Sept. 20, 1971 R. L. NALBONE 3,605,883

HEAT EXCHANGER

Filed April 25, 1969

Fig. 1.

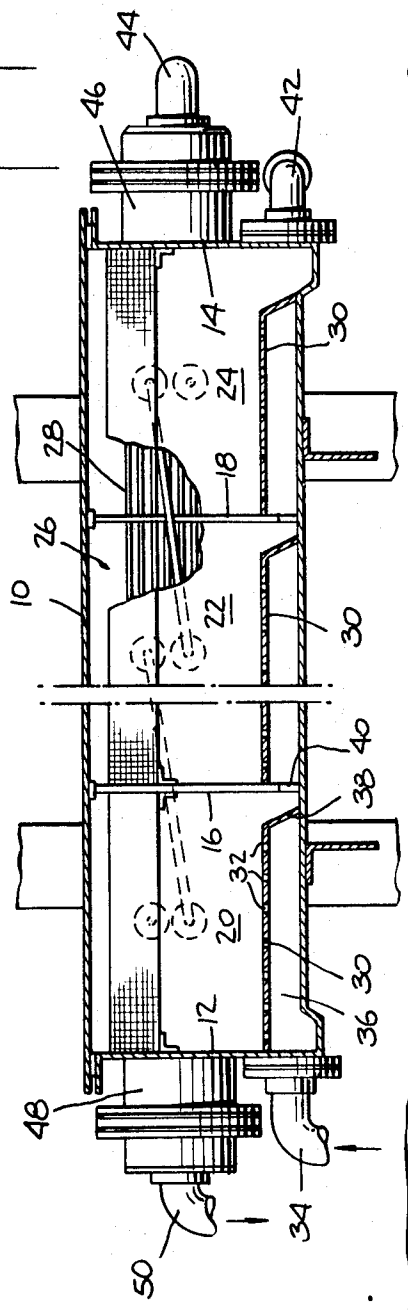


Fig. 2.

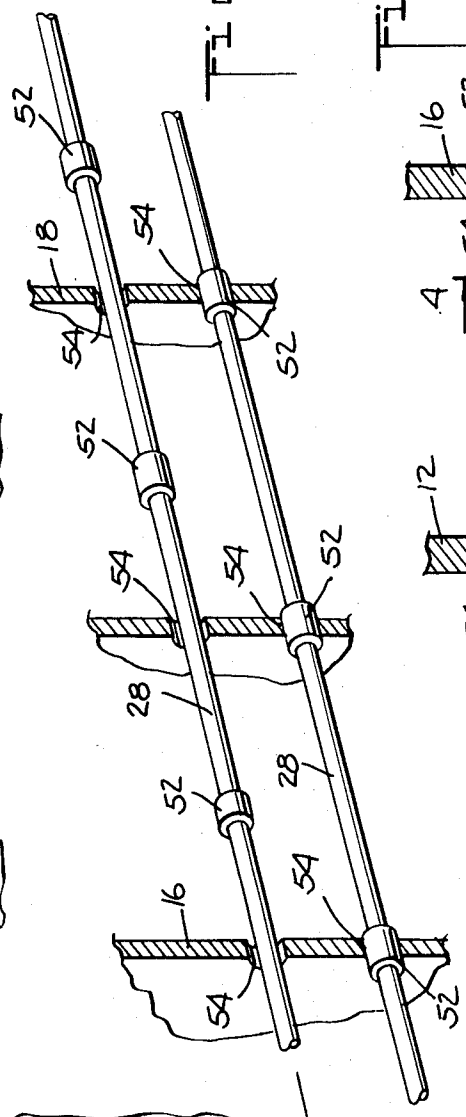


Fig. 3.

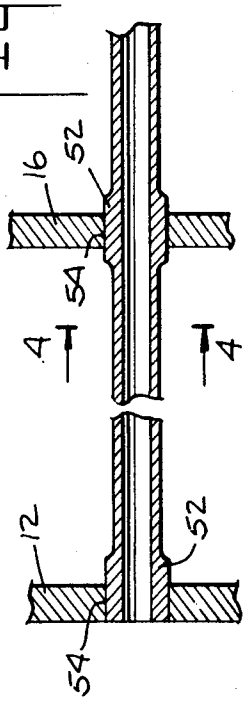
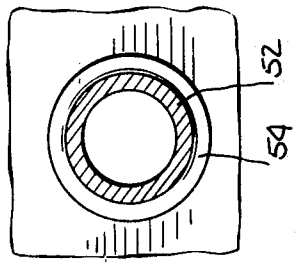


Fig. 4.



