Sept. 6, 1966 P. E. STEADMAN 3,270,807

HEAT EXCHANGER HAVING DISTRIBUTION TUBE INTERNAL FLOW DIRECTORS

Filed May 1, 1964

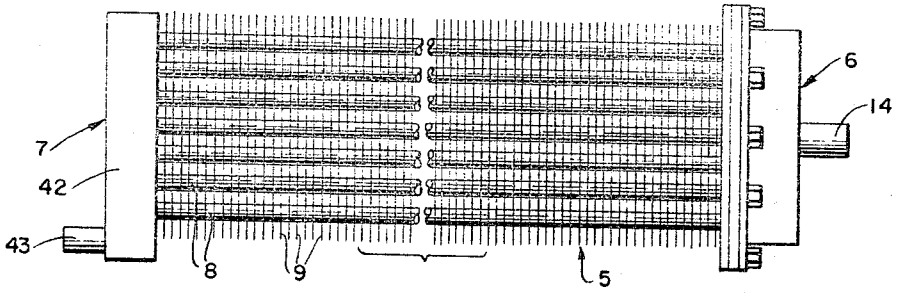


FIG. 1.

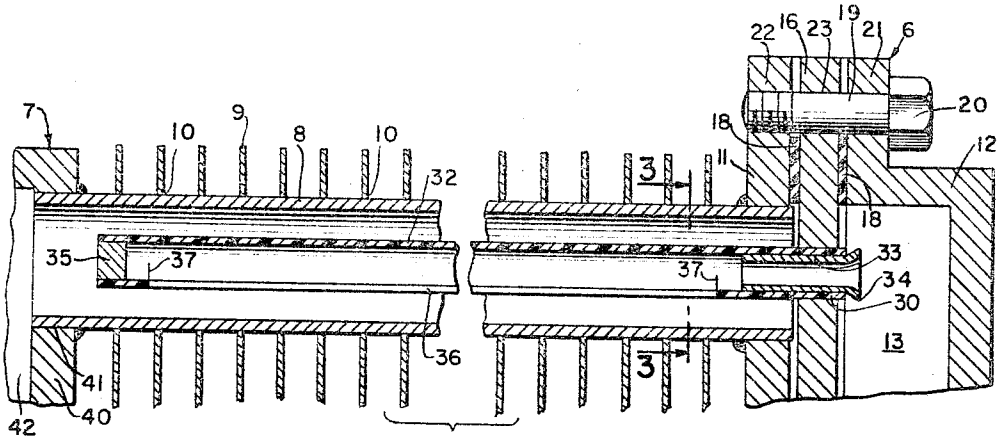


FIG. 2.

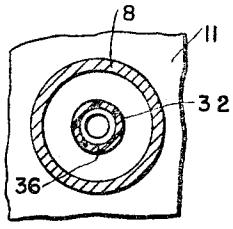


FIG. 3.

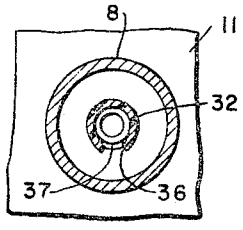


FIG. 4.

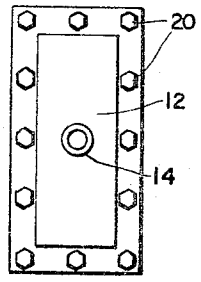


FIG. 5.

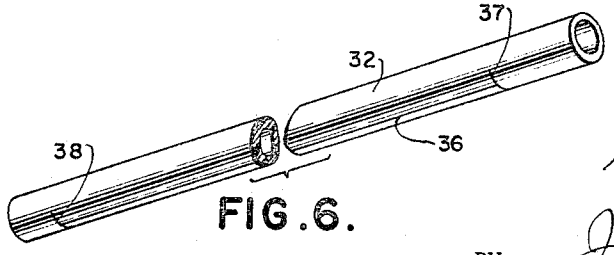


FIG. 6.

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United States Patent Office 3,270,807 Patented Sept. 6, 1966

3,270,807

HEAT EXCHANGER HAVING DISTRIBUTION TUBE INTERNAL FLOW DIRECTORS

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Filed May 1, 1964, Ser. No. 364,144
7 Claims. (Cl. 165—174)

The present invention relates to improvements in heat exchangers, and more particularly to a heat exchanger having opposed headers connected by conduction tubes on which is supported a bank of heat dissipating fins and in which the heating medium is distributed throughout the entire length of said tubes by means of a longitudinally extending distribution tube.

One object is to provide a heat exchanger in which the heating or cooling medium is uniformly distributed throughout the entire length of the conduction tubes by employing a distribution tube extending from one header to the other and concentric with relation to the conduction tubes so that the heating or cooling medium may be distributed through a longitudinally extending slot in said distribution tube.

