Oct. 28, 1969 W. F. SHRIVER 3,474,856

CONDENSING APPARATUS

Filed Jan. 2, 1968 5 Sheets-Sheet 1

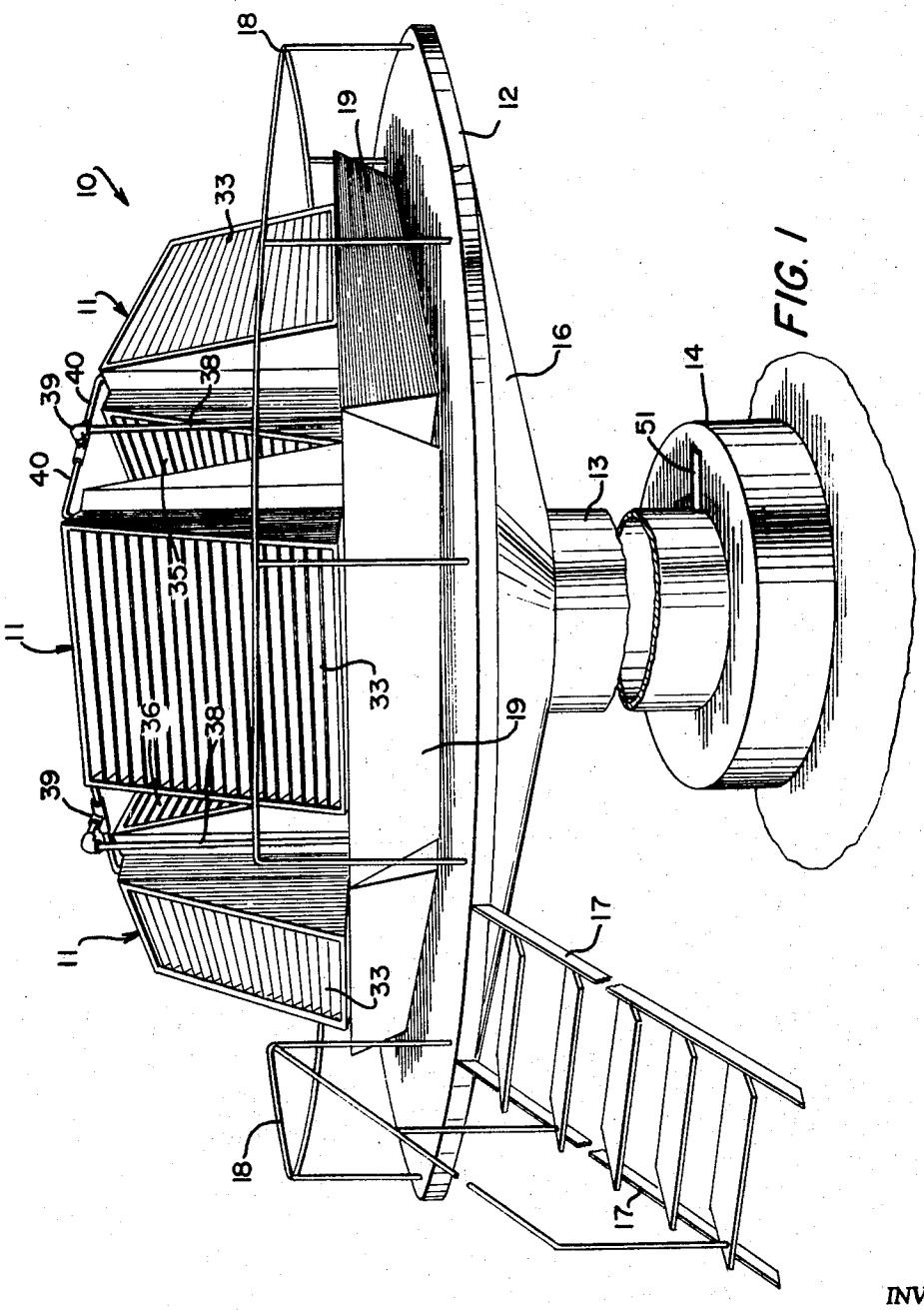


FIG. 1

INVENTOR

WILLIAM F. SHRIVER

BY