INVENTOR.
ROBERT LOUIS NALBONE
BY
Wood, McClenon, Brooks & Fitzpatrick
ATTORNEYS

United States Patent Office 3,605,883 Patented Sept. 20, 1971

3,605,883

HEAT EXCHANGER

Robert Louis Nalbone, Westwood, N.J., assignor to Saline Water Conversion Corporation, Oradell, N.J.

Filed Apr. 25, 1969, Ser. No. 819,169
Int. Cl. F28f 9/14
U.S. Cl. 165—178 1 Claim

ABSTRACT OF THE DISCLOSURE

A heat exchanger having a tube configuration with a uniform inside diameter and periodically placed thickened sections which serve to eliminate the requirement of sealing devices between tubes and the divider plates of a multistage evaporator, thereby serving as a seal between adjacent stages.

This invention relates to heat exchangers and more particularly to a heat exchanger tube configuration. Heat exchanger tubing constructed according to the concept of this invention is useful in substantially all kinds of tube type heat exchangers.

While heat exchangers having many different types of tube configurations have been successfully used heretofore, my contribution to the art is a new and improved heat exchanger which is a substantial improvement over such prior art.

Conventionally, prior art heat exchangers employed tubing having substantially constant outside diameter, and each tube was inserted from one end of the heat exchanger through apertures in the partitions and tube sheets. In order to effect an almost leak-proof joint, which is desirable between the tubing and the partition, a very close fit is required which may be of the order of about .001 inch total clearance, for example. Accordingly, assembly of these tubes was a tedious and time-consuming operation because there are hundreds or even thousands of tubes that must be so inserted. In addition, if alignment between adjacent partitions was not just right, the friction increased substantially, thereby slowing down the longitudinal progress. An object of this invention is to provide a heat exchanger which may be fabricated in a substantially shorter period of time than in prior art such devices.

In another form, prior art heat exchangers were provide with tubes having enlarged cylindrical portions. The segment of the tubes between the enlarged portions were corrugated and of a reduced diameter for purposes of producing turbulence in the fluid moving therethrough for heat transferring purposes. However, such a tubing structure employed a constant tube wall thickness, and hence had sections of reduced internal diameter. The pressure drop loss in the fluid flowing through the tube was apt to be substantial, and it is, therefore, one of the objects of this invention to overcome this disadvantage found in the prior art structures.

Briefly, my invention contemplates the provision of a new and improved heat exchanger having a tube bundle construction which includes a large number of straight tubes arranged to pass through apertures in chamber partitions in the heat exchanger. It will be appreciated that each of the tubes has longitudinally spaced enlarged portions extending through the apertures in close-fitting engagement. In addition, each of the tubes has a substantially uniform inside diameter throughout the length thereof.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to

the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter which will form the subject of the claim appended hereto. Those skilled in the art will appreciate that the conception on which this disclosure is based may readily be utilized as the basis for the design of other structures for carrying out the several purposes of the invention. It is important, therefore, that this disclosure be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

One embodiment of the invention, in the form of a multistage flash evaporator, has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a vertical, longitudinal sectional view of a heat exchanger constructed in accordance with the concept of this invention;

FIG. 2 is an enlarged perspective view of heat exchanger tubes and their relationship with respect to partition or divider plates;

FIG. 3 is an enlarged, fragmentary, longitudinal, sectional view showing details of the relationship between the heat exchanger tube and the divider plates; and

FIG. 4 is an enlarged sectional view taken along the line indicated at 4—4 of FIG. 3.

Referring to the drawings in greater detail, an evaporator casing **10** is provided with end walls or headers **12** and **14** which together with a pair of divider plates or partitions **16** and **18** divide the casing into three separate chambers **20**, **22** and **24**. A tube bundle indicated generally at **26** consisting of a relatively large number of straight tubes **28** passes linearly through each of the chambers **20**, **22** and **24**. That is, each of these tubes extends without a bend from one header **12** to the other header **14**. This may be a distance of the order of about 85 feet, for example. It will be appreciated that with this tube arrangement, the pumping force required to circulate the relatively cool feed water through the tubes is low.

