

Sept. 13, 1955

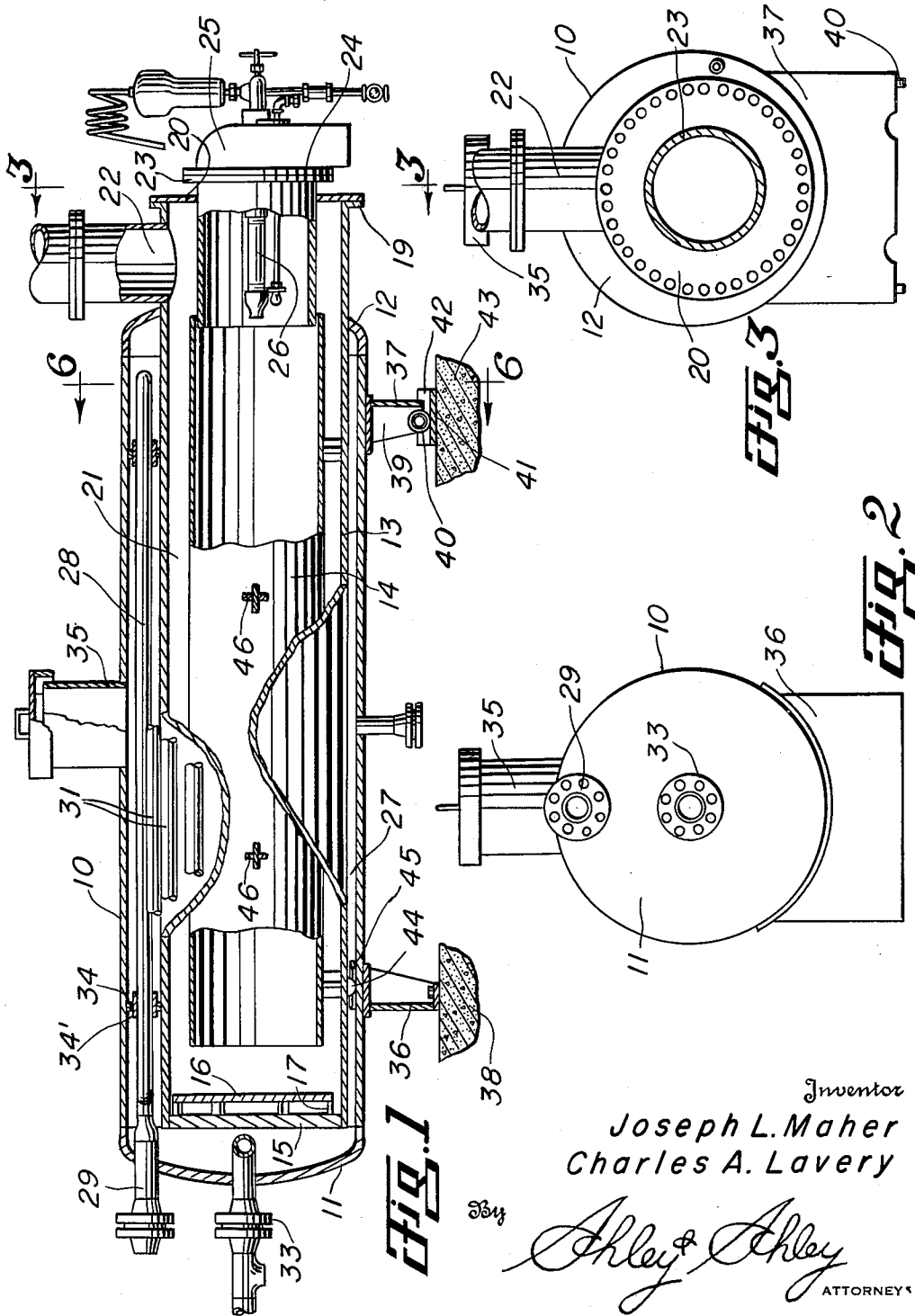
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2,717,580

