June 3, 1969 D. KAESS, JR 3,447,598

AIR COOLED HEAT EXCHANGER

Filed May 12, 1967

FIG. 1

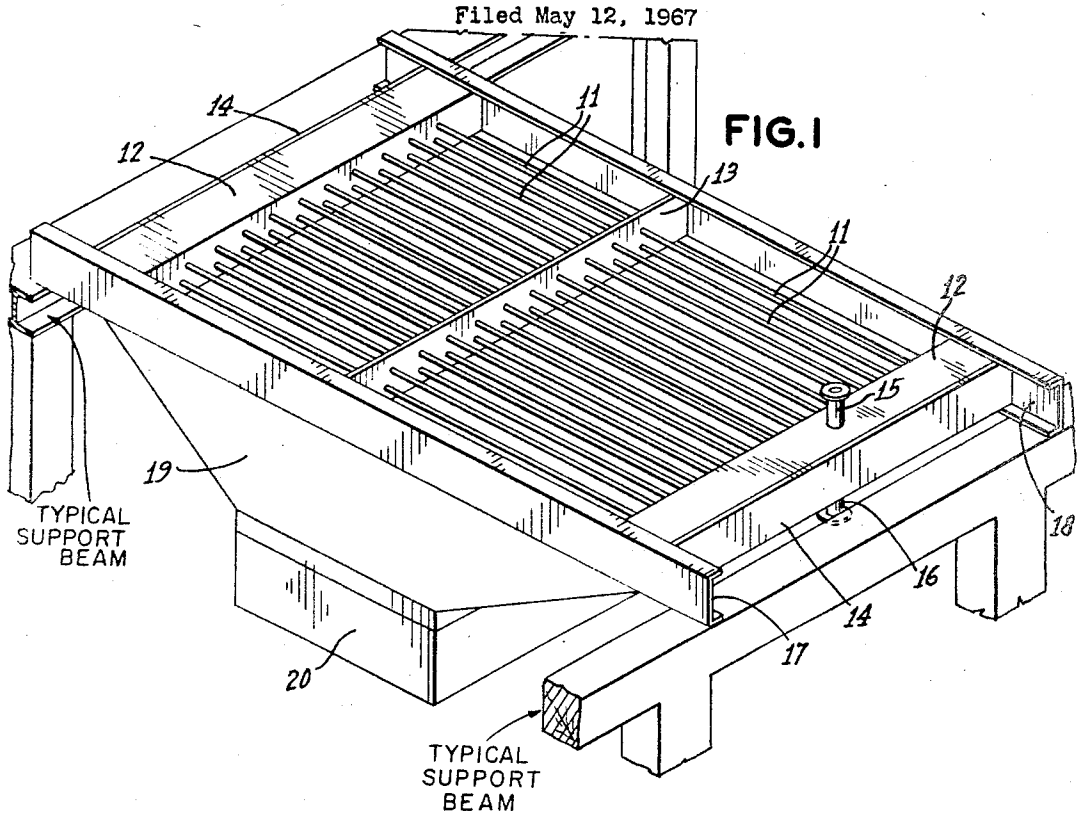
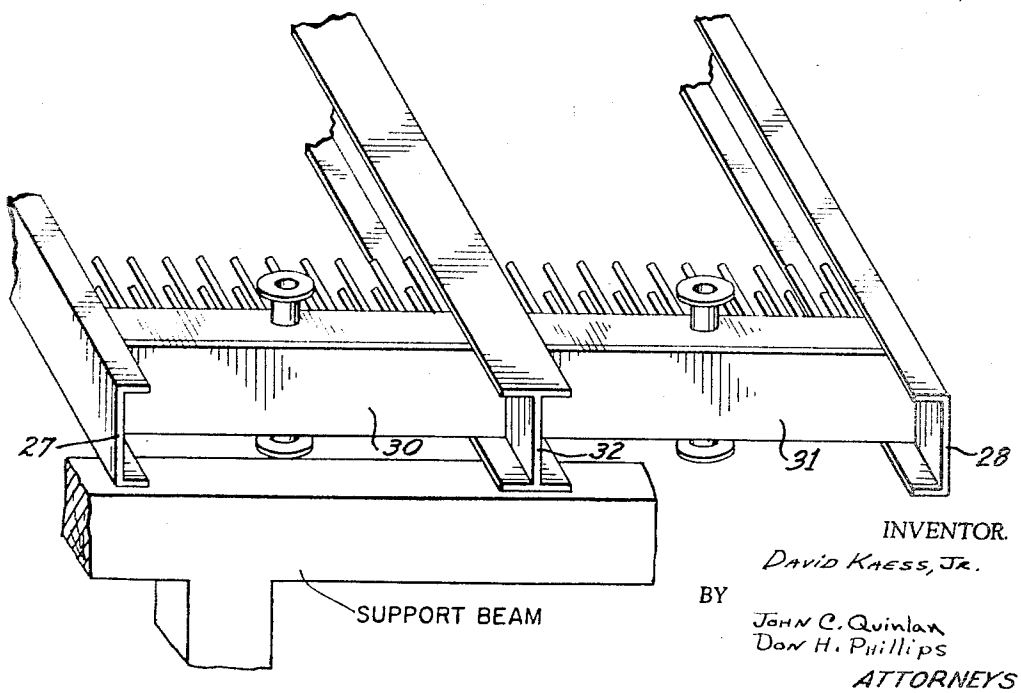


