TRITUBE HEATING ELEMENT

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The invention relates to detachable units or elements for use in heating liquids, such unit being adapted to be inserted through a manhole or the like in the side of a vessel containing a liquid to be heated. The unit is particularly intended for use with liquid or gaseous fuel, the hot combustion gases of which pass through the unit in heat interchange relation to the liquid to be heated and are subsequently discharged through a suitable outlet pipe. While in its broadest aspects the invention is not confined to such use, the heating unit of the present invention is particularly adapted for use with emulsion treating apparatus such as is disclosed in my Patent No. 2,261,101, dated October 28, 1941.

More specifically described, the invention relates to a tri-tube or three-way heating element, preferably made wholly of metal and designed primarily for heating liquids in tanks or vessels. The heating tubes may be permanently attached or welded to a manhole cover plate whereby the entire unit may be readily removed from any vessel where it is used simply by unbolting the manhole plate from the vessel manway.

One of the objects of the invention is to provide a compact, economical, efficient and easily removable heating unit that lends itself to ready installation on any type of liquid containing vessel.

Another object is to provide a safe and rugged heating element suitable for use with either liquid or gaseous fuel burners.

A further object of the invention is to provide an improved heating unit for use with emulsion treating apparatus such as is disclosed in my Patent No. 2,261,101.

Various forms of heating units have been proposed, some removable and others forming permanent parts of the heating vessel. Of the removable type of heating units one form which is now commonly used in connection with emulsion treating apparatus is of the U-tube type such as is shown, for example, in McMurray Patent No. 1,946,529, and Walker Patent No. 2,161,687. Another form which has been widely used is composed of a large number of small flues or tubes secured together as a unit such as is shown in my Patent No. 2,261,101. The present apparatus, however, constitutes a marked improvement over these prior devices.

By making the element a tri-tube instead of the conventional U-tube the element is more compact for a comparable amount of heating surface and may be built on a circular manhole cover instead of an elliptical or rectangular lid, thereby simplifying the construction and offering a stronger, safer manhole connection with the main vessel.

By using three larger tubes instead of many small flues or tubes to achieve comparable heating surface, the evils of flue or tube failure due to scaling up is greatly minimized by the fact that scale formed on the large tubes sloughs off and leaves the heating zone, whereas a bundle of small tubes forms the scale, sloughs it off and holds it in the meshes of the tube bundle between the tubes.

Of course, the removable feature is an advantage when compared to elements that are a built-in permanent part of a heating vessel.

As compared to small flue type elements, this element is much simpler and more economical to build by eliminating expensive flue sheets and much welding.

This tri-tube element offers an advantage of flexibility that no other known element offers in that one of the burners and tubes may be taken out of service if the load is light, thus allowing the other burner to operate at full capacity which is often more efficient for fuel consumption on some type burners, rather than have two burners running at half-capacity and burning inefficiently. Then if the load is increased later, both burners may be put back into operation.

Having two separate heating tubes and burners also permits uninterrupted operation in case one of the burners must be removed for cleaning, replacement, or repairs.

It has been found that the combustion, draft and flame may be controlled more readily in a smaller burner than in a larger burner; also in a smaller tube than in a larger tube; hence two smaller burners and tubes offer this advantage of easter control and greater heat transfer efficiency than would a larger single tube and burner of the same surface and heating capacity. The heat transfer efficiency is greater because all of the hot gases have more opportunity for intimate contact with the tube surface in the smaller tubes than they would in a larger tube where gases passing through the center portion of the tube cross-section may pass clear through without giving up their heat.

The invention will be more readily understood by reference to the accompanying drawing and the following detailed description, in which a specific embodiment of the inventive thought is set forth by way of illustration.

In the drawings:

Fig. 1 is a vertical section through the vessel.
and heating unit, parts of the heating unit being shown in elevation:

Fig. 2 is a side elevation showing the heating unit and a fragmentary portion of the side wall of the heating vessel;

Fig. 3 is a section taken on the line 3-3 of Fig. 1 and

Fig. 4 is a section taken on the line 4-4 of Fig. 1, portions of the heating unit or element being shown in plan.

Referring to the drawings, A denotes a heating vessel which may be of any desired type as, for example, an emulsion treater such as is shown in my Patent No. 2,261,101, the elements related to the heating unit being omitted for the sake of simplicity. The heating vessel is adapted to contain any suitable liquid B, which may be an oil or water emulsion to be treated, or may be water or other liquid to be heated. The heating unit or element is designated at C and includes a manhole cover plate to which the tubes are permanently secured, which cover plate is adapted to be removable secured to a manhole neck at the side of the vessel by means of bolts or the like.

The heating vessel A, which is shown only fragmentarily, may be of cylindrical construction and includes a side wall portion 10 having an opening 11 preferably at one side thereof and located near the bottom of the vessel. A manhole neck 12 is secured within the opening and is suitably welded thereto at 13. The manhole neck includes a flange 14 to which the heating unit C is adapted to be removably attached by securing thereto a plate 15 carrying the heating tubes, the plate being secured by any suitable means; as, for example, bolts 16.