ATTORNEY

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CONDENSING APPARATUS

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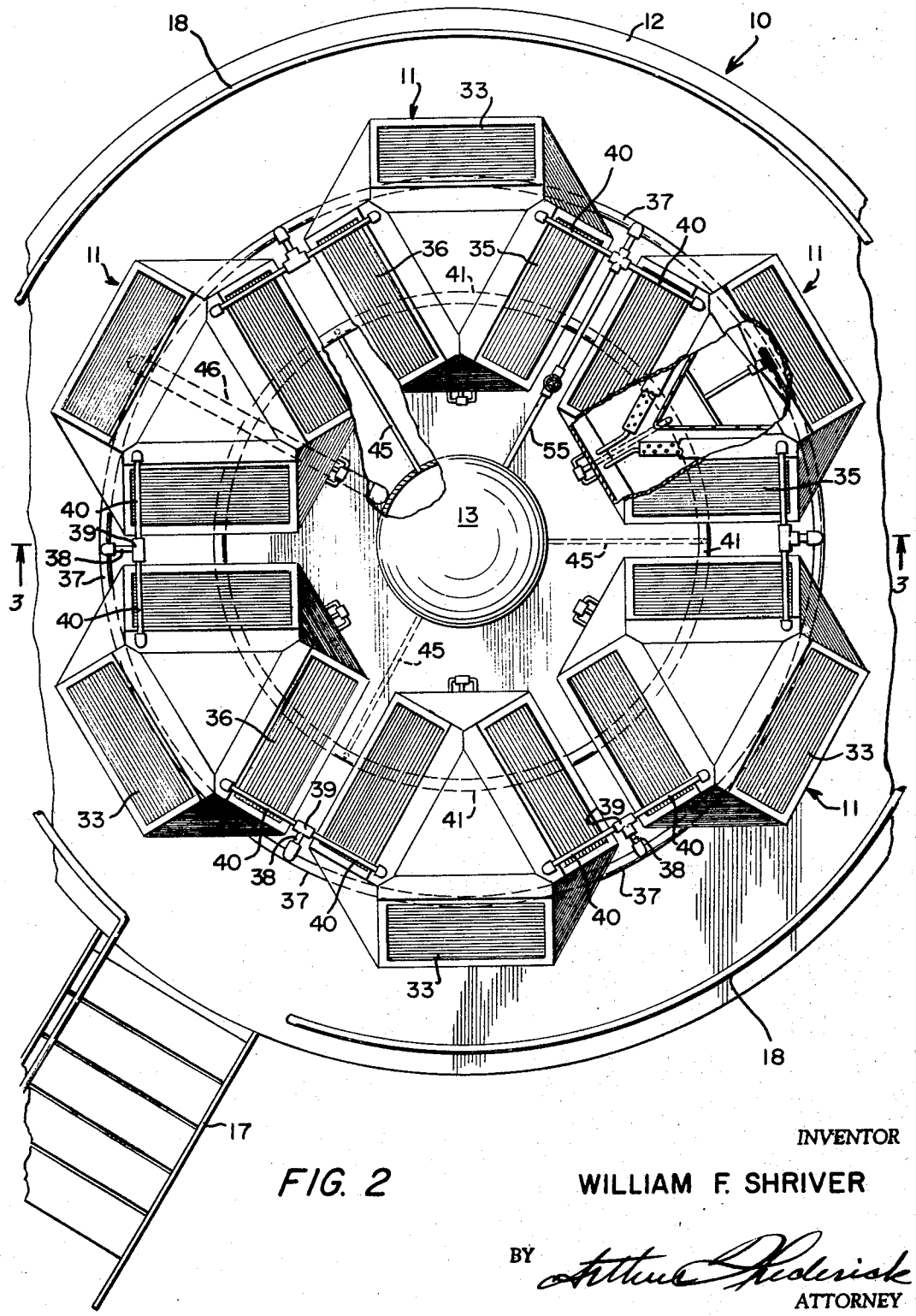