FIG. 2



INVENTOR.
DAVID KAESS, JR.

BY
JOHN C. QUINLAN
DON H. PHILLIPS
ATTORNEYS

United States Patent Office 3,447,598
Patented June 3, 1969

3,447,598

AIR COOLED HEAT EXCHANGER

David Kaess, Jr., Valhalla, N.Y., assignor to Pullman Incorporated, Chicago, Ill., a corporation of Delaware

Filed May 12, 1967, Ser. No. 637,948
Int. Cl. F28f 9/02, 9/00
U.S. Cl. 165—67 5 Claims

ABSTRACT OF THE DISCLOSURE

An air cooled heat exchanger consisting of a tube bundle, header boxes and tube supports, the tube bundle being supported by members extending laterally of the bundle and beyond the header boxes.

This invention relates to heat exchangers. More specifically, this invention relates to air cooled heat exchangers, that is, heat exchangers in which air is forced or induced to flow across a bundle of tubes and, in doing so, cools the process material flowing within the tubes.

Air cooled heat exchangers consist principally of a horizontal section containing a bundle or bank of heat exchanger tubes across which air is forced or induced to flow. Such exchangers find wide usage particularly in areas having limited supplies of cooling water and are provided in a wide assortment of sizes and capacities. In recent years, as plant capacities have been steadily increasing, larger and larger air cooled heat exchangers have been designed and fabricated.

All air cooled heat exchangers generally have the same basic design. They consist of a tube bundle made up of tubes and header boxes, the tubes being supported at various points along their length by tube supports with the bundle being supported laterally by structural members such as channels. One such structural member is supplied on each side of the tube bundle, the structural member being disposed parallel to the tubes. The exchanger is mounted on structural support members, or legs. The plenum chamber, a fan ring, a fan with drive assembly and miscellaneous accessories are generally supported from the legs or hung from the structural channel frame. The tube bundle support members are frequently made strong enough to support the header piping through which that material to be cooled is introduced into the tubes of the exchanger. When integrated with other structural steel supports or piping supports of present day plants, such supporting structure is often found to be unsuited or unadaptable to more economical methods of equipment support.

Accordingly, it is an object of this invention to provide an air-cooled heat exchanger of improved design.

It is another object of this invention to provide an exchanger having a simplified support.

It is a further object of this invention to provide an air-cooled heat exchanger with structural supports which simplify integration of the heat exchanger into modern plants.

It is also an object of this invention to provide an air cooled exchanger of such construction as to be relieved of major pipe support loads and forces induced by the weight or thermal expansion of its attached header piping.

In general, air cooled heat exchangers comprise a number of heat exchanger tubes interconnecting two header boxes. The heat exchanger tubes are generally arranged in rows so as to form, in cross section, a rectangular configuration having a greater width than depth. Tube bundles are laid out in rectangular configuration, the tubes generally in triangular pitch, although a layout having a rectangular pitch may be employed. At various points along the length of the tubes, tube support plates

are employed. These plates support the tubes in a longitudinal direction and minimize tube sagging. The portion of the cooler consisting of header boxes, tubes and tube support plates is known as the tube bundle, and is supported by side members, generally of structural steel of a channel-like configuration, which run the length of the unit, that is, from one header box to the other header box on the opposite end of the tube bundle. Tube bundles are generally designed to be rigid and self-supporting with a minimum of tube sag.

