April 7, 1953 R. W. DRAKE 2,634,164

HEAT EXCHANGER CLEANING DEVICE

Filed Nov. 15, 1946 2 SHEETS—SHEET 1

FIG. 1

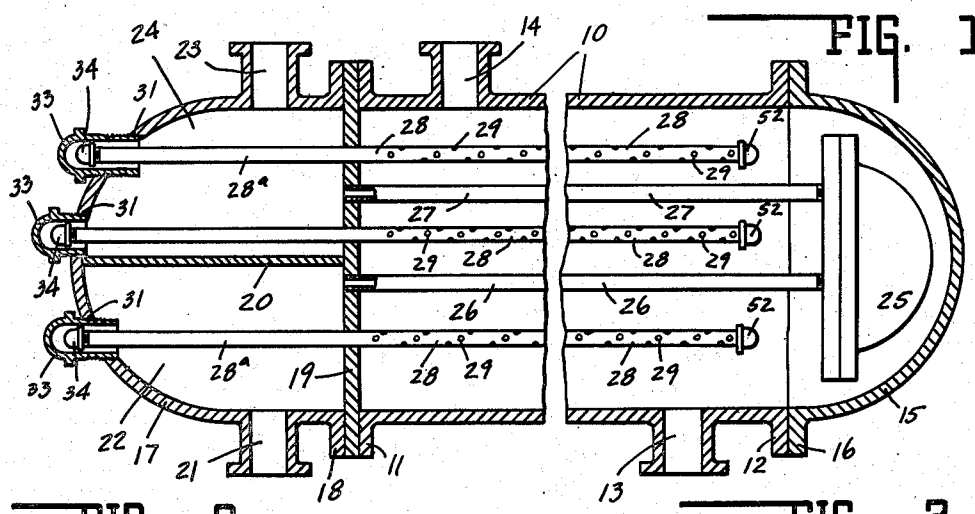


FIG. 2

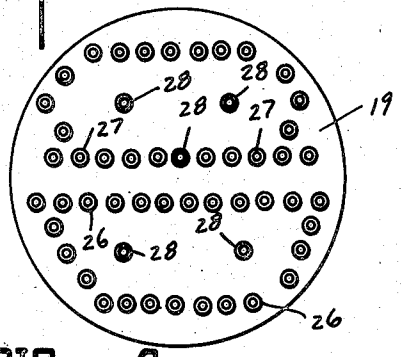


FIG. 3

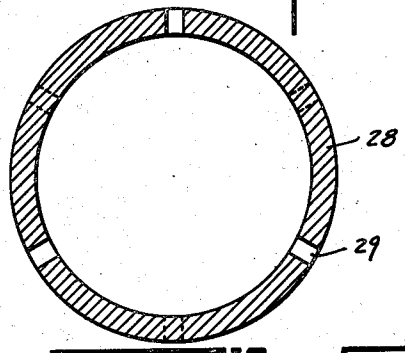


FIG. 4

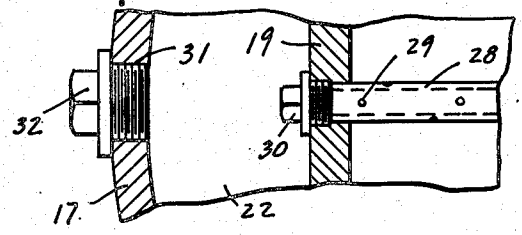


FIG. 5

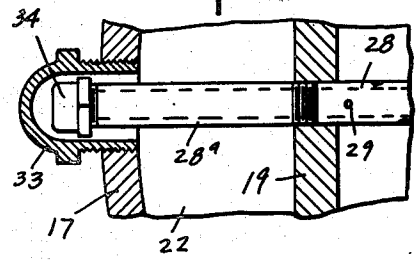
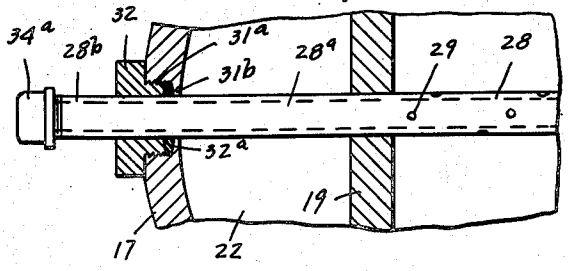


FIG. 6



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HEAT EXCHANGER CLEANING DEVICE

