Feb. 12, 1963

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3,077,226

HEAT EXCHANGE DEVICE

Filed Nov. 15, 1956

Fig. 1.

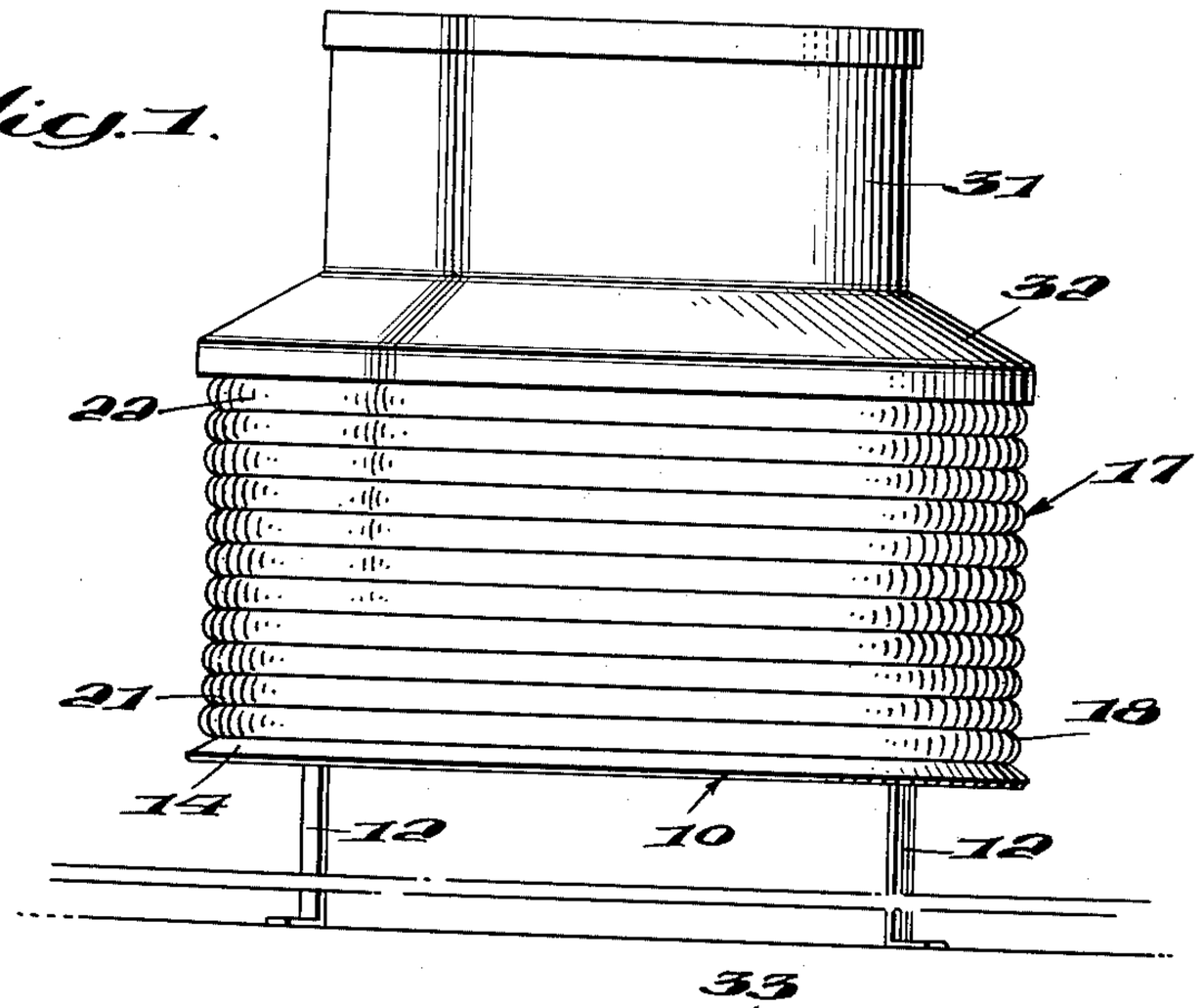


Fig. 2.