Another object is to provide a heat exchanger including spaced headers having horizontal conduction tubes, one end of each tube being carried by a header plate and sealed from the header compartment by means of a secondary header plate which supports the distribution tubes so that the heating medium will be distributed through the conduction tube by a flexible distribution tube sealed from the conduction tube by suitable gaskets.

Another object is to provide a heat exchanger as set forth in which the distribution tubes are formed of semi-rigid or flexible material so that the pressure head of the cooling or heating medium will expand the same and force the longitudinal slot in the distribution tube to be opened and thus discharge the heating or cooling medium uniformly along the entire length of the conduction tubes.

Another object is to provide a distribution tube supported concentrically within the conduction tubes of the heat exchanger which is formed of a synthetic plastic composition such as Teflon, nylon or similar polyvinyl derivative which will not be affected by extremely high or low temperatures of the heating and cooling medium distributed through the conduction tubes of the heat exchanger.

Another object is to provide a heat exchanger as set forth in which the plastic distribution tubes are anchored in place in the secondary header plate by means of a wedge-shaped tubular member having a flared outer end to securely grip and lock the supported end of the distribution tube in place.

Other objects and advantages of the invention will become apparent during the course of the following description of the accompanying drawing wherein:

FIGURE 1 is a side elevational view of one type of heat exchanger unit embodying the present invention.

FIGURE 2 is an enlarged longiutdinal fragmentary cross-sectional view illustrating the manner in which the distribution tubes are supported in the conduction tubes of the heat exchanger and the manner in which the header at one end of the heat exchanger is sealed from the conduction tubes so that the heating medium will pass through the distribution tubes and be uniformly distributed in the heat exchanger tubes.

FIGURE 3 is a vertical cross-sectional view taken on line 3—3 of FIGURE 2 and looking in the direction of the arrows illustrating the manner in which the plastic distribution tube is anchored in place by means of a tubular nipple.

FIGURE 4 is a vertical cross-sectional view similar to FIGURE 3, but showing the distribution slot therein

opened or separated by the pressure head of the cooling or heating medium.

FIGURE 5 is an end elevational view of the header casing of the heat exchanging unit, and

FIGURE 6 is a perspective view, partly broken away, of the flexible plastic distribution tube illustrating the longitudinal dispensing slot extending from spaced circumferential slots adjacent the ends of the tube.

In the drawing, and more in detail, attention is directed to FIGURE 1 wherein the reference character **5** will generally be employed to designate a heat exchanger unit having a header casing generally designated **6** and a discharge header casing generally designated **7**. The headers **6** and **7** are connected by conduction tubes **8** on which is mounted a plurality of heat dissipating fins **9** arranged in the form of a bank with the heat dissipating fins **9** arranged in spaced apart relation. The fins **9** are each provided with openings through which the heat conducting tubes **8** extend, and said fins are soldered or otherwise secured in place as at **10** (FIG. 2).

The header **6** is formed of a header plate **11** which is provided with a series of openings for receiving the ends of the conduction tubes **8**, and said ends are secured in place in any approved manner as by welding or brazing or the like. The header **6** also includes a casing **12** shaped to form a chamber **13** and attached to said casing section **12** is a pipe section **14** for the admission of the heating or cooling medium to the header chamber **13**.

A secondary header plate **16** is secured in place against the header plate **11** and suitable sealing gaskets **18** are arranged on opposite sides of the secondary header plate **16** to seal off the header chamber **13** from the interior of the conduction tubes **8**. Machine screws **19** having heads **20** are inserted through openings in the flange **21** of the header casing **12** and correspondingly aligned openings **22** and **23** in the header plates **11** and **16** to secure the parts together in sealed clamping relationship. The machine screw **23** has its threaded end received in corresponding threads in the opening **22**.

Formed in the secondary header plate **16** is a series of openings **30** of a diameter considerably smaller than the diameter of the conduction tubes **8**, and said openings **30** are of a diameter equal to substantially one-third the diameter of said tubes. The openings **30** are bored or drilled in alignment with the axis of the tubes **8** and the secondary header plate **16** is provided with as many openings or bores **30** as there are tubes **8** with one opening in registry with each of the conducting tubes **8**. The sealing gaskets **18** can be formed of a synthetic plastic composition or synthetic rubber composition such as neoprene.