Filed Nov. 15, 1946 2 SHEETS—SHEET 2

FIG. 7

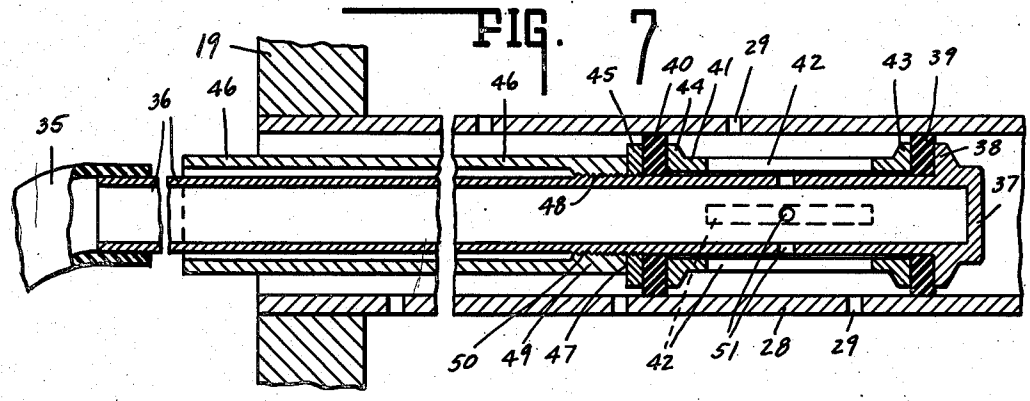


FIG. 8

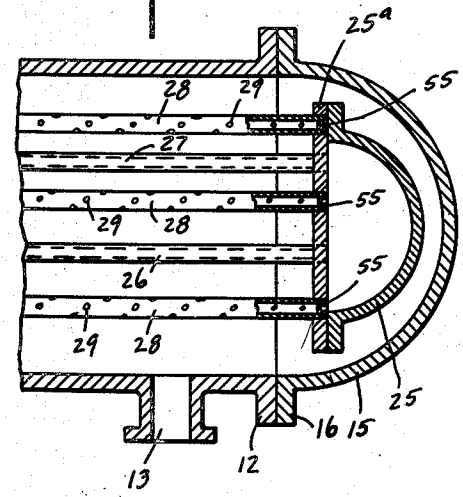


FIG. 9

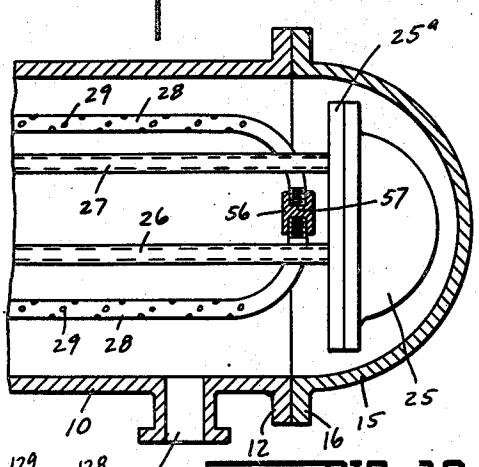


FIG. 11

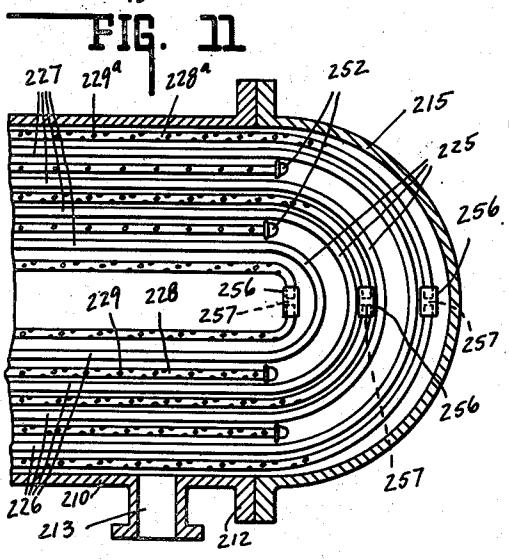
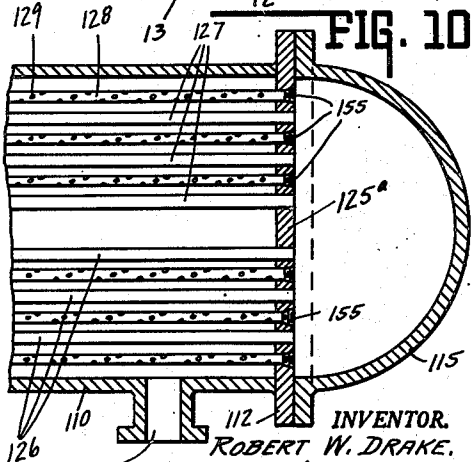


FIG. 10



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HEAT EXCHANGER CLEANING DEVICE

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2 Claims. (Cl. 299—27)

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This invention relates to cleaning of heat exchangers having tubes or tube bundles.