The tubes of such heat exchangers may be of any size and material, tubes of one inch outside diameter being most commonly used. The tubes may have a smooth exterior surface or may be finned. Tubes of any one unit are all of the same length, lengths up to thirty feet being common. Bundle widths are generally between four and eight feet and bundle depths may vary up to thirty rows of tubes. Individual bundles may also be stacked to operate as individual units or as separate passes of the same unit.

The header box consists of a tube sheet, generally rectangular, with sides extending therefrom at right angles to form a box-like enclosure which is closed by a cover plate. Holes are drilled in the tube sheet to receive the tubes which are roller expanded or seal welded therein. The cover plate may be either of the bolted on, removable type, or may be welded to the side members.

A tube bundle may have either one or two header boxes. If the unit is of U-type configuration, a single header box is supplied, it being partitioned into inlet and outlet sections. If the unit is of single or multi-pass design, a separate header box is supplied on each end of the tube bundle.

The header box or boxes are provided with a conduit communicating with the inside of the boxes for introducing the material to be cooled into the tubes, and for removing such material from the bundle thereafter. These are generally flange-type connections and are interconnected to the manifold supplying the medium to be cooled to the exchanger.

At various points along the tube bundle there are provided tube support plates which minimize longitudinal sag of the tubes. These tubes support plates comprise a relatively stiff plate drilled with tube holes in a configuration similar to that of the tube sheet of the header boxes. The tubes pass through these holes, fitting snugly therein with the result that the support plates tend to tie the tubes together into a unitized bundle and thereby minimize tube sagging, The exterior dimension of the tube supports are generally the same as those of the exterior of the header box or boxes.

The side supports which contribute strength and support to the longitudinal axis of the bundle generally are structural members such as channels, I-beams or wide flange beams having a depth between flanges just sufficient to accommodate the header boxes and tube support plates. Channels are most frequently used, one on each side of the bundle, positioned with their flange in a horizontal plane and the long axis in the vertical plane. Fixed to the header box at one end, they provide parallel lateral surfaces on which the tube supports and header boxes rest and are supported and on which the bundle is enabled to slide during periods of thermal expansion. As is conventional within the industry, these side support members extend from one header box to the header box on the opposite end of the bundle. In those instances where a single header box is employed, the side support members extend from that header box to a point sufficient to provide support surfaces for the most distant tube support at the opposite end of the bundle.

In forced-draft exchangers, air is pushed across the tube surfaces and the fan and plenum chamber are lo-

cated beneath the tube bundle. In the induced draft unit, air is pulled across the tube surfaces and the fan and plenum chamber are located above the tube bundle. In either instance, it is customary to support the tube bundle at some distance above the ground in order to provide unrestricted flow of air up into the unit and across the tube surfaces.

Generally, this is accomplished by supporting the unit by vertical support members, or legs, extending from grade, and interconnecting with the lateral supports of the tube bundle at or near the header boxes. Usually, four such supports are provided for each tube bank and these are designed to support only the weight of the unit itself in addition to some slight additional load imposed by the piping to the exchanger. However, when a large number of units are operated in parallel service, the inlet piping manifold to the units is of considerable size, being frequently fifty or more inches in diameter and it becomes impractical to design these support legs to carry the piping load and separate pipe supports for the piping is provided. Separate pipe supports for the piping are also frequently necessitated by the thermal stresses established within the interconnected piping itself. Also, it frequently happens that due to the manifolding required, piping loads are often located a considerable distance above grade and the supports provided for the air cooled heat exchanger are inadequate under these conditions. Accordingly, it is not unusual to find in present day industrial installations a long row of air cooled heat exchangers supported on vertical support members and, running parallel thereto, a long row of pipe supports adapted to carry the interconnected piping. Such construction is unnecessarily expensive when, in accordance with this invention, an exchanger is provided which is capable of being supported without the use of separate legs and which may be supported from the same pipe supports as are employed for the support of the piping interconnected with the heat exchanger.

According to this invention there is provided an improvement in air cooled heat exchanger having a tube bundle, header boxes, and means for passing air over the bundle, the improvement comprising members lateral of the tube bundle and extending beyond the header boxes to provide support for the exchanger in a horizontal plane.

FIGURE 1 is an isometric view of an air cooled heat exchanger showing one embodiment of the invention.

FIGURE 2 is an isometric view of a plurality of air cooled heat exchangers employing a common support as another embodiment of this invention.

