April 28, 1959 J. J. REAGAN 2,883,973

INTERMEDIATE TUBE GUIDE

Filed Dec. 13, 1956 2 Sheets-Sheet 1

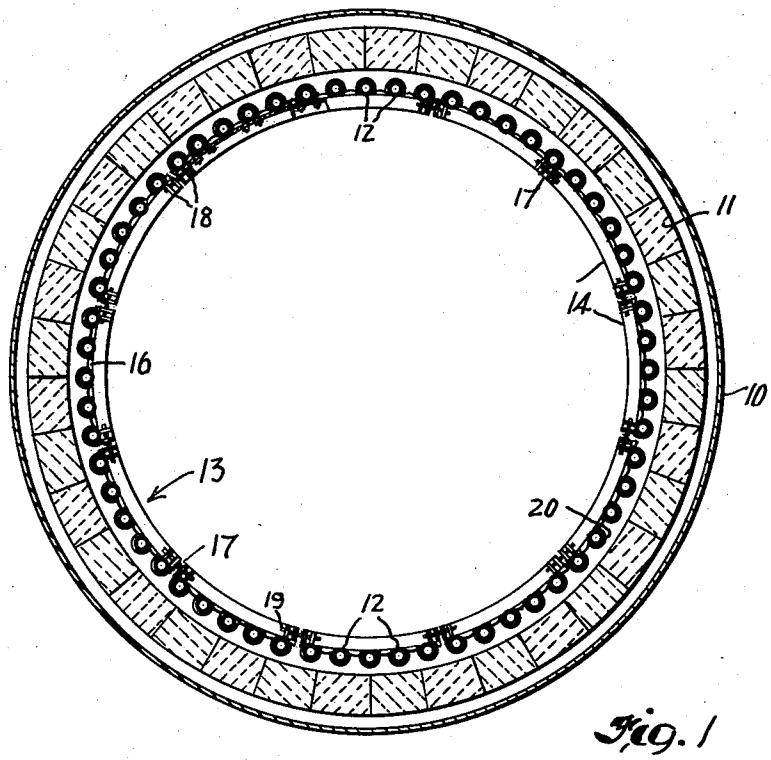


Fig. 1

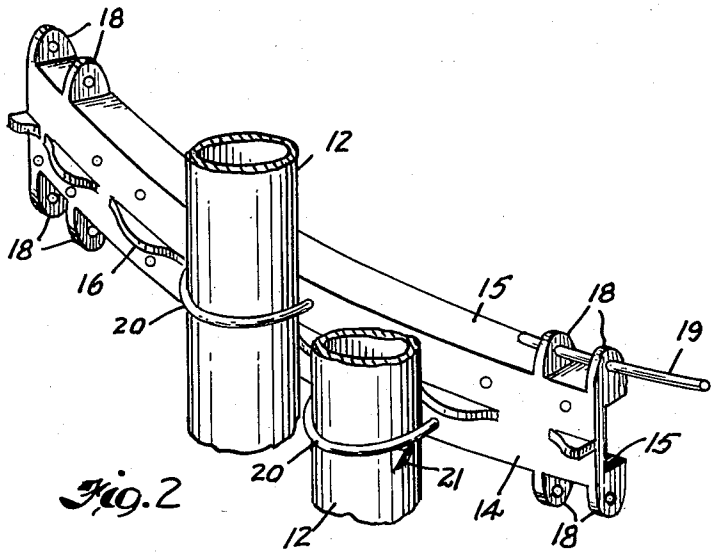


Fig. 2

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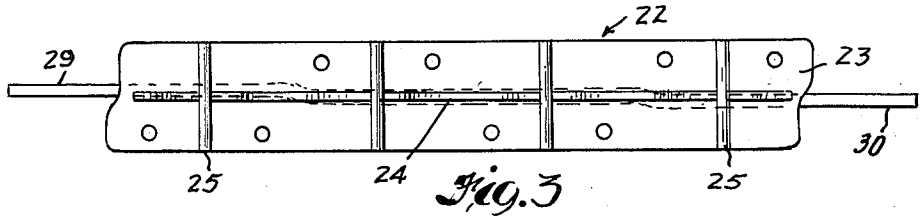