INDIRECT HORIZONTAL FLUE BOILER

Filed April 7, 1951

2 Sheets-Sheet 1



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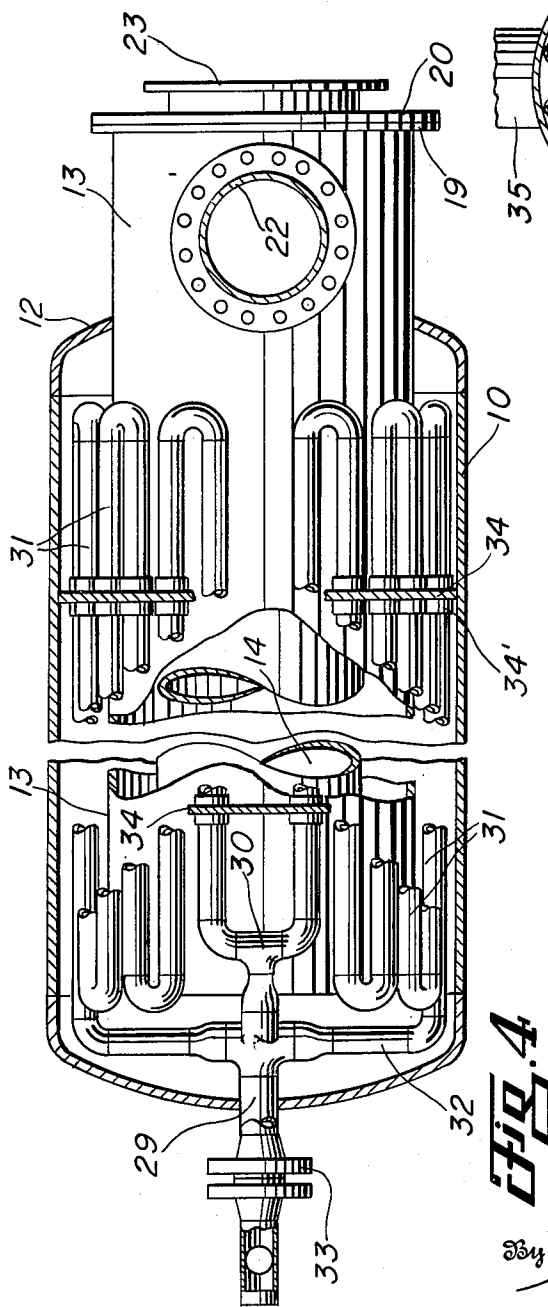


Fig. 4

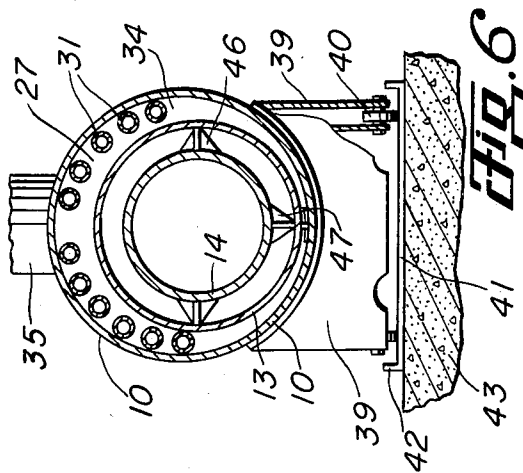


Fig. 6

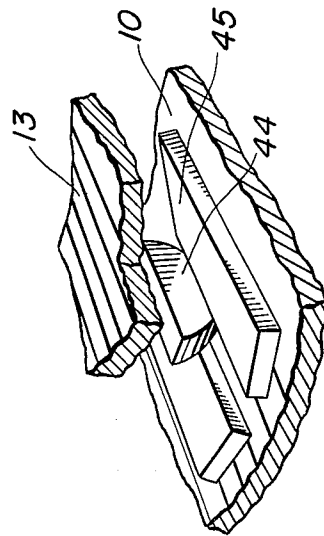


Fig. 5

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INDIRECT HORIZONTAL FLUE BOILER

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4 Claims. (Cl. 122—33)

This invention relates to new and useful improvements in indirect fire tube heaters.

