Jan. 2, 1968 R. M. BRECKENRIDGE ETAL 3,361,118

TUBE HEATER

Filed April 8, 1966

FIG. 2

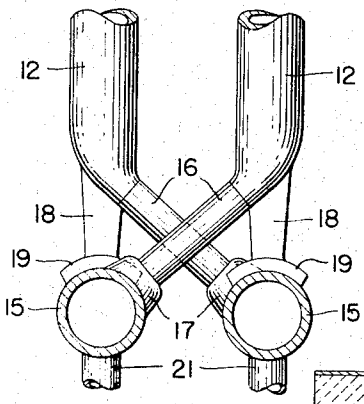
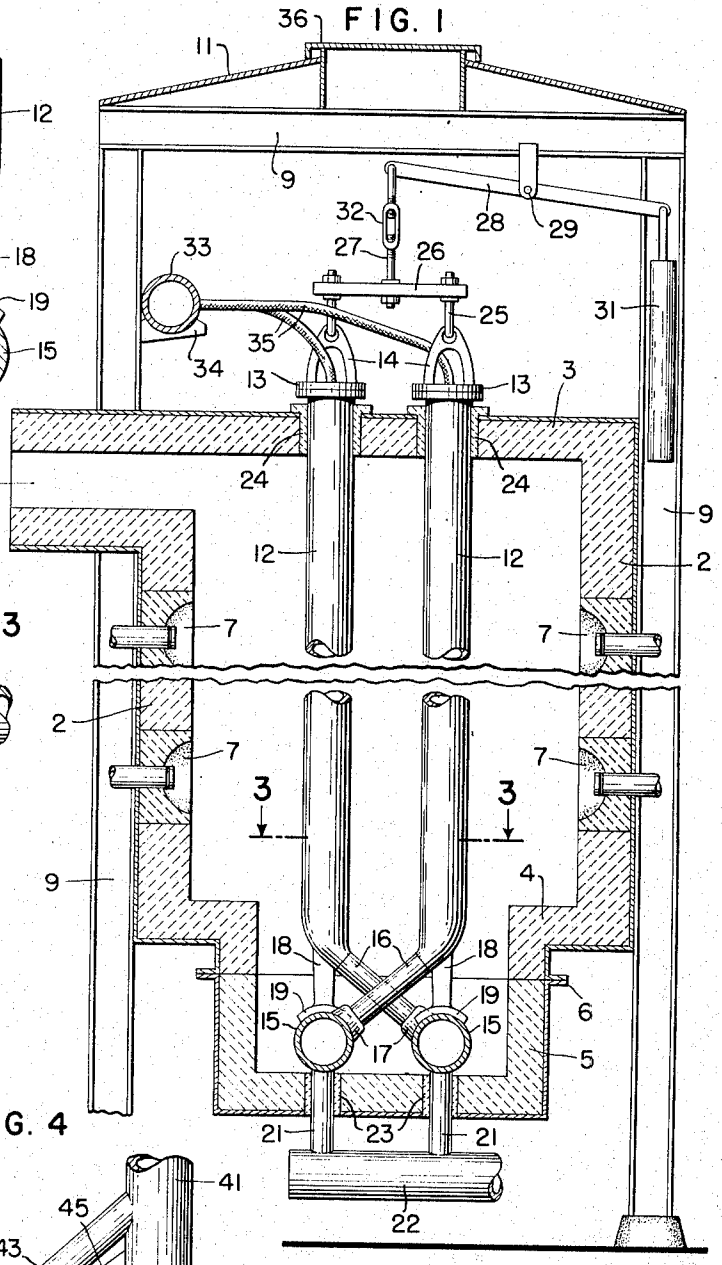


FIG. 1



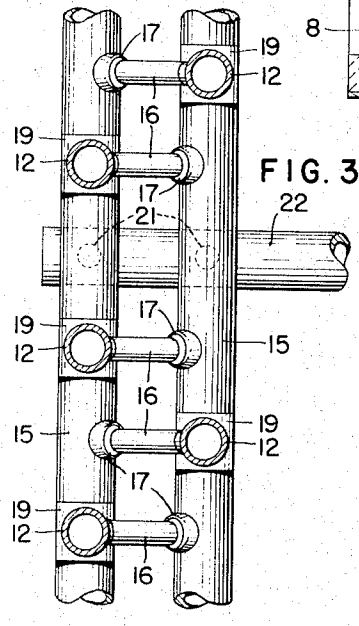
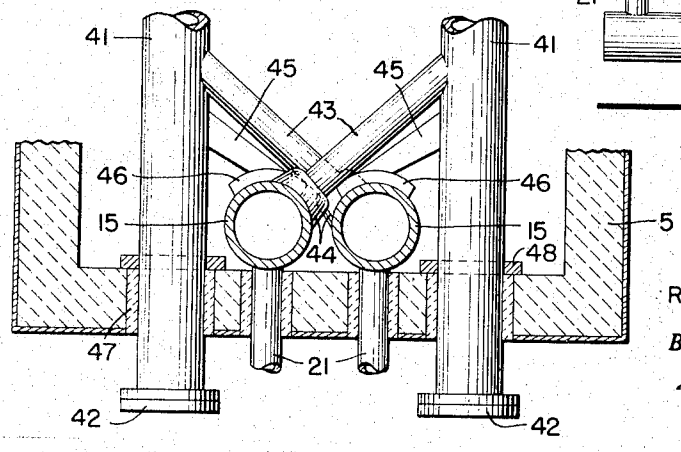


FIG. 3

FIG. 4



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TUBE HEATER

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ABSTRACT OF THE DISCLOSURE

Parallel vertically extending tubes in a hydrocarbon pyrolysis furnace rest on a horizontally extending manifold that is located in a lower, protected portion of the furnace chamber to shift the lower ends of the tubes laterally as the manifold expands.