Fig. 3

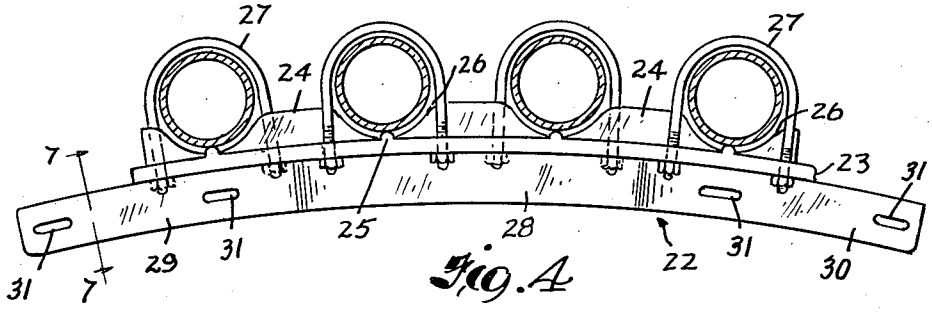


Fig. 4

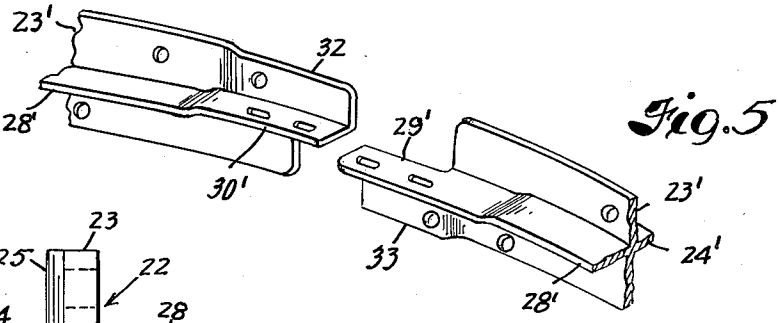


Fig. 5

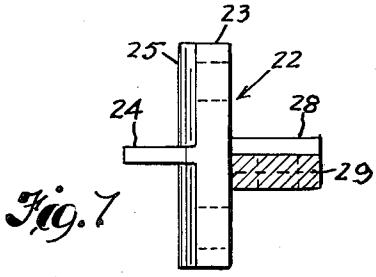


Fig. 7

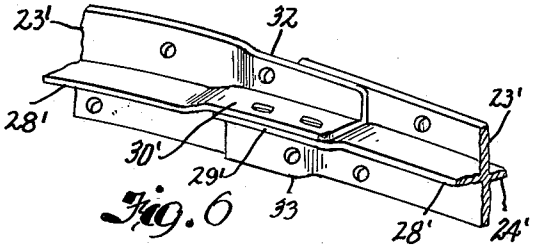


Fig. 6

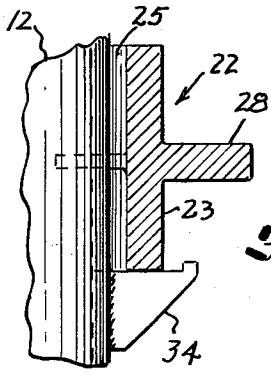


Fig. 8

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INTERMEDIATE TUBE GUIDE

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Application December 13, 1956, Serial No. 628,192

6 Claims. (Cl. 122—510)

This invention relates to improved means for guiding and restraining the tubes of a cylindrical tube heater intermediate their ends, the latter being supported in conventional manner.

I have been particularly concerned with the construction and operation of vertically fired crude oil heaters, used widely today in oil refineries and reaching considerable heights, to the extent that the tubes thereof are often longer than fifty feet. Such tubes are arranged in rather close circularly spaced relation adjacent a lining of firebrick or other refractory material and, where positioned and secured only at the ends, the unsecured lengths are so great that bowing of the tubes under thermal stress is a serious problem. Tubes which bow inwardly or towards the burners become damaged by the flame, while outward bowing of the tubes reduces the normal spacing from the insulating brick liner and, with the correspondingly reduced heat transfer, damage to the brick almost always follows. Bowed tubes also are difficult to clean properly in regular maintenance, and it is often impossible to inspect such tubes visually after cleaning to determine if all the coke has actually been removed.

Certain types of intermediate supports for such tubes have been proposed, but these have either been wholly ineffective or unsatisfactory for one reason or another. In particular, prior guides have been prone to mechanical failure, they have been limited for practical purposes to original construction in requiring an impractical amount of time and labor for installation in an existing heater, or they have been seriously limited with respect to permitting removal and replacement of tubes in proper maintenance of the heaters.

It is accordingly a principal object of my invention to provide an intermediate tube guide of reliable and durable construction, which is capable of ready incorporation in existing tube heaters as well as in new construction.