Heat exchangers of this general type may have a few tubes or as many as several hundred, and although such exchangers are used for a great many and variety of materials they all have the same general function.

Ordinarily the product to be cooled is allowed to flow through the tubes and the cooling medium, usually water, is allowed to circulate around the outside of the tubes but within the casing, commonly termed the shell.

Usually units are connected in series, parallel, or series-parallel relation in the requisite number to effect the desired heat transference.

In certain installations where the product to be cooled is unusually hot, scales and sludges accumulate around the outside of tubes upon the shell exposed portions thereof.

The chief object of the present invention is to remove such accumulations through means capable of inclusion in old or new exchangers without necessitating the dismantling for cleaning of such exchangers, which in many instances comprise installations of several tons.

The chief feature of the present invention resides in providing permanently installed chemical spray tubes, entrance to which is readily effected, and when desired associating therewith a localizing chemical supply tube whereby selected sections of the spray tube are pressure supplied with liquid chemical under pressure. The chemical spraying of the exterior of the adjacent heat transfer tubes effects dissolution and separation of such scale and sludge from the heat transfer tube exteriors so that the efficiency thereof is reestablished. The separated sludge and scale deposits in the bottom of the exchanger casing from whence same may be readily removed from the heat exchange unit.

Other objects and features of the invention will be set forth more fully hereinafter.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

In the drawings Fig. 1 is a longitudinal sectional view through one form of heat exchanger unit equipped with one form of the invention.

Fig. 2 is a diagrammatic layout of one arrangement of the conventional tube and the cleaning tube.

Fig. 3 is an enlarged transverse sectional view of a cleaning tube shown in Figs. 1 and 2.

Fig. 4 is a longitudinal sectional view of a modified form of the invention.

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Fig. 5 is a similar view of the same provided with a bridging tube.

Fig. 6 is a similar view of a slightly modified form of the invention shown in Fig. 1.

Fig. 7 is a longitudinal sectional view of a cleaning tube and pressure chemical liquid supplying and localizing structure.

Fig. 8 is a view similar to Fig. 1 and of a modified form of cleaning tube structure and support at the remote end thereof.

Fig. 9 is a similar view of a U-shaped cleaning tube at the U-end thereof.

Fig. 10 is a central sectional view of modified form of the invention wherein the exchanger is of non-floating head type and the cleaning tubes are of the tube sheet anchored type.

Fig. 11 is a similar view of a further form wherein the heat exchange tubes are of the return bend type and a part of the cleaning tubes are of return bend type shown in Fig. 9 and others are of the type shown in Fig. 1, although all may be of either type.

Before proceeding to describe in detail several embodiments of the invention, herein set forth by way of example only, it appears highly desirable to describe one conventional type of heat exchanger to which same may be applied.

In Fig. 1, 10 indicates a shell or casing flanged at 11 and 12 and provided with an inlet 13 and outlet 14, or vice versa. A head 15, flanged at 16, is secured to shell 10 at flange 12. Another head 17, flanged at 18, is secured to the shell at flange 11.

Interposed between the shell and one head is a tube sheet 19. The head 17 is spaced from shell 10 by said sheet. The head includes inlet 21 to chamber 22 formed by said baffle and an outlet 23 from chamber 24 formed by said baffle. Flow obviously may be reversed.

Within the head 15 is a floating head structure 25 and tubes 26 and 27 are secured at opposite ends to that head structure and the tube sheet 19 in conventional manner so that the circulation is from chamber 22 to head 25 and from same to chamber 24 or vice versa.

If hot liquid or vapor be thus circulated and cold water passed through the shell, etc., the tube (26—27) confined product will be cooled and such cooling results in the formation and accumulation of sludge and scale upon the exterior of said tubes resulting in decreased efficiency and possible failure.

The present invention contemplates the addition of apparatus whereby the exchanger may be

reconditioned without necessitating disassembly and manual removal of such sludge and scale.