One object of the invention is to provide an improved indirect, fire tube heater involving elongate mediums, one within the other and arranged to undergo longitudinal expansion without buckling or disjuncture.

A particular object of the invention is to provide a fire tube heater wherein high temperatures and high heating capacities are achieved in a small unit.

A further object of the invention is to provide an improved indirect, fire tube heater having an elongated chamber filled with a heat exchange liquid or material and containing fluid conductors, surrounding a fire tube having a burner, whereby a high degree of heat is transmitted to a fluid flowing through said conductors.

Another object of the invention is to provide an improved heater of the type described including an outer shell disposed around a jacket to form a chamber in which coil bundles are immersed in a heat exchange or transfer material, whereby heat transmitted from the fire tube is intensified and a higher degree of heat is transmitted to a fluid flowing through said bundles than would otherwise be obtained.

Still another object of the invention is to provide an improved heater of the type described including a fire tube disposed longitudinally in an elongate jacket which, in turn, is mounted longitudinally in a shell, each of said elements being movably sustained at one end, whereby it may elongate or contract without distortion to itself or surrounding elements.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, wherein an example of the invention is shown, and wherein:

Fig. 1 is a longitudinal, sectional view of a heater constructed in accordance with the invention,

Fig. 2 is an inner or rear end elevational view of the heater,

Fig. 3 is an outer or front end transverse, sectional view, taken on line 3—3 of Fig. 1,

Fig. 4 is an enlarged, cross-sectional view of the heater, broken away at its medial portion,

Fig. 5 is a detail view of the jacket support, and

Fig. 6 is a transverse, vertical, sectional view taken on the line 6—6 of Fig. 1.

In the drawings, the numeral 10 designates an elongate, horizontal, cylindrical shell having a crowned head 11 at its inner or rear end, welded thereto. The outer or forward end 12 of the shell is contracted and welded around the front end of a cylindrical jacket 13 which surrounds a fire tube 14. The tube is concentrically mounted in the jacket, but the jacket is eccentrically mounted in the shell, being nearer the bottom of said shell.

The inner or rear end of the jacket is closed by a flat circular head 15, which has a flat circular deflector 16 spaced from and supported on the inner side thereof by spacers 17. This deflector may be made of any suitable

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material, either metal or ceramic or a combination of both. The jacket extends through and snugly fits in the contracted end 12 of the shell, whereby its forward end projects from the shell. The front or outer end of the jacket has an outwardly directed annular flange 19, to the outer face of which a flat closure ring 20 is secured.

The fire tube 14, while disposed concentrically in the jacket, is spaced therefrom throughout its length so as to provide a surrounding flue 21 which leads to a vent collar 22 on the top side of the front end of the jacket, adjacent its flange 19. It is quite desirable to make the fire tube of a high chromium and nickel alloy such as stainless steel because of its durability. The rear end of the tube is spaced from the deflector 16. The front end of the tube extends snugly through the ring 20 and has an annular flange 23 on its forward end a short distance from the ring. A draft box 25 has an annular flange secured to the flange 23. A conventional gas or gaseous fluid burner 26 extends through the box into the fire tube and is equipped with standard supply and control appliances.