Another object is to provide such a guide which is supported on the tube array itself, as distinguished from connection to the heater shell. The latter arrangement is obviously difficult and expensive to provide in a completed heater, since the insulating brick in the area where the guide is to be located must be removed to expose the shell for attachment, for example, by welding, and then replaced.

It is also an object of the invention to provide an intermediate tube guide which forms an assembly operative to embrace all of the tubes of the heater or furnace. Moreover, the new guide permits the removal and replacement of two of the tubes at one time, this feature further greatly simplifying maintenance since heater tubes are usually joined in pairs by welded end return bends.

Another object is to provide a tube guide characterized by the noted advantageous features which is nevertheless economical to produce and install.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related

ends, the invention, then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a transverse sectional view of a vertically fired tube heater equipped with a tube guide in accordance with the present invention;

Fig. 2 is a perspective view of one section of such guide, the same being formed of a plurality of similar sections;

Fig. 3 is a side elevational view of a modified form of guide section;

Fig. 4 is a plan view of this modified section, showing the same as engaged with a number of the tubes;

Fig. 5 is a perspective view of the ends of two further sections in separated relation preparatory to being interengaged;

Fig. 6 is a further perspective view showing the end sections of Fig. 5 as brought together;

Fig. 7 is a section viewed from the plane of the line 7—7 in Fig. 4; and

Fig. 8 illustrates in elevation a tube-carried bracket used for support of the guide.

Referring now to the drawings in detail, the vertically fired tube heater used to illustrate the operative disposition of my new guide comprises an outer metal shell **10** and a cylindrical wall of insulating brick **11** therewithin. The several fluid conducting tubes **12** are arranged in circularly spaced-apart relation adjacent but out of contact with the inner periphery of the insulating wall. This type of construction is well known, and further details of the heater are not necessary to appreciate and understand the manner in which the new guide is employed.

The guide, indicated generally by reference numeral **13**, is ring-like and of such diameter as to engage the several tubes at the inner side of the array. It is made up of a plurality of identical arcuate sections **14** of general channel-shaped cross section, shown more clearly by the section illustrated in Fig. 2. The flanges **15** formed by the channel are inwardly directed, and in a line along its outer or base face, each section has a number of rounded lugs **16** defining, in effect, a scalloped rib which provides recesses in which the tubes are engaged by the particular section in their proper spaced relation.

To accommodate expansion of the guide in operation of the heater, the several sections are of such extent that their adjacent ends are normally separated by gaps **17**, with suitable expansion joints connecting the same. For such purpose, the Fig. 2 section is formed with a pair of spaced ears **18** projecting from its upper and lower flanges at each end, and such ears are apertured to receive loosely a connecting bar, one of which is shown at **19**. It will be clear that each such bar bridges the gap at the section end at which it is located and passes through the like apertured ears of the adjoining section, the fit being loose for relative movement of the sections upon expansion.

The guide sections **14** are held laterally against the tubes **12** by means of U-bolts **20**, with each bolt being engaged about one of the tubes and having its ends secured to the guide. Certain of the tubes, in variable number depending upon the size of the installation, have welded thereto small clips **21** uniformly positioned to engage beneath the U-bolts associated with these tubes, and it is in this manner that the guide is supported directly on the tubes at the desired elevation.

The modified form of guide section **22** illustrated in Figs. 3 and 4 differs primarily with respect to the type

of expansion joint between the adjacent sections of the complete guide. Each section of this type has a vertical portion **23** provided with recess-defining lugs **24** at its outer side, similarly as the guide section first described, but contact with the tubes is here more limited by virtue of the small vertically extending ribs **25** centrally of the recesses. Thus there is provided an air space **26** about most of the peripheral extent of each tube which would otherwise be disposed against the guide. The tubes are again joined to the guide by U-bolts **27** in the manner previously set forth.

This guide section is further formed with a horizontal portion **28** at the inner side of the vertical portion **23** and extending beyond the respective ends of the latter. At one end **29**, the portion **28** is depressed over a predetermined length, while at the other end **30**, it is correspondingly off-set upwardly, so that these end portions of adjacent sections in the guide may be overlapped. Such portions are provided with slots **31** adapted in assembly of the complete guide to receive locked pins or bolts which will hold adjoining ends together while permitting the sliding shift needed to accommodate expansion.