The tubes 26—27 are arranged in bundles or as desired and are of the requisite number. Herein there is secured cleaning tubes 28 properly distributed and disposed so that chemical liquid discharged from orifices 29 suitably disposed upon the length of and around each tube 28, will impinge upon substantially all of the tubes 26—27 and upon substantially the entire length thereof exposed in shell 10.

Preferably the supply to the tubes 26—27 is cut off and the supply to the shell is cut off and the unit in question drained. Then chemical liquid is supplied under pressure to the supply ends of cleaning tubes 28 until the scale and sludge collected upon tubes 26—27 separates therefrom and falls to the bottom of the shell. It can then readily be removed by flushing or mechanically, or it can be left, as desired.

Thus the heat exchanger is reconditioned for efficient operation without disassembly.

Fig. 2 as stated illustrates one arrangement of cooling and cleaning tubes and is given by way of example only. Fig. 3 illustrates the simplest form of cleaning tube 28 in that spray discharge of chemical liquid is effected through ports 29 variously disposed about and along said tube, see Figs. 1 and 3. Nozzles applied externally may be provided when desired or required. For the preferred (localized selective) operation the interior of tube 28 should be free of all obstructions.

In Fig. 4 the supply end of cleaning tube 28 is secured to tube sheet 19 and opens upon the chamber formed thereby. A threaded plug 30 normally closes this end of the tube. In longitudinal alignment with tube 28 said head has opening 31 normally closed and sealed by threaded plug 32.

When cleaning is to be effected plugs 32 and 30 may be removed and the chemical supply tube operatively connected to tube 28 at sheet 19, being introduced thereto through opening 31 which, see Fig. 4, is larger than the tube sheet opening closure (plug 30).

The foregoing describes a modification of the invention shown in Fig. 1 wherein cleaning tube 28 is extended through chamber 22 or 24 as at 28^a and through opening 31 in the head 17. Extension 28^a may comprise a nipple, see Fig. 5. Cap 33 herein closes the head opening 31 and envelopes cap 34 applied to the head exposed end of nipple 28^a.

Removal of both caps permits the chemical liquid supply tube to be applied to tube 28—28^a.

Whenever the tube 28 and its extension 28^a is continuous or whenever the dual cap arrangement is not desired, the tube 28 or nipple 28^a, as the case may be, respectively, extends through the opening 31^a see Fig. 6, which is shouldered at 31^b. A packing gland structure 32^a seals the head. The head 17 exposed end 28^b then can be capped as at 34^a.

All the aforesaid describe mechanically equivalent methods of anchoring the supply end of the cleaning tube and normal closing of same as well as rendering that closed end readily accessible for conduit connection for chemical liquid supply thereto.

The aforesaid pressure supply conduit may be a valve controlled pressure tube which when connected to tube 28 or extension 28^a insures pressure discharge from all ports 29 therein.

However, when localized directional cleaning is desired the pressure supply tube structure includes additional parts and same is more fully illustrated in Fig. 7 to which reference will now be had.

Herein 35 indicates a valve controlled flexible hose discharging to one end of a tube 36 closed at the opposite end as at 37, which may be an externally flanged cap provided with shoulder or fixed collar portion 38.

Adjacent thereto and enveloping the tube 36 is the annular packing or ring 39. Spaced therefrom is a similar ring 40. Therebetween is a flanged or shouldered sleeve 41 that includes longitudinal slots 42 therein. Collars or shoulders 43 and 44 at opposite ends confront said rings. A metal bearing washer or ring 45 is oppositely disposed relative to collar 44 with ring 40 therebetween.

A tightening ferrule or tube 46 envelopes tube 36 and is slidable thereon and rotatable thereon. The end 47 bears against washer 45. Tube 36 is externally threaded as at 48. Tube 46 adjacent ring 45 has an internal collar 49 threaded as at 50. Tube 36 also includes ports 51.

Since the diameters of tubes 36, 46, cap 37 (with flange 38) and collar portions 43—44 are less than the inside diameter of tube 28, the entire structure aforesaid can be positioned as desired in said tube 28 and then tube 46 rotated relative to supply tube 36.

By virtue of the thread connection therebetween pressure is exerted upon the packing rings 39 and 40 to expand radially same into sealing relation within said tube 28 and thus localize a portion thereof. Pressure fluid supplied to tube 36 than escapes by ports 51 and slots 42 to the localized portion of tube 28 so that chemical spray is only discharged therefrom by ports 29 which then are in free communication with tube 36.

When spraying is effected the tube or ferrule 46 is unthreaded and the structure repositioned as aforesaid or removed and applied to another cleaning tube 28 for the cleaning of other heat exchange tubes 26—27.