FIG. 2

INVENTOR

WILLIAM F. SHRIVER

BY Arthur Frederick

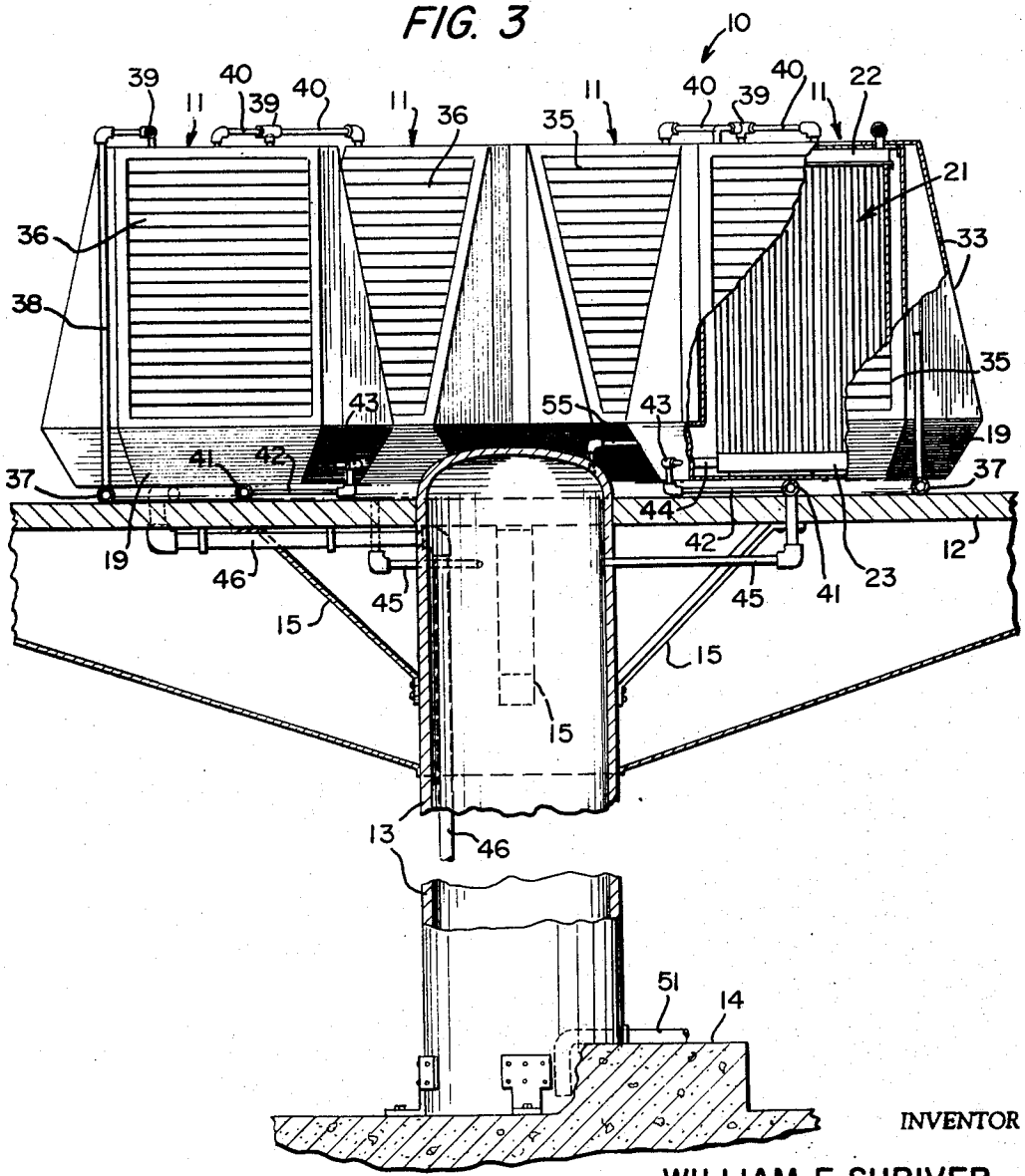
ATTORNEY

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FIG. 3



INVENTOR

WILLIAM F. SHRIVER