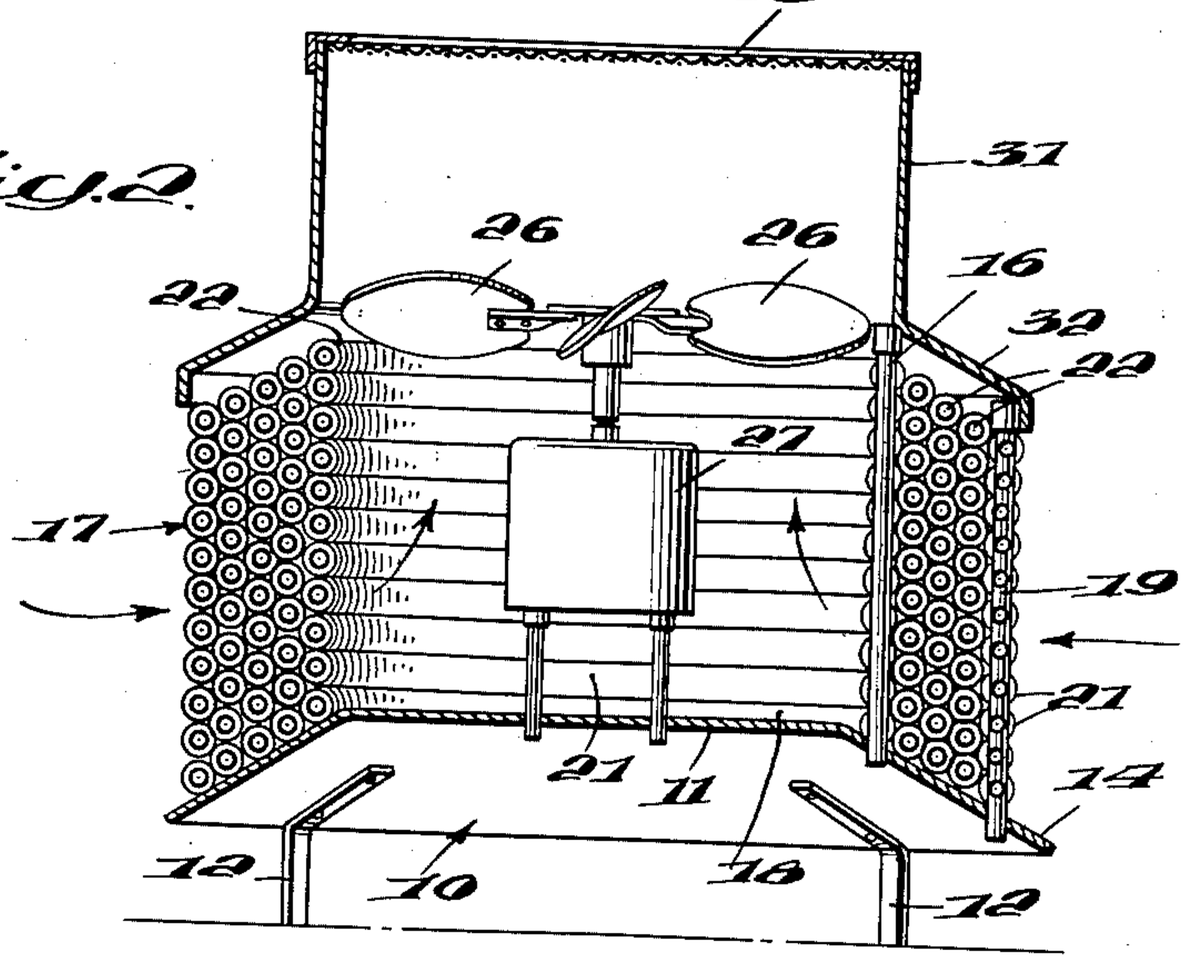


Fig. 3.

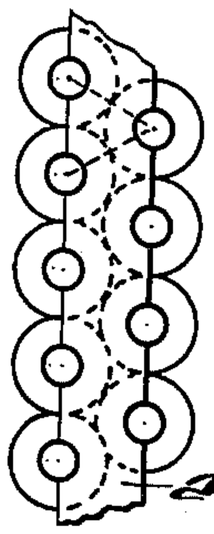
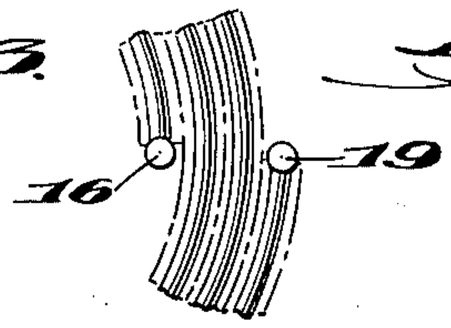


Fig. 4.