The shell 10 surrounding the jacket 13 and being eccentrically spaced from said jacket, provides a longitudinal eccentric space or chamber 27 therebetween, sealed at the inner end by the head 11 and at the front end by the contraction 12. A pipe coil, indicated generally by the numeral 28, is disposed in this chamber, which is sealed off from the fire tube 14. The coil has an inlet nipple 29 which extends through the upper portion of the head 11 to a manifold 30 (Fig. 4), which connects with and supplies coil groups or bundles 31, disposed in the chamber on each side of the upper half thereof, and extending back and forth therein (Figs. 1, 4 and 6). The outlets of the coils are connected to the ends of a transverse manifold 32 (Fig. 4), which in turn is attached to a nipple 33 extending out through the head 11.

The pipes of the coils 31 are supported in arcuate spacer yokes 34 secured transversely in the upper portion of the chamber 27 between the jacket and the shell. The pipes of the coils are mounted to slide through small sleeves or collars 34' fixed in the yokes, whereby elongation and contraction of the pipes is provided for. The chamber may be filled with a molten salt bath or other material having relatively high heat conduction and a high boiling and/or a high temperature decomposition point, and thus, a fluid passing through the coils 31, may be heated to a higher degree than would otherwise be obtainable. An expansion dome 35 is mounted on the medial portion of the shell.

It is obvious that under relatively high degrees of heat, as for instance between 500° F. and 750° F., the shell 10, coils 31, jacket 13, and the tube 14 would be subject to expansion and elongation. For the foregoing reason the shell 10 is mounted in both a stationary cross standard 36 and a movable cross standard 37. The shell is cradled in the standard 36 which is fastened on a base 38, near its inner end. The standard 37, as is best shown in Figs. 1 and 6, is U-shaped in cross section having vertical legs 39, from the lower ends of which, rollers 40 protrude on each side of the standard. This standard supports the forward outer end portion of the shell. A cross plate 41 having upturned ends 42 is mounted transversely of the standard, receives the rollers and is secured on a base 43.

The jacket 13 being eccentrically mounted in the shell is supported at its inner end for longitudinal movement. A semi-circular lug 44, shown in detail in Fig. 5, is secured longitudinally and centrally to the bottom of the jacket 13 adjacent its inner end. The lug, while free to move longitudinally on the inner face of the shell in a yoke-shaped guide 45 fastened on the inner face of the shell, is held against lateral movement by said guide. The flame from the burner 26 being directed toward the inner end of the tube 14, it is obvious the inner ends of

both the jacket and the tube will be hotter and thus the tendency of the jacket will be to expand longitudinally toward the deflector 16.

The fire tube 14 is equipped at its central portion with studs 46 (Figs. 1 and 6) on opposite sides engaging the inner face of the jacket. Near its inner end and at its outer portion the shell is carried on studs 47 disposed along the longitudinal center of its bottom. Each of these studs is of the winged, pyramid type with its base secured on the face of the tube and its apex engaging the inner face of the jacket.

It is obvious that under a relatively high degree of heat, usually greater than 500° F., the main elements, which are the shell 10, the pipe coils 31, the jacket 13, and the fire tube 14, being elongated, will expand longitudinally. The movable supports are arranged so that outer shell 10 may elongate outwardly toward the outer or front end of the heater, which is provided for by the rollers 40. The elongation of the jacket will be largely in an inward direction, the lug 44 riding toward the head 11. The fire tube is free to elongate toward the deflector 16.

The structure is very important. The fire tube 14, being made of stainless steel will not deteriorate under relatively high temperatures and is completely free to expand and contract as the heater temperatures change. The connection of the tubular elements 10, 13 and 14 to each other at one end only, so that each element may independently expand and contract is highly advantageous. Further, the coil groups 31 are free to elongate or contract. The chamber 27 being filled with a suitable heat exchange material, it is pointed out that a higher degree of heat is thus contributed to the coil groups 31, than would otherwise be obtainable. This is quite important. A heat transfer salt has been used and under firing will be maintained in a molten condition by the heat radiated from and/or conducted from the fire tube. Any fluid passing through coil groups will be adequately heated.