BY Arthur Sedwick

ATTORNEY

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CONDENSING APPARATUS

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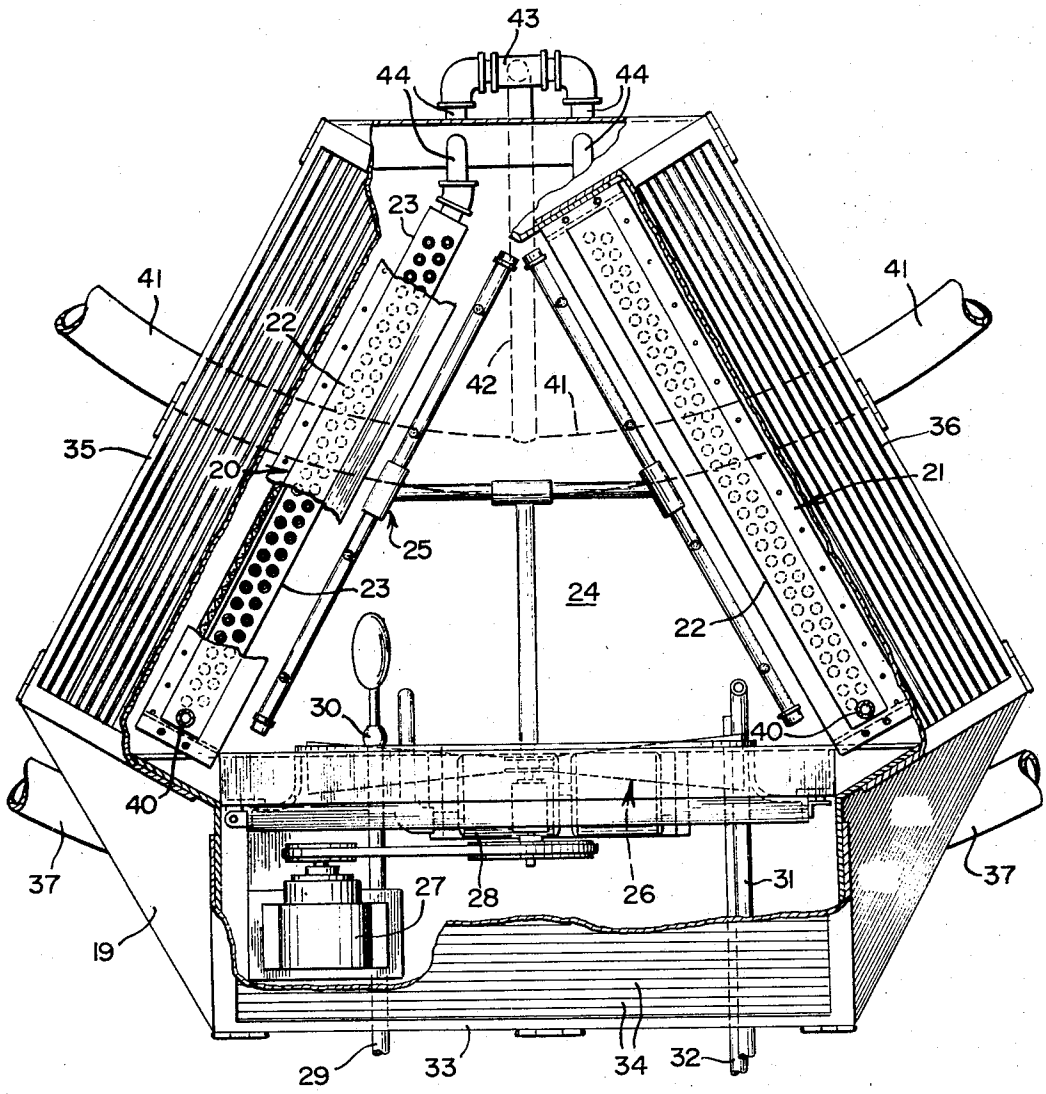