In addition to the plate 15 the removable element includes two parallel horizontal metal tubes 17 and 18 which pierce the manhole cover plate 15 and are suitably welded to the same at joints 19 which are opposite each other and outside the plate 15 and extending completely about the circumference of both tubes. These two tubes 17 and 18 extend horizontally back into the vessel A as far as the size of the vessel permits to a limit of approximately fifteen feet and then make a ninety degree turn at points 23 and 24 which may be either a prefabricated smooth ninety degree turn or a bevelled sharp welded ninety degree turn, as shown by the drawing. Both tubes turn upward at this point and join each other together with return tube 25, each making a one hundred twenty degree angle with the others at juncture 26. Return tube 25, which is preferably of the same diameter as tubes 17 and 18, makes a ninety degree turn at 27 similar to the other two tubes 17 and 18, and then runs horizontally, forming tube 28, which pierces the manhole plate 15 and is welded to same both inside and out at 29 and 30. At the front end of tube 28 is a bolt flange 31 which permits bolting an end cover plate 32 to the same, which may be removed for inspection at the inside of tube 28. Also at the front end of tube 28 a few inches from the manhole cover 15 is welded the smoke-stack neck 33. This neck may contain a simple control damper (not shown) if the builder desires one. The neck may be from six to twenty-four inches in length. Its diameter is usually the same as the stack 34 which is secured thereto, and is usually somewhat smaller than tube 28. Stack 34 is bolted to stack neck 33 by means of flanges 35 and 37 and bolts 38.

The two lower tubes 17 and 18 extend from plate 15 approximately sixteen to twenty inches and contain perforated damper plates 40 and 41 that are attached to ends of the tubes by means of flanges 42 and 43. Conventional burners 45 of any desired type may be provided for the tubes 17 and 18. The burner 45 should be so located as to allow the flame to start where the liquid to be heated contacts plate 15.

If the heating element C extends as much as six feet into the vessel it should be supported by a suitable support such as angle iron 46 as shown in the drawing, this support being bolted or welded to walls of vessel A. The diameter of the three tubes may be from four to twenty-four inches, depending on the heating job to be done and the size of the vessel A.

The three-way heating element C may be used to heat any sort of liquids that may be contained in a vessel. If liquids are of a corrosive nature, then the element may be made of corrosion resisting metals. It has been designed especially for the purpose of heating crude oil emulsions and oil-field brines in vessels for separating the brine from the oil and breaking the emulsion. The operation is quite simple, consisting of firing with any of several designs of burners, with two of said burners in the lower two tubes of the element as shown. Air for combustion enters at point O through holes in damper plates 41 and 42, then forms a combustion mixture with the fuel at point P and follows both lower tubes 17 and 18 to the juncture with the discharge tube 28 at point Q and all combustion products flow through upper tube 28 at point R and into smoke stack at point S. The whole heating element is immersed in fluid to be heated at point T. It is preferable that the vessel be heated as it is drawn into the vessel A beneath the heating element, as set forth in my Patent No. 2,261,101; especially crude oil being treated in a hot water wash, as the oil will travel upward and assure good contact with the element.

To inspect the element C, etc., the upper tube 28 may be examined by taking off the end cover 32; the lower tubes 17 and 18 may be inspected by removing damper plates 40 and 41 and burners 45. The outside of the tubes of the heating element, or the portions thereof that are wetted by the liquid B being heated may be inspected by draining the vessel and examining through any suitable inspection manhole (not shown) in the vessel; or by unbolting manhole cover 15 and removing the whole heating element C from the vessel.

The quantity of heat supplied to the liquid may be regulated by regulating the quantity of gas supplied to the burners, and the amount of air supplied through the dampers.

The invention has been described in detail for the purpose of illustration but it will be obvious that numerous modifications and variations may be resorted to without departing from the spirit of the invention.

I claim:

1. For use with a vessel for heating liquids having a lateral opening therein, a removable circular cover plate for said opening, a symmetrical tri-tube heating unit carried by said cover plate, the tubes of said unit having parallel axes, the front end of said tubes extending through said cover plate to the outside of the vessel and the rear ends being interconnected, said tubes being of substantially the same diameter and symmetrically arranged with reference to each other and to the circular cover plate, two of the
tubes being inlet tubes for heating fluid and arranged on the same level with each other and the third being an outlet tube for the heating fluid and arranged on a higher level than and above the plane of the inlet tubes, burners for supplying hot combustible gases located at the entrances to the inlet tubes, and a smoke stack detachably connected to said outlet pipe outside the cover plate.

2. A heating unit as set forth in claim 1, wherein the tubes are joined equilaterally, symmetrically and at substantially 120° angles.

RANSOME W. ERWIN.

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