwardly through apertures **46.** To prevent bypassing of air around one end of the condenser, the condenser has an end panel **48** which is provided with a service door for access to the motors **50.** The partition **52** between the fans is provided with a similar service door **54** for the same reason.

At the end of subframe **12** opposite from condenser **20** is a shell-and-tube refrigerant evaporator heat exchanger **56** which is mounted on a pair of short I beams **58** connected to and nested between I beams **14** as shown in FIG. **2.** Heat exchanger **56** has a cylindrical shell **60** having a diameter of about 2½ times its length which length extends; normal to the longitudinal axis of the unit. Within the shell are a plurality of tubes **62** also extending normal to the longitudinal axis of the unit. The tubes are provided with headers at the ends of the shell in such a manner that conduit **64** serves as a water inlet and conduit **66** serves as a chilled water outlet. The water passes through the tubes in passing from inlet **64** to outlet **66.**

Mounted on top of shell **60** is a motor driven centrifugal compressor **68** whose axis of rotation is also normal to the longitudinal axis of the water chiller unit. Compressor **68** is connected to withdraw refrigerant gas from the interior of shell **60** through suction conduit **70** and deliver compressed refrigerant gas to the condenser through refrigerant gas supply conduit **40.** The condensed refrigerant from condenser **20** is re-

turned via condensed refrigerant discharge conduit **42** to the interior of shell **60** through a throttling means not shown.

Because the operating temperature of the shell **60** is often below the dew point of the ambient air, a drain pan **72** having a drain hole **74** is provided for collecting atmospheric condensate which may form and run off the exterior of shell **60.**

The evaporator heat exchanger **56** and centrifugal compressor **68** are enclosed in a weather resistant shelter **76** having top **78,** bottom **80,** front **82,** back **84,** first side **86** and second side **88** walls all of which are thermally insulated. First side wall **86** serves also to close off the end of the condenser **20** opposite panel **48** to prevent air from bypassing the coils thereof. The front wall **82** is provided with a service door **90** opening into the service area between the heat exchanger **56** and condenser **20.** The shelter housing is supported by subframe **12.**

Having now described the preferred embodiment of the invention, it is contemplated that many changes may be made without departing from the scope or spirit of the invention as limited only by the claims.

We claim:

1. A portable self-contained unitary water chiller machine comprising: an elongated air cooled heat exchanger having a generally U-shaped vertical cross section normal to the longitudinal axis thereof; each of the leg and bottom portions of said U-shaped section including a plurality of parallel spaced horizontally conducting refrigerant tubes extending longitudinally from one end to the other end thereof through a plurality of longitudinally and horizontally spaced heat exchanger fins; an elongated portable subframe disposed beneath said air cooled heat exchanger having a portion extending longitudinally beyond one end of said air cooled heat exchanger; first elongated header means at said one end of said air cooled heat exchanger extending transversely to said portable subframe for conducting refrigerant with respect to one longitudinal end of said tubes; second header means at the other end of said air cooled heat exchanger extending transversely to said portable subframe for conducting condensed refrigerant with respect to the other longitudinal end of said tubes; means for supporting said air cooled heat exchanger in spaced relation above said subframe to provide a space for passing air above said subframe below said bottom portion of said U-shaped section; a plurality of longitudinally spaced fan means disposed above said bottom portion and intermediate said leg portions of said U-shaped section for drawing air through each of said bottom and leg portions; an elongated shell-and-tube refrigerant evaporator heat exchanger disposed entirely at said one end of said air cooled heat exchanger supported transversely on said portion of said elongated portable subframe extending beyond said one end of said air cooled heat exchanger; a centrifugal refrigerant compressor at said one end of said air cooled heat exchanger supported by said portion of said portable subframe extending beyond said one end of said air cooled heat exchanger; first conduit means for conducting refrigerant from the shell of said evaporator heat exchanger to the inlet of said compressor; second conduit means for conducting refrigerant gas from said compressor longitudinally of said portable subframe to said first header means at said one end of said air cooled heat exchanger; third conduit means for conducting condensed refrigerant from said second header at the other end of said air cooled heat exchanger longitudinally of said portable subframe to said evaporator heat exchanger; and means for conducting water to be chilled transversely of said portable subframe within the tubes of said shell-and-tube evaporator heat exchanger.

2. The apparatus as defined by claim **1,** wherein said second conduit means includes tubes of the bottom portion of said U-shaped section which function as a subcooler.

3. The apparatus as defined by claim **1** including a weather resistant shelter supported by said subframe entirely at one longitudinal end of said air cooled heat exchanger and generally extending about said compressor and said evaporator heat exchanger.

4. The apparatus as defined by claim **3** wherein said shelter has a first wall abutting said one end of said air cooled heat exchanger and a second wall opposite from said first wall, said evaporator heat exchanger being substantially closer to said second wall than said first wall.

5. The apparatus as defined by claim **4** wherein the length of said heat exchanger is greater than the spatial distance between said first and second walls.

6. The apparatus as defined by claim **1** including thermal insulation means for said shell and tube evaporator heat exchanger wherein the primary insulation for said shell and tube evaporator heat exchanger is at the walls of said shelter.

7. The apparatus as defined by claim **6** including a drain pan disposed below said shell-and-tube evaporator heat exchanger to collect atmospheric condensate formed within said shelter on the external surface of said shell-and-tube heat exchanger.

8. The apparatus as defined by claim **1** wherein the axis of rotation of said compressor is transverse to the longutidinal axis of said air cooled heat exchanger.

* * * * *