FIG. 4

INVENTOR

WILLIAM F. SHRIVER

BY Arthur Frederick

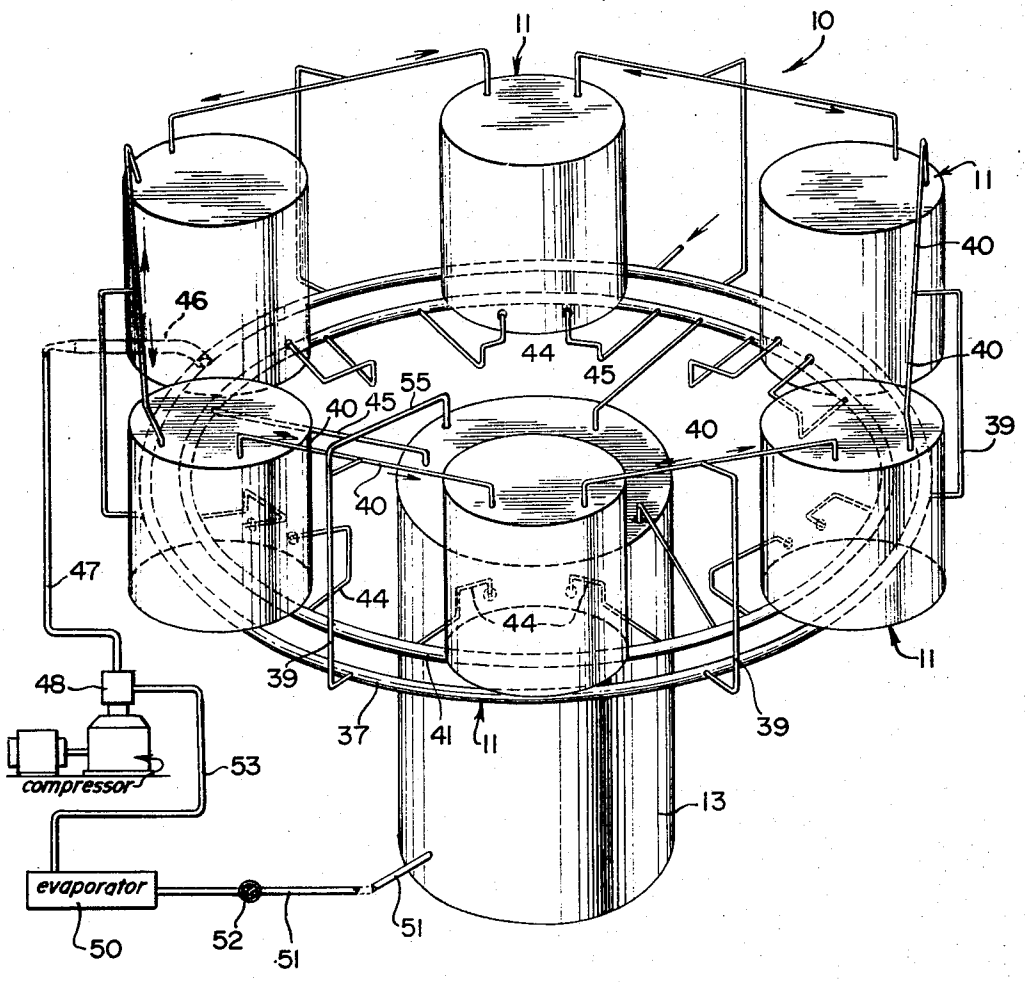
ATTORNEY

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FIG. 5



INVENTOR

WILLIAM F. SHRIVER

BY Arthur Federicks

ATTORNEY

United States Patent Office 3,474,856 Patented Oct. 28, 1969

3,474,856

CONDENSING APPARATUS

William F. Shriver, Waynesboro, Pa., assignor to Frick Company, Waynesboro, Pa., a corporation of Pennsylvania

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Int. Cl. F28f 9/00, 3/00, 13/12
U.S. Cl. 165—67 12 Claims

ABSTRACT OF THE DISCLOSURE

A large capacity condensing apparatus comprising a plurality of closely spaced condensing units supported in an elevated position by a platform secured to a column-receiver. Each of the condensing units are constructed and arranged to receive and pass fluid to be condensed in indirect heat exchange relationship with a cooling fluid to condense the gaseous fluid. Each of the condensing units communicate with the column-receiver to pass condensed fluid to the latter for storage and removal when needed by a means utilizing the condensed fluid.

This invention relates to condensers and more particularly to refrigeration condensers.

In comfort air conditioning or refrigeration systems, where the capability of condensing large quantities of refrigerant is a requirement, special sized condensing units were designed and fabricated with the required condensing capacity. Since such units were of special design and construction, they were expensive. In some cases, standard units were coupled together, which resulted sometimes in providing more condensing capacity than was required and, thus, were uneconomical installations.

Accordingly, it is an object of this invention to provide a relatively large capacity condensing apparatus which is relatively simple to install and relatively inexpensive.

Another object of the present invention is to provide a large capacity condensing apparatus which is aesthetically attractive and, therefore, suitable for use where exposed to view.

A feature of this invention is the use of a plurality of relatively small condensing units connected together and to a common receiver or accumulator.

Another feature of the present invention is the connecting together of a plurality of relatively small condensing units or modules, and with an accumulator, or receiver which also serves as a support column to support the condensing units in an elevated position.