Reference will now be had to Figs. 1, 8 and 9. In Fig. 1 tubes 26, at the remote end as distinguished from the supply end, are suitably closed by capping as at 52. Whenever desired, see Fig. 8, the said remote ends may be supported by the rear tube sheet 25^a and plugged as at 55.

Whenever this type of support is not desired certain of the cleaning tubes may be mechanically connected, see Fig. 9. Herein the remote ends are united as at 56 by a curved tubular portion and, preferably approximately midway thereof, said tube is plugged or blocked as at 57 for obvious reasons. This is a U-shaped cleaning arrangement.

In Fig. 10 there is illustrated what might be designated the right hand portion of a heat exchanger comparable to that shown in Fig. 1, although the left hand end of such exchanger can be of any type such as illustrated in Figs. 1 and 4 to 7 inclusive.

This form of the invention embodies the casing 110 closed by the head 115, and the casing is united by suitable bolt and nut means not shown, etc., to this head, the end 112 of the casing being herein defined by a tube sheet 125^a.

Each of the several tubes 126 and 127 are suitably anchored or secured in and to the tube sheet 125^a and communicate with the interior of the head 115 which, of course, is sealed off by the sheet from the interior of the casing 110.

In the present form of the exchanger it is preferred to secure each of the cleaning tubes 128 perforated or provided with nozzles as at 129

by securing the same in the tube sheet comparable to the method disclosed in Fig. 8 and then plugging the tube sheet anchored ends by the expansion plugs **155**. If it is not desired to have these ends of the cleaning tubes anchored, they may terminate immediately adjacent the tube sheet and be closed by the cap structure comparable to the cap **52** shown in Fig. 1.

Reference will now be had to Fig. 11 wherein the casing **210** is provided with flange **212**, to which is secured a head **215**. Herein the tubes **226** and **227** are connected together by the curved portions **225** so that the tubes **226** and **227** are in effect return bend tube stabilizing.

Racks or spacers may be provided, if desired, but same are not shown herein for they form no part of the present invention.

The cleaning tubes herein may be either or both of the type illustrated in this figure. Cleaning tubes **228** include the discharge ports or nozzles **229** and are closed by the caps **252**. Cleaning tubes **228** include the discharge ports or nozzles **229a** and are of the mechanical return bend type being united as at **256** and closed as at **257** so that they do not communicate one with the other insofar as each half of the tube is concerned relative to the other half.

This, of course, is desirable because cleaning fluid is injected into the cleaning tube under pressure for pressure discharge. That is why also return bend type cleaning tube, shown in Fig. 9, is closed or cut off at the mid-portion.

Herein return bend type of cleaning tube, when used, is preferably so arranged that its curved portion is concentric with the curved portion **225** of the heat exchanger tubes. As stated, either or both forms of cleaning tubes may be incorporated with the heat exchanger or transfer tubes **226—227** shown in Fig. 11.

While the invention has been illustrated and described in great detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character.

The several modifications described herein as well as others which will readily suggest themselves to persons skilled in this art, all are considered to be within the broad scope of the invention, reference being had to the appended claims.

The invention claimed is:

1. A cleaning device for insertion in a perforate cleaning tube disposed within a heat exchanger, comprising a fluid pressure supply tube of smaller diameter than said cleaning tube adapted for insertion longitudinally in the latter, a pair of spaced packing rings surrounding said fluid supply tube and adapted to engage the inner walls of said cleaning tube, an apertured sleeve surrounding said pressure supply tube bearing at its ends against adjacent faces of said packing rings, a stop holding one of said packing rings against sliding movement in one direction on said pressure supply tube, means supported by said pressure supply tube for exerting pressure against the other of said packing rings in the direction of the said first ring, and said fluid pressure supply tube having perforations therein disposed between said packing rings.

2. A cleaning device for insertion in a perforate cleaning tube disposed within a heat exchanger, comprising a fluid pressure supply tube of smaller diameter than said cleaning tube adapted for insertion longitudinally in the latter, a head on the inner end of said pressure supply tube, a packing ring surrounding said supply tube and engaged with said head, an apertured sleeve surrounding said pressure supply tube and bearing at one end against said packing ring, a second packing ring surrounding said pressure supply tube and engaged with the opposite end of said sleeve, a tubular member threadedly engaged with the exterior of said pressure supply tube and bearing against said last named packing ring, and said pressure supply tube having openings therein communicating with the interior of said sleeve.

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