Mounted in each of the openings **30** is a plastic distribution tube **32** which is of a length substantially equal to the length of the conduction tubes **8**, and said plastic distribution tube **32** is secured in the bore **30** of the secondary header plate **16** by means of a tubular nipple **33** having an outwardly flared and tapered end portion **34** to frictionally grip the plastic tube **32** when the same is driven home and forced into position as shown in FIGURE 2. With the plastic tubes **32** in place as shown in FIGURE 2 communication between the header chamber **13** and the interior of the tubes **32** is established while the chamber is blocked from the ends of the conduction tubes **8**.

Each of the plastic distribution tubes is provided at its free end with a plug **35** formed of metal or plastic material and each of the distribution tubes **32** is provided on its underside with an elongated slot **36** in the form of a slit which extends from short circumferential slots or slits **37** and **38** adjacent the ends of the plastic distribution tubes **32**.

The plastic distribution tubes **32** are formed of a synthetic plastic material such as compositions of various

phenols and resins including cellulose acetate, cellulose butyrate, cellulose nitrate, ethyl cellulose, polyvinyl chloride and any of the lower alkyl alcohols such as methyl, ethyl, propyl, butyl or amyl alcohol. The plastic material can be of different wall thickness, but of a character in which the lips of the slot or slit **36** will separate as shown in FIGURE 4 under pressure head of the heating and cooling medium to discharge the same uniformly throughout the entire length of the conduction tubes **8**. It has been proposed to employ such plastic materials as Teflon (polytetrafluorinated ethylene resin composition). Teflon possesses characteristics which produce the most efficient results and when the distribution tube **32** is formed of such material the lips **36** of the elongated slot between the circumferential slots **37** are flexed to permit the discharge of the heating or cooling medium in a uniform manner throughout the length of the conduction tubes **8**. It is to be pointed out that the slot or slit **36** which intersects the circumferential slits **37** and **38** forms flexible lips on the marginal edges of said slit which separate slightly as shown in FIGURE 4 and form a restricted longitudinal passage for the heating or cooling medium.

It is to be noted, that the conduction tubes **8** are supported by the header plate **11**, while the distribution tubes **32** are supported by the secondary header plate **16**.

Thus, the distribution tubes **32** are maintained in a centered position concentric with the conduction tubes **8** and are secured in place by the tubular expanding members **33**.

The header **7** is of conventional construction and includes a header plate **40** having a series of openings **41** for receiving the other ends of the conduction tubes **8**, and the header plate **40** may be formed integral with or connected to a casing **42** having a discharge pipe **43**.

In operation the inlet pipe **14** is connected to a heating or cooling medium source so that the same will enter the chamber **13** and pass through the expanding tubes **33** and to the full length of the distribution tubes **32**. If the heating medium is steam the pressure will separate the lips of the slit **36** and permit the steam to be directed downwardly within the conduction tubes **8** in a longitudinal jet extending substantially the entire length of the conduction tubes **8**. If the cooling medium is a vapor or gas the pressure will similarly separate the lips of the slit **36** and permit the same to be directed downwardly in a longitudinal jet toward the lower portion of the conduction tube **8** and thus uniformly distribute the vapor or gas throughout the induction tubes **8**. The heating or cooling medium is discharged from the conduction tubes **8** through the chamber **42** and the discharge pipe **43**. It being understood that the inlet and discharge pipes **14** and **43** are included in a pipe system in circuit with a source of a suitable heating or cooling medium such as a steam generator or refrigeration unit.

In certain heating and cooling installations the header casing **12** can be detached from the header plate **11** and the secondary header plate **16** sandwiched therebetween so that the distribution tubes **32** project longitudinally into the conduction tubes **8** of the heat exchanger unit. Thus, assemblies can be constructed and suppiled for use in connection with certain types of heat exchangers to convert the same and provide an anti-stratifying system.

Where the heat exchanger includes a flanged header plate **11** and a flanged header casing **12** separably connected thereto by fastener elements **19** the secondary or auxiliary header plate **16** can be installed by simply removing the fastener elements and the header casing **12** and sandwiching the auxiliary header plate **16** in position therebetween and inserting the fastening elements to clampingly engage the packing or gasket elements **18** therebetween.

Should it be desired to remove the distribution tubes **32** for the purpose of repair, the tapered nipples **33** can be displaced and new distribution tubes installed.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment thereof, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

What I claim is:

1. In a heat exchanger, a supply header and a condensate header arranged in spaced relation, heat conduction tubes extending between said headers, a header plate in said supply header having a series of openings aligned with said heat conduction tubes, said header plate being arranged in sealing engagement with said heat conduction tubes, and synthetic plastic distribution tubes each having one end mounted in said openings and provided with discharge passages to supply said heat conduction tubes uniformly throughout their length upon expansion of said synthetic plastic tubes.