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HEAT EXCHANGE DEVICE

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3 Claims. (Cl. 165—125)

The present invention relates to a heat exchange unit and is more specifically directed to an air cooled condenser utilizing the counterflow heat exchange principle and with gravity drainage of the tubes to provide an efficient device for extracting heat from a gaseous medium or liquid such as a refrigerant and the condensate thereof.

An object of the invention is to provide a heat exchange unit for non-solids wherein a plurality of tubes for guiding the medium are arranged in an annular bundle and so arranged that the medium in its hottest state enters the tubes at the inner periphery thereof and as it progresses through the tubes is cooled by air entering from the outer periphery of the tube bundle whereby the air first entering the tube assembly is at its lowest temperature and the coldest air thus comes in contact with those portions of the tubes containing a gaseous medium or the condensate thereof which has already been cooled to some extent throughout the inner periphery of the tube bundle whereby the hottest medium guided by the inner convolutions of the coils is cooled by the warmest air and the coolest portion of the medium is in heat exchange relation with the coolest air to provide a counterflow principle in an annular arrangement of tubes in a heat exchange unit.

Another object of the invention is to provide a condenser with the coils arranged in an annular assembly wherein each convolution of each tube slopes downwardly in proceeding to the outlet header thereby assuring positive drainage of the condensate and thereby insures that the maximum tube wall area is available for the condensation of vapor within the tubes.

Other objects and features of the invention will be appreciated and become apparent as the present disclosure proceeds and upon consideration of the accompanying drawing and the following detailed description wherein an exemplary embodiment of the invention is disclosed.

In the drawing:

FIG. 1 is an elevational view of a heat exchange unit exhibiting the invention.

FIG. 2 is a vertical sectional view taken through the axis of the unit.

FIG. 3 is an enlarged fragmentary view illustrating the manner in which the convolutions of the tubes are maintained in spaced relationship.

FIG. 4 is a fragmentary plan view of a portion of the tube bundle showing the disposition of the inlet and outlet headers.

Referring to the drawing the tubes for guiding a medium to be cooled are supported on a frusto-conically shaped base member **10**. This member may be formed of metal and provided with a flat central disc-shaped portion **11** which is desirably erected and maintained in a horizontal plane. The base member may be supported in any suitable manner such as by legs **12**. The area under the base member **10** may be utilized to accommodate a compressor and other equipment and parts of a refrigeration system. The peripheral or skirt portion **14** of the base member **10** slopes downward in proceeding outwardly from the periphery of the central portion **11** at an angle with respect thereto. In the embodiment illustrated the angle of inclination of the annular skirt portion **14** is about thirty degrees with respect to the horizontal plane of the central portion **11**. This sloping portion provides a foundation for an annular group of tubes.

An inlet header for the tubes is shown at **16** and it will be noted that this inlet header is arranged at the inner periphery of the circular bundle of tubes **17**. In the embodiment illustrated eleven tubes are connected to the inlet header **16**. The lowest tube **18** after leaving the inlet header **16** makes four complete turns and is supported along the plane of the sloping skirt portion **14** of the base member. The end of the outermost convolution of the tube **18** is connected to an outlet header **19**. The outermost convolution of the tube **18** is approximately three diameters below the point where it is connected to the inlet header **16**. Each convolution of the lowest tube **18** lies along and is supported on the sloping skirt portion **14**. Thus each turn or convolution outwardly of the inlet header **16** is at a lower elevation and positive drainage of liquid or condensate from the inlet header end of the tube to the outlet header **19** is assured. Additional tubes are connected to the inlet header **16** above the tube **18**. Each of these tubes makes four turns and the low positions of the outer convolutions of these tubes is indicated at **21** in FIG. 2. The ends of the outermost convolution of these tubes are connected to the outlet header **19**. As many tubes may be employed as desired to form the annular bundle and in order to provide a unit of desired capacity. The uppermost tube **22** and the successive outer convolutions thereof slope downwardly as shown in FIG. 2 so that the top portion of the coil assembly slopes downwardly in proceeding outwardly.

The tubes are of the fin type well known in the art and in the embodiment illustrated the tubes are arranged in such position that the centers thereof define a triangle as indicated by the dotted lines in FIG. 3. The periphery of the fins of one tube in the central portion of the group engage the fins of six adjacent tubes. The tube portions of the innermost and outermost convolutions engage the fins of four adjacent tubes. The tubes may be held in spaced relation by spacer elements such as shown at **24** in FIG. 3. The spacer element is desirably formed of metal having good heat conducting characteristics such as aluminum.