The heat supplied by the tube 14 is largely radiant in nature, and here again, the use of stainless steel to form the fire tube is of importance. The heat is transferred from the stainless steel fire tube by radiation and convection to the jacket through the annular space therebetween and this maintains the heat exchange material therein at the desired operating temperature. Thermal circulation of the heat exchange material within the shell, while desirable, is not essential, and the space between the shell 10 and the jacket 13 may therefore be kept small. This results in reduction of the size or diameter of the shell, and hence provides for a greater heat output by equipment occupying a relatively small space. The radiant heating, use of a high temperature and use of a heat exchange material having a high operating temperature, all contribute to the end result of obtaining high temperature heating capacity in a relatively small unit.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What we claim and desire to secure by Letters Patent is:

1. An indirect fire-tube heater for heating fluids, including, an elongate outer shell closed at each end, one end of the shell being supported for longitudinal movement, an elongate jacket extending into the shell through one end thereof and having its outer end supported by said end of the shell and its inner end movably supported within the shell, the shell and jacket being cylindrical and having their walls closely spaced to form a narrow annular space between the shell and jacket of small cubical capacity, a high temperature resisting metal fire tube extending into the jacket through the outer end thereof and mounted therein for longitudinal expansion, means for heating said fire tube to a red heat so as to convey heat to the jacket by radiation, a heat transfer material completely

filling the annular space between the jacket and shell, said material being a solid at room temperature and having a high melting temperature and a normal operating temperature of 500° to 750° F., a stack connected to the outer end of the jacket, and fluid conductors in the annular space between the jacket and the shell.

2. An indirect fire-tube heater for heating fluids, including, an elongate horizontal cylindrical outer shell closed at each end, one end of the shell being supported for longitudinal movement, an elongate jacket extending into the shell through one end thereof and having its outer end supported by said end of the shell and its inner end movably supported within the shell, the shell and jacket being cylindrical and having their walls closely spaced to form a narrow annular space between the shell and jacket of small cubical capacity, a high temperature resisting metal fire tube extending into the jacket through the outer end thereof and mounted therein for longitudinal expansion, means for heating said fire tube to a red heat so as to convey heat to the jacket by radiation, a heat transfer material completely filling the annular space between the jacket and shell, said material being a solid at room temperature and having a high melting temperature and a normal operating temperature of 500° to 750° F., a stack connected to the outer end of the jacket, and fluid conductors in the annular space between the jacket and the shell arranged in a semi-cylindrical configuration in the upper half of said space.

3. An indirect fire-tube heater for heating fluids, including, an elongate, horizontal outer shell closed at each end, one end of the shell being supported for longitudinal movement, an elongate jacket mounted longitudinally within the shell and having its inner end closed and closely spaced to one end of the shell, the opposite outer end of the jacket being supported in the opposite end of the shell and projecting therethrough externally of the shell, the inner end of the jacket being movably supported within the shell, the shell and jacket being cylindrical and having their walls closely adjacent so as to form a thin annular space between the shell and jacket of small volume, a high temperature heat transfer material completely filling the annular space between the jacket and shell, said material having a normal operating temperature of 500° to 750° Fahrenheit, fluid conductors in the annular space between jacket and shell completely surrounded by the heat transfer material, a stack connected to the projecting outer end of the jacket, a high temperature resisting metallic fire-tube extending longitudinally within the jacket through the outer end thereof, the fire-tube being mounted in the outer end of the jacket and having its inner end open and adjacent the inner end of the jacket, supporting and spacing elements projecting from the exterior of the fire-tube and slidably engaging the inner wall of the jacket to support and center the fire-tube within the jacket, and means for heating said fire-tube to a red heat so as to convey heat to the jacket predominantly by radiation.

4. An indirect fire-tube heater as set forth in claim 3 wherein the fluid conductors extend through and are mounted in one end wall of the shell, and supports within the shell for the fluid conductors, the conductors having their portions within the shell movably carried by the supports whereby the conductors may undergo elongation.

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