2. In a heat exchanger, supply and condensate headers arranged in spaced relation, heat conduction tubes extending between said members, a header plate in said supply header having a series of restricted openings in alignment with the heat conduction tubes, and synthetic plastic distribution tubes each with one end supported in said openings and the opposite end of each of said tubes extending toward said condensate header, said plastic tubes each being provided with an elongated slot to discharge a heat conducting medium from said supply header upon expansion of said plastic distribution tubes.

3. In a heat exchanger, supply chamber and condensate headers arranged in spaced relation, heat conduction tubes extending between said headers, heat conducting fins on said tubes, a series of plastic tubes each having one end closed with said closed end projecting into said conducting tubes with their open ends in communication with said supply chamber, and sealing means for sealing the supply chamber with respect to said conducting tubes, said plastic distributing tubes being provided with elongated discharge openings which are separated upon expansion of said distribution tubes.

4. In a heat exchanger, supply and condensate headers arranged in spaced relation, heat conduction tubes extending between said headers, heat conducting fins on said tubes, a header plate in said supply header having a series of openings of a diameter smaller than the diameter of said heat conduction tubes and in alignment with said heat conduction tubes, sealing members for said header plate to seal communication between said supply header and heat conduction tubes, distributing tubes formed of synthetic plastic material having one end closed and the other end supported in the openings in said header plate and fastener elements inserted in the ends of the plastic tubes to expand the same into engagement with their corresponding openings in said header plate for securing said distribution tubes in said openings, said distribution tubes being formed of elongate shape to extend the entire length of said heat conduction tubes, and each of said tubes being provided with a downwardly elongated slot forming a discharge opening.

5. In a heat exchanger, supply and condensate headers arranged in spaced relation, heat conduction tubes having radiating fins connecting said headers, a header plate in the supply header having openings aligned with the heat conduction tubes, sealing members interposed between said header plate and said supply header for sealing said header plate between the ends of said conduction tubes and said supply header, elongated synthetic plastic distribution tubes extending into said conduction tubes with their free ends closed and their opposite ends supported in the openings in said header plate, tubular tapered fastener elements inserted in the open ends of said distribution tubes to expand the same for securing said distribution tubes in position in the openings in said header plate, and each of said distribution tubes being provided with an elongated slotted opening terminating at its ends in circumferential slotted openings to form flexible lips, said lips being adapted to separate uniformly along the

length of said elongated slotted openings when the distribution tubes are expanded under the pressure head of the heat exchange medium and uniformly distribute the same throughout the length of said conduction tubes.

6. In a heat exchanger, supply and condensate headers arranged in spaced relation, heat conduction tubes extending between said headers, heat radiating fins supported on said tubes, said supply header being provided with a supply chamber, a header plate having a plurality of openings, said plate being mounted between said supply chamber and conducting tubes, sealing gaskets interposed between said supply chamber and header plate for sealing the adjacent surfaces thereof, elongated synthetic plastic distribution tubes extending the length of said conduction tubes with their inner ends closed and their other ends supported in said openings in said header plate, and a tapered tubular fastening element inserted in each of said synthetic plastic distribution tube at said other end to expand said other end of the plastic distribution tube into frictional engagement with said openings and securely lock each of the same in its corresponding opening in each of said header plate, said elongated synthetic plastic distribution tubes being provided with circumferential slots adjacent the ends thereof connected by a longitudinal slot to form flexible lips on opposite sides of said slot whereby the conduction tubes will be uniformly supplied and the condensate will be discharged therefrom through said condensate header, the slots of said tubes being opened upon expansion thereof.

7. In a heat exchanger having supply and condensate headers, finned conduction tubes connecting said condensate header and said supply header, said supply header including a header plate and a header casing separably connected, an auxiliary header plate mounted between said header plate and said header casing, sealing gaskets positioned between said header casing and said auxiliary header plate as well as said first mentioned header plate for sealing said auxiliary header plate therebetween, said auxiliary header plate being provided with a series of transverse openings of a diameter smaller than the diameter of said heat conduction tubes, elongated synthetic plastic distribution tubes having one end closed and the opposite end supported in said transverse openings in the auxiliary header plate and tapered tubular fastener elements inserted in said opposite end of each distribution tube to expand the same into tight engagement with its corresponding opening and for securing said synthetic plastic tubes in said openings, each of said synthetic plastic distribution tubes being provided with a circumferential slot adjacent the ends thereof connected by a longitudinally extending slot to form flexible lips on opposite sides of said slot whereby the pressure header of the medium supplied by said supply header will separate said lips and permit the medium to be uniformly discharged throughout the length of said conduction tubes and the condensate will flow freely toward said condensate header.

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