In view of the foregoing, the present invention contemplates a novel condensing apparatus comprising a plurality of interconnected condensing units or modules, each of which is constructed and arranged to receive and pass gaseous fluid to be condensed in indirect heat exchange with a cooling fluid. Each of the condensing units communicate with a common accumulator or receiver to deliver condensed fluid to the latter. The accumulator or receiver provides a reservoir of condensate and is connected to deliver condensate to a place of use, such as an evaporating means in a refrigeration system. In a more specific aspect of the present invention, it is contemplated to utilize the accumulator or receiver as a support column to support the plurality of condensing units in an elevated position to permit gravity flow from the condensing units to the receiver.

The invention will be more fully understood from the following description when considered in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a condensing apparatus according to the present invention;

FIG. 2 is a top plan view of the condensing apparatus shown in FIG. 1 with parts broken away for illustrative purposes;

FIG. 3 is a cross sectional view taken substantially along line 3—3 of FIG. 2;

FIG. 4 is a top plan view, with parts broken away for illustrative purposes, of a condensing module; and

FIG. 5 is a schematic perspective view of the condensing apparatus shown in FIGS. 1 to 3, inclusive.

Now referring to the drawings and more particularly to FIGS. 1 to 3, inclusive, the reference number **10** generally designates the condensing apparatus according to this invention, which condensing apparatus is particularly suitable for use in comfort air conditioning and refrigeration systems to condense refrigerant such as schematically shown in FIG. 5.

The condensing apparatus **10** comprises a plurality of condensing units or modules **11** arranged in spaced relationship to each other on a platform **12** which is supported by a column **13**. In accordance with this invention, column **13** is a fluid tight vessel constructed and arranged to function as an accumulator or receiver as hereinafter more fully explained. Since column **13** serves a dual function, it will be hereinafter referred to as a column-receiver.

Column-receiver **13** is an elongated cylindrical vessel disposed with its longitudinal axis extending vertically and supported at its lower end in a concrete base **14** or in some other suitable manner secured to the ground, roof or other structure. The platform **12** is secured to the upper end portion of column-receiver **13** by a plurality of braces **15** or by other suitable means well known to those skilled in the building construction art. As best shown in FIGS. 1 and 3, a skirt **16** is connected to platform **12** and column-receiver **13** to provide a more pleasing appearance by hiding braces **15** and piping.

To permit easy access to platform **12** for inspection and/or repair of modules **11**, a ladder or stairway **17** may extend from the ground, roof or other supporting base to platform **12**. For protection of personnel on platform **12**, a guard rail **18** may be provided around the outer peripheral portion of the platform.

As best shown in FIG. 4, each module **11** may be of the type fully disclosed in co-pending U.S. patent application, Ser. No. 665,080, filed Sept. 1, 1967. While modules **11** are shown and will be hereinafter described as evaporative condensers of the type disclosed in the aforementioned U.S. patent application, it is to be understood that other types of condensing units may be employed without departure from the scope and spirit of the present invention.

As illustrated in FIG. 4, each module **11** comprises a base **19** constructed and arranged to define a sump and two vertical tube banks **20** and **21** supported by base **19** in converging-diverging planes. Each of the tube banks **20** and **21** includes an upper inlet header **22** to receive fluid to be condensed and a lower outlet header **23** to receive condensed fluid. The tube banks **20** and **21** and other walls contiguous with the tube banks and base **19** define with the base a plenum **24**. A water spray assembly **25** is disposed in plenum **24** to spray water on tube banks **20** and **21** to effect wetting of the exterior surfaces of the tubes of the tube banks. A fan **26** is disposed in one of the walls to draw ambient air into plenum **24** and force the air in two streams through tube banks **20** and **21** and in indirect heat exchange relationship with fluid flow through tube banks **20** and **21**. A motor **27** is connected to drive fan **26**. A pump **28** is connected to withdraw water from sump **24** and deliver the same to water spray assembly **25**. A water make-up pipe **29** is connected, at one end, to a source of water and, at the other

end, communicates with sump 24. To control water flow through pipe 29 and assist in maintaining a predetermined level of water in sump 24, a float controlled valve 30 is disposed in pipe 29. An overflow drain pipe 31 and a drain pipe 32 for emptying sump 24 are provided in the module in communication with the sump 24 and a sewer (not shown). A hinged cover member 33, having louvers 34, is disposed adjacent fan 26 and similar louvered covers 35 and 36 are disposed adjacent tube banks 20 and 21, respectively. The louvered covers 33, 35 and 36 function to prevent ambient wind conditions from interfering with the efficiency of the module by the louvers shielding plenum 24 from direct communication with ambient air.