A fan for moving air over the coils in the direction of the arrows in FIG. 2 is provided which includes fan blades **26** driven by a motor **27**. The motor may be supported on the base member **10** and the fan blades may be supported and driven by the shaft of the motor **27**. It will be noted that the fan blades **26** are such that they move in a path which is quite close to the innermost convolution of the top tube **22**.

An annular fan stack **31** is provided above the fan and this member includes a frusto-conical skirt portion **32** which partly shrouds the fan blades **26**. The skirt **32** desirably slopes downwardly in proceeding outwardly to cover the annular assembly of tubes. A guard screen **33** may be provided over the upper end of the fan stack member **31**.

While the invention has been disclosed with regard to a condenser for a refrigeration system it will be appreciated that the invention has utility in other fields of heat exchange. Changes may be made in the structural arrangement and the overall organization. Such modifications and others may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. An air cooled condenser for a refrigeration system comprising, an impervious base member having a disc-shaped central portion and a frusto-conical depending skirt forming the periphery of the base member, a vertically disposed inlet header for receiving a refrigerant in a gaseous state, a plurality of tubes connected to said inlet header at vertically spaced points, each tube having a plurality of convolutions which slope downwardly

in proceeding outwardly to the larger diameter convolutions thereof forming an annular assembly with the convolutions of the lowermost tube lying along and supported on said skirt, a vertically disposed outlet header connected to each of said tubes at the outer periphery of the annular assembly for guiding condensate downwardly from outer ends of said tubes, said annular assembly having an open unobstructed central area defined by the inner convolutions of said tube, an impervious annular member overlying the upper portion of said annular assembly and closing areas between the convolutions of the tubes and having an open central portion in registration with said open central area, and a fan having blades rotatable adjacent the upper end of said annular assembly for drawing air radially inward over all circumferential portions of the tubes from the outer periphery of the annular assembly and discharging the air axially upward from the central area of the annular assembly.

2. An air cooled condenser comprising, a vertically disposed inlet header for receiving a hot gaseous substance to be condensed, a plurality of tubes connected at vertically spaced points to the inlet header and arranged in an annular assembly with convolutions of each tube sloping downwardly in proceeding outwardly from said inlet header, a vertically disposed outlet header connected to all of said tubes at the outer periphery of the annular assembly for guiding condensate downwardly from outer ends of said tubes, said annular assembly having an open unobstructed area defined by the inner convolutions of said tubes, a base member supporting said tubes and closing a lower central portion of the assembly and areas between the convolutions of the tubes, and a fan mounted to move air radially inward over all portions of the convolutions of the tubes from the outer perimeter of the annular assembly and to move the air axially upward from said central area of the assembly.

3. A forced draft air cooled condenser comprising, an impervious base member having a horizontal circular central portion and a frusto-conical depending flange forming the peripheral portion of the base member, a

vertically disposed inlet header extendng vertically from the perimeter of the circular horizontal central portion of the base member for receiving a hot gaseous substance to be condensed, a tube connected to said inlet header and having a plurality of convolutions each lying and supported on said frustro-conical flange so that said tube slopes constantly downwardly in proceeding to the outer end of said tube, another tube connected to said inlet header at a point above the first tube and having a plurality of convolutions overlying the convolutions of the first tube with the second tube sloping constantly downwardly in proceeding to the outer end thereof, said tubes forming an annular assembly having an open and unobstructed central area defined by the inner convolutions of said tubes above said circular central portion of the base member, a vertically disposed outlet header connected to each of said tubes at the outer periphery of the annular assembly for guiding condensate downwardly from the outer ends of said tubes, a stack having a skirt overlying the uppermost of said tubes, said stack extending above said skirt and having an open interior substantially in registration with said open area, and a fan having blades rotatable adjacent an upper end of said central area for drawing air radially inwardly over all circumferential portions of said tubes and through the annular space provided between said skirt and said frustro-conical flange and discharging the air through an open end of said stack.

References Cited in the file of this patent

UNITED STATES PATENTS

1,991,176	Rutishauser	Feb. 12, 1935
2,044,832	Child	June 23, 1936
2,115,288	Smith	Apr. 26, 1938
2,270,665	Wheller	Jan. 20, 1942
2,644,322	Preble et al.	July 7, 1953
2,662,748	Huber	Dec. 15, 1953

FOREIGN PATENTS

417,455	Great Britain	Mar. 29, 1934