A plate **30** extends horizontally above and spaced from the bottom of each chamber. This plate has a number of orifices **32**, and flashing or vaporization of the fluid takes place on the upper side thereof. Heated feed water is introduced from an inlet **34** into a space **36**, and due to the weir **38** passes through the flash plate **30** into the chamber **20**. Thence, the water flows over the plates and through an opening **40** into the space beneath the plate in the chamber **22**. The same action is repeated in this chamber before the water flows through an orifice into the chamber **24**. After repeating the action in chamber **24**, the water passes out of the exit passage **42**, provided for the purpose.

At the same time relatively cool feed water enters the tube bundle **26** by means of a conduit **44** and a manifold **46**, and passes in the tubes **28** through the chambers **24**, **22** and **20** to a manifold **48** at the other end of the casing, and thence into a conduit **50**. In operation, water vapor condenses on the tubes and drops to the bottom of the chambers **20**, **22** and **24** below the tube bundle and separated from the spaces **36**, as by means of a vertical longitudinal plate and demister, not shown, the distillate being collected and discharged through an outlet, not shown, in a conventional manner. Also, in a conventional manner, a vacuum pump, not shown, serves to remove the non-condensable gases.

Sealing means are provided between each of the tubes **28** in the tube bundles and the headers **12** and **14** and the partition plates **16** and **18**, in order to maintain a pressure differential between the chambers. As best seen in FIGS. 2–4, the tubes **28** are drawn down to a desired outside diameter in such a manner as to retain spaced enlarged portions **52** extending through the aperture **54** in the par-

titions **16** and **18** and in the tube sheets **12** and **14** in close fitting engagement therewith. Preferably, the total diametrical clearance between the enlarged portions **52** and the apertures **54** is of the order of about .001 inch. Because only a small portion of the tube is enlarged, and the narrow portions pass freely through the partitions, as best seen in FIG. 2, the time for assembling the tubes in the partitions is about 25% of the time required with prior art tubes of constant outside diameter. In addition, it will be appreciated that the inside diameter of the tubes is constant throughout the length of the tube, thereby minimizing the pressure drop loss in the fluid flowing therethrough.

It will thus be seen that the present invention does indeed provide an improved heat exchange tube configuration which is superior in simplicity, economy and efficiency as compared to prior art such tubes.

Although a particular embodiment of the invention is herein disclosed for purposes of explanation, various modifications thereof, after study of the specification, will be apparent to those skilled in the art to which the invention pertains.

What is claimed and desired to be secured by Letters Patent is:

1. A heat exchanger for flash evaporators comprising a casing having a fluid inlet at one end and a fluid outlet at the other end thereof,

a tube sheet mounted at each end of said casing,

a plurality of spaced partitions mounted in said casing to divide said heat exchanger into a plurality of chambers having pressure differentials therebetween, means for passing said fluid from one chamber to the next adjacent chamber,

a plurality of parallelly disposed tubes extending from the tube sheet at one end of the casing to the tube sheet at the other end thereof and passing through apertures in said partitions and in said tube sheets, inlet means for a second fluid to enter said tubes adjacent said other end of the casing and outlet means for said second fluid to leave said tubes at said one end of the casing,

the inside diameter of said tubing being substantially uniform throughout the length of the tubing including the portion passing through said tube sheets,

said tube having longitudinally spaced enlarged thickened-walled portions of the same material as said tubing, said enlarged thickened-wall portions extending through said apertures in sealing engagement to form a substantially leakproof connection with said tube sheets and said partitions.

References Cited

UNITED STATES PATENTS

1,704,097	3/1929	Muhleisen	165—162X
2,139,367	12/1938	Kearney	122—510X
2,241,209	5/1941	Lea	122—510X
3,045,981	7/1962	Hendrickson	165—82
2,779,316	1/1957	Meigs et al.	122—510

FREDERICK L. MATTESON, Primary Examiner

T. W. STREULE, Assistant Examiner

U.S. Cl. X.R.

202—173