To interconnect each of the modules 11 into a unitary assembly, each inlet header 22 is in communication with a main distribution header 37, via a feed pipe 38, a T connection 39 and a branch pipe 40, while each outlet header 23 is in communication with a main outlet header 41, via a secondary outlet pipe 42, a T connection 43 and branch outlet pipes 44. The main distribution header 37 and main outlet header 41 are preferably circular in configurationn and disposed in concentric relationship to each other on platform 12, with each of the modules resting upon the headers.

As shown in FIGS. 2 and 3, main outlet header 41 is connected, through a plurality of pipes 45, with column-receiver 13, to discharge condensed fluid, such as refrigerant, into the column-receiver. Each of the pipes 45 extend, from the connection with main distribution header, vertically through platform 12 and, thence radially inwardly toward column-receiver 13. The distribution header 37 communicates with at least one supply pipe 46 which extends, from connection with main outlet header 41, through platform 12 and then radially inwardly to column-receiver 13. From column-receiver 13, supply pipe 46 extends downwardly adjacent the outer surface of the column-receiver to connection with a conduit means 47 (see FIG. 5) to communicate with a source of gaseous fluid to be condensed, such as the discharge side of a refrigerant compressor 48 (see FIG. 5). While but one supply pipe 46 is shown, it is within the contemplation of this invention to provide two or more supply pipes 46, each of which would communicate with conduit means 47 through a manifold or header means (not shown).

The condensed liquid, such as refrigerant, which is conducted into column-receiver 13 by pipes 45 from each of the outlet headers 23 of modules 11, is collected and held in the lower portion of column-receiver 13 until required. As best shown in FIGS. 3 and 5, column-receiver 13 connects with a user of condensate, such as one or more evaporators 50, by way of a pipe 51 which extends into the lower portion of the column-receiver. An expansion valve 52 (see FIG. 5) may be disposed in pipe 51 to control flow of fluid into evaporator 50. From evaporator 50 the heated, gaseous refrigerant is conducted to compressor 48, by way of pipe 53, for recompression and delivery to modules 11 for condensing, as is conventional in closed refrigerant systems.

In operation of condensing apparatus 10, as it might be employed in a comfort air conditioning or a refrigerant system, gaseous refrigerant is compressed in compressor 48 and discharged into conduit means 47 (see FIG. 5). From conduit means 47, the compressed, gaseous refrigerant is delivered to one or more supply pipes 46 which conduct the fluid to main distribution header 37. After entry into main distribution header 37, the gaseous refrigerant flows into each of the inlet heaters 22 of each of the modules 11 via feed pipes 38, T connections 39 and branch pipes 40. As best illustrated in FIGS. 3 and 4, the gaseous refrigerant entering inlet headers 22 of each of the modules 11 flows into the plurality of tubes of tube banks 20 and 21 and into indirect heat exchange relationship with the air streams flowing between the tubes under the force of fan 26. The gaseous refrigerant, in passing in indirect heat transfer with the ambient air stream, is cooled and condensed, the condensed or liquid refrigerant flowing into outlet headers 23. From outlet headers 23, the liquid refrigerant flows into main outlet header 41 by way of branch outlet pipes 44, T connection 43, and secondary outlet pipe 42. The liquid refrigerant then flows from main outlet header 41 into column-receiver 13 by way of a plurality of pipes 45. The liquid refrigerant is conducted from column-receiver 13 by pipe 51 to evaporator 50 in which it flows in indirect heat exchange relationship with a fluid to be cooled, such as air or water, and is thereby heated and converted to a gaseous state. The gaseous refrigerant is conducted, from evaporator 50, by suction pipe 53 to compressor 48 where it is again recompressed and passed to condensing apparatus 10.