In FIGURE 1, tubes **11**, which may be smooth surface or finned, extend between header boxes **12** and are supported at intermediate points along their length by tube supports **13**. Header boxes **12** are closed by cover plates **14** and are equipped with inlet nozzle **15** and outlet nozzle **16**, the exchanger depicted being a two pass unit in which entrance and exit of the medium being cooled is made in the same header box, the header box being divided into two sections by an internal baffle plate, not shown. Side channels **17** and **18**, positioned on opposite sides of the tube bundle, run the entire length of the bundle and extend beyond cover plates **14** at both ends of the exchanger by a length sufficient to rest on supports. Plenum chamber **19** and fan ring **20** enclosing a fan, not shown, extend downward from the tube bundle being supported from side channels **17** and **18**.

Side channels **17** and **18**, positioned on opposite sides of the tube bundle, are sufficiently deep to encompass the depth of the header boxes **12** and tube supports **13**. Any means of fastening the side channels to one of the header boxes may be used. It is important that provision be made to permit longitudinal movement of the tube bundle and accordingly, fastening of the tube bundle to the side channels is preferably made only at one point along the length of the exchanger. By doing so, the bundle is allowed to slide along the flanges of the side channels when expanding. Similarly, side channels are so located as to permit side movement of the bundle caused by thermal expansion of the pipe header attached to the nozzle of the exchanger.

As shown in FIGURE 2, exchangers **30** and **31** are supported adjacent to each other, the supports consisting of a combination of channels and an I-beam.

Side channels **27** and **28** are positioned on opposite sides of two adjacent tube bundles **30** and **31**. A common I-beam **32** is employed to support the adjacent sides of the tube bundles **30** and **31**, encompassing the depth of the header boxes and tube supports. All supporting structural members extend beyond the header boxes of the exchanges at both ends of the exchanger by a length sufficient to rest on supports.

It is seen from the above description that with the lateral support members of adequate size and strength, the unit may be mounted with the lateral support members resting on vertical supports, the heat exchanger spanning the distance between supports. In this manner, the structural steel supports normally with the heat exchanger and supporting the unit at or near the header boxes are eliminated and the construction of the heat exchanger simplified. Separate columns or supports can then be used be used to support the lines to and from the exchanger and a single set of supports can then be employed for heat exchanger pipelines and headers to and from the exchanger.

It will be understood that the supporting members, either those sections used for lateral supports or those sections extending beyond the header boxes, need not be limited to channels as described in the above embodiment, but that any structural shape or combination of structural shapes can be used. For example, the side channels can be terminated at any point along their length and another structural shape affixed thereto by any means, the latter then being extended beyond the header box to act as support. It is only necessary that the structural member provided be of sufficient size and strength to rigidly support the exchanger along its length and at its ends when the exchanger spans the intervening distance between supports.

It will be obvious to those skilled in the art that variations can be made to the embodiments discussed herein. Accordingly, all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, I claim:

1. In an air cooled heat exchanger having a horizontal tube bundle, one or more header boxes and means for passing air across the tube bundle, the improvement which comprises lateral support members in longitudinal contact with vertical sides of said bundle, said members extending to vertical supports located sufficiently beyond the ends of said tube bundle to permit said vertical supports to support loads additional to the load imposed by said heat exchanger.

2. The heat exchanger defined in claim **1** in which said members comprise flanged structural shaped members, the sides of the tube bundle being encompassed between the flanges of said members.

3. The heat exchanger defined in claim **2** in which said members comprise a channel-shaped member.

4. The heat exchanger defined in claim **2** in which said members comprise an I-shaped member.

5. In a plurality of air cooled heat exchangers having horizontal tube bundles, one or more header boxes and means for passing air across the tube bundles, said bundles being adjacently positioned in spaced relationship, the improvement which comprises at least one lateral support member encompassing adjacent sides of adjacent bundles and at least one lateral support member encompassing each of the outer sides of the adjacent bundles, said members extending longitudinally of said bundles along the vertical sides of said bundles, said members extending to ver-

tical supports located sufficiently beyond the ends of said tube bundles to permit said vertical supports to support loads additional to the load imposed by said heat exchanger.

References Cited

UNITED STATES PATENTS

1,825,656	10/1931	Derry	165—1
2,743,088	4/1956	Bach	165—122
2,615,687	10/1952	Simmons	165—78
2,729,433	1/1956	Berg	165—78 X

2,843,367	7/1958	Bogus et al.	165—78

OTHER REFERENCES

Elonka: Air Cooled Heat Exchangers, in Power, p. 180, November 1964.

ROBERT A. O'LEARY, *Primary Examiner.*

A. W. DAVIS, *Primary Examiner.*

U.S. Cl. X.R.

165—78, 82, 122