For increased lateral restraint at the joints, the section ends can be formed as shown in Figs. 5 and 6, with the vertical portions **23'** of each having inwardly displaced end lengths **32** and **33** respectively at the top of one section end and at the bottom of the other end. These end lengths are co-extensive with the horizontal portions **29'** and **30'**, and it will be clear that such construction adds a vertical overlap which precludes relative lateral movement of the thus interengaged sections.

The support of the guide on the tubes can also be realized by means on the latter engaged with the guide section body, rather than with the U-bolts attached thereto, and in Fig. 8 I have illustrated such an assembly comprising a bracket **34** welded to tube **12** at the burner side of the same and providing a ledge on which the lower margin of the guide section **22** rests.

It will be seen, however, that all of the sections disclosed constitute in assembled relation an inner, expansible ring guide of unitary nature, which may very conveniently be installed in a tube heater, in number depending upon the tube length, service conditions, and the like. In the case of a vertically fired heater or furnace, such guide is supported by the tubes, and in all applications, the guide is independent of the heater shell, thereby freeing the same from a certain amount of stress which would obtain in a rigid type of shell attachment. Tubes which are only slightly bowed can be brought into alignment in applying the guide thereto, with the assurance that bowing of all tubes will be eliminated by the restraining action of the guide.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In heater construction including an enclosure wall and a plurality of heating tubes therewithin and spaced therefrom, said tubes extending vertically in circularly spaced relation with long lengths thereof free of connection to the enclosure wall, an intermediate guide for supporting said tube lengths comprising an expansible ring disposed within the tube assembly and contacting the inner peripheries of the several tubes, means individually securing the tubes to said ring in their proper spaced-apart relation, and support means carried by at least certain of the tubes engaged with the guide and supporting the same at a desired elevation in the assembly, said support means being the sole support for said guide.

2. In heater construction including an enclosure wall and a plurality of heating tubes therewithin and spaced

therefrom, said tubes extending vertically in circularly spaced relation with long lengths thereof free of connection to the enclosure wall, an intermediate guide for supporting said tube lengths comprising an expansible ring disposed within the tube assembly and contacting the inner peripheries of the several tubes, means carried by said ring defining recesses in which the tubes are seated in their proper spaced relation, means individually releasably securing the tubes laterally to said ring, and support means carried by at least certain of the tubes engaged with the guide and supporting the same at a desired elevation in the assembly, said support means being the sole support for said guide.

3. In a tube heater including an enclosure wall and a cylindrical array of vertical heating tubes therewithin and spaced therefrom, said tubes having long lengths free of connection to the enclosure wall, guide means for supporting said tube lengths in predetermined circularly spaced relation, said guide means comprising a plurality of arcuate sections having their ends interconnected by expansion joints to form an expansible ring assembly, said sections contacting the tube peripheries and having spacer means partially embracing the tubes, laterally extending loop members secured to the sections and respectively engaged about the tubes, and bracket means carried by certain of the tubes for supporting the guide means, said bracket means being the sole support for said guide means.

4. In a tube heater including an enclosure wall and a cylindrical array of vertical heating tubes therewithin and spaced therefrom, said tubes having long lengths free of connection to the enclosure wall, guide means for supporting said tube lengths in predetermined circularly spaced relation, said guide means comprising a plurality of arcuate sections having their ends interconnected by expansion joints to form an expansible ring assembly, laterally extending loop members secured to the sections and respectively engaged about the tubes, and bracket means carried by at least certain of the tubes for supporting the guide means, said bracket means being the sole support for said guide means.

5. In heater construction including an enclosure wall and a plurality of heating tubes therewithin and spaced therefrom, said heating tubes extending vertically in circularly spaced relation with long lengths thereof free of connection to the enclosure wall, an intermediate guide for supporting said tube lengths comprising a plurality of curved sections arranged and interconnected by expansion means to form a ring, the outer surfaces of said sections defining seats partially embracing the heating tubes, the tubes being spaced about the ring and extending axially with respect thereto, clamping members carried by the sections for securing the tubes to the same, an axially oriented rib in each such tube seat for reducing the area of contact between the tube and the guide, and support means carried by at least certain of the tubes engaging the guide to support the same at a desired elevation, said support means being the sole support for the guide.

6. In a tube heater including an enclosure wall and a cylindrical array of vertical tubes therewithin and spaced therefrom, said tubes having long lengths free of connection to the enclosure wall, an intermediate guide for supporting said tube lengths, said guide comprising an expansible ring, means clamping the tubes laterally against the ring in circularly spaced relation, and brackets secured to at least some of the tubes providing ledges on which the guide rests, said brackets being the sole support for the guide.

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