An equalizing pipe 55 (see FIGS. 2, 3 and 5) may be provided to communicate the vapor space of column-receiver 13 with the main distribution header 37 to flow gaseous refrigerant from the column-receiver 13 and thus relieve the pressure in the column-receiver 13 if a pressure build-up develops in the column-receiver due to exposure to heat, as for example, exposure to more of the sun's rays than the modules. This possibility of the heating of the column-receiver 13 to a greater extent than modules 11 by the exposure to the sun's rays is minimized by skirt 16.

The condensing apparatus 10 may be provided with suitable valves (not shown) in the various interconnecting piping to enable one or more of the modules 11 to be isolated (removed from the system) when inspection or repair is required or when maximum condensing capacity is not required. For example, a valve may be provided in each of the branch pipes 40 and outlet pipes 42, which valves associated with a particular module 11, when closed, would remove the module from communication with the refrigeration system.

It is believed now readily apparent that a novel large capacity condensing apparatus has been disclosed which is relatively simple and easy to construct and can economically provide the condensing capacity required for a particular system. It is an apparatus which combines the function of structural support with the provision for providing a liquid reservoir for the system. It is also a condensing apparatus that has aesthetic as well as functional value.

What is claimed is:

1. A fluid condensing apparatus comprising
   (a) a plurality of individual compactly arranged and connected, generally triangular condensing units having angular sides in generally parallel relation and providing the desired capacity,
   (b) each of said condensing units having banks of tubes disposed in angular upright relation with means for passing fluid to be condensed in indirect heat exchange with a cooling fluid,
   (c) inlet header means connected to receive gaseous fluid to be condensed,
   (d) main outlet header means,
   (e) each of said plurality of condunsing units being connected to said inlet header means to receive fluid to be condensed and with the main outlet header means to pass condensed fluid to the latter, and
   (f) receiver means connected to said main outlet header means to receive condensed fluid from the latter and provide a reservoir of such condensate.

2. The apparatus of claim 1 wherein said condensing units are supported on a platform, and said receiver means is an elongated vessel held at one end with the longitudinal axis thereof extending substantially vertically, said platform being connected to the upper end of said vessel to support the condensing units in an elevated position.

3. The apparatus of claim 1 wherein said inlet header means is a pipe having a circular configuration.

4. The apparatus of claim 1 wherein said outlet header means is a pipe having a circular configuration.

5. The apparatus of claim 1 wherein said condensing units are disposed above the inlet and outlet header means.

6. The apparatus of claim 1 wherein a platform is provided to support said inlet and outlet header means and said plurality of condensing units.

7. The apparatus of claim 1 wherein a platform is held in an elevated position to support inlet and outlet header means consisting of pipes of circular configuration arranged in concentric relation to each other, the plurality of condensing units being disposed in close spaced relationship to each other on said concentric inlet and outlet pipes.

8. A fluid condensing apparatus for condensing gaseous refrigerant comprising

(a) an elongated receiver vessel supported with the longitudinal axis thereof extending vertically and forming a reservoir for condensed refrigerant,

(b) a platform supported in an elevated position by the receiver vessel adjacent the upper end portion of the receiver vessel,

(c) a plurality of condensing units disposed in close spaced relationship on said platform,

(d) each of said condensing units having means for passing gaseous refrigerant to be condensed in indirect heat exchange with cooling fluid,

(e) main inlet header means supported by the platform and connected to receive gaseous refrigerant to be condensed, and

(f) main outlet header means supported by the platform and connected to said receiver vessel to conduct condensed, liquid refrigerant to the latter,

(g) each of said plurality of condensing units being connected to the main inlet header means to receive gaseous refrigerant to be condensed and with the main outlet header means to pass condensed refrigerant to the latter.

9. The apparatus of claim 8 wherein said main inlet header means consists of a pipe formed into a circle.

10. The apparatus of claim 8 wherein said main inlet and said main outlet header means consists of pipes formed into concentric circles.

11. The apparatus of claim 8 wherein said main inlet and said main outlet header means consists of pipes formed into concentric circles and wherein said condensing units rest upon the concentric circular pipes.

12. The apparatus of claim 8 wherein a plurality of pipes communicate the receiver vessel with the main outlet header means, each of said pipes radially extending from the receiver vessel and through the platform to connection with the main outlet header means.

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ROBERT A. O'LEARY, Primary Examiner

A. W. DAVIS, JR., Assistant Examiner

U.S. Cl. X.R.

62—507; 165—111, 124