The present invention relates to tube heaters, and more particularly to means for supporting vertically disposed tubes and attaching these tubes to an outlet manifold.

In hydrocarbon pyrolysis it is customary to provide a number of vertically disposed tubes located in a furnace chamber. The material to be heated is supplied to the top of the tubes and is withdrawn from the bottom after it has been heated. Due to the high temperature of the furnaces, much difficulty has been encountered at the inlet and outlet connections, as well as warping of the tubes themselves, due to thermal expansion.

It is an object of the invention to provide a novel means for supporting tubes in a tube heating furnace so that the strain on the tubes due to thermal expansion and contraction will be reduced. It is a further object of the invention to provide a tube supporting means which will permit individual tubes to be removed easily for replacement or repair.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a vertical section through the heater;

FIG. 2 is an enlarged view of the manner in which the lower ends of the tubes are supported;

FIG. 3 is a section taken on line 3—3 of FIG. 1; and

FIG. 4 is a view similar to FIG. 2 showing a modified tube arrangement.

The heater of the present invention is primarily intended for the pyrolysis of hydrocarbons and is of the type shown in Fleischer Patent No. 3,062,197. The furnace or heater comprises structure forming a furnace chamber which is vertically extending and elongated in a plane perpendicular to the drawing. The structure includes side walls **2**, top wall **3** and floor **4**, which are constructed in accordance with ordinary furnace practice, of a refractory material suitable to withstand the temperatures that are encountered, with the refractory being backed up with sheet metal. The floor has a depression **5** in its center, which depression extends lengthwise of the furnace chamber. This depression is also made of refractory that is backed up by sheet metal. Preferably the depression is separate from the floor and can be dropped in sections to give access to the lower ends of the tubes by removing bolts in the flanges **6**.

The furnace chamber is heated by horizontally extending rows of radiant type burners **7** located in side walls **2**. These burners can be grouped and fired in any desired

or necessary fashion depending upon the temperature and the gradient of the heat that is needed for the material flowing through the tubes. The products of combustion are exhausted through one or more ducts **8** which extend to one side of the upper end of the chamber. The entire furnace is supported in its location by means of a steel framework **9** which includes a part extending above the furname. This upper part can be protected by siding, if desired, and is provided with a roof **11**.

The material to be heated flows through a plurality of vertically extending tubes **12**, the upper end of each tube projecting above top wall **3**. The tubes, the number of which varies in accordance with the size of the heater, are located in a double row lengthwise of the furnace with every other tube offset so that they form a zig zag line as shown best in FIG. 3 of the drawing. The upper end of each tube is covered with a cap **13** having an inlet formed therein and each cap being provided with a bail or yoke **14**. Beneath each of the offset lines of tubes, which form the row lengthwise of the furnace, extends a manifold **15** which rests on the floor of the furnace. The tubes on one side are connected by short pipe sections **16** with the manifold on the other side so that each tube is connected with the manifold opposite it. Each of the manifolds is provided with fixtures **17** with the sections **16** welded to both the tube and fixture **17**. Each of the tubes is supported on the manifold directly under it by means of a support **18** fastened to the tube, the lower end of which has a shoe **19** that rests on the top of the manifold. Material heated in the tubes flows downwardly through tube **12** and the pipe **16** and into the manifolds. From the manifolds the material flows through extensions **21** into a common discharge pipe **22**. Preferably the extensions **21** are located approximately midway between the ends of the manifolds as shown in FIG. 3, so that movement of the ends of the manifolds due to expansion is reduced to a minimum. It is noted that sleeves **23** are provided in the floor of the furnace through which the pipes **21** extend and sleeves **24** are provided in the top wall through which the upper ends of the tubes project. The sleeves **24** have a loose enough fit so that the tubes can moves in the sleeves as required by thermal expansion and contraction of the tubes.

An upwardly directed force is applied to the upper ends of the tubes to help reduce any tendency to bend as they expand or contract. The means for accomplishing this includes bolts **25** fastened in the yokes **14**, with the bolts of adjacent pairs of tubes connected to a cross bar **26**. Each of these bars is biased upwardly through a rod **27** and a lever **28** which is pivoted at **29**. The other end of the lever is biased downwardly by means of a weight **31**. A turnbuckle **32** is inserted in rod **27** in order to provide some adjustment. Normally, the tubes rest on manifolds **15** and the weight **31** serves to bias the upper ends of the tubes sufficiently to prevent binding in sleeves **24** as the tubes expand and contract due to temperature changes in the furnace chamber. If desired, however, weight **31** can be heavy enough to support a portion or substantially all of the weight of the tubes in order to lighten the load on the manifolds **15**. Fluid to be heated is supplied to the upper ends of the tubes from a supply manifold **33** that is supported on brackets **34** extending from frame **9**. The liquid flows from manifold **33** to the tubes through pipes **35** that extend through caps **13**. These pipes are long and flexible enough to permit the tubes to change in length without undue restraint. From time to time it may be necessary or desirable to replace one or more tubes in the furnace. When this is done the proper section of trough **5** is dropped and the weld between the lower end of the tube to be removed and pipe **16** is broken, and the weld between cap **13** and pipe **35** is broken. The tube can then

be moved vertically from the furnace chamber by bail 14. To this end the roof 11 is provided with a center section 36 that can be lifted to one side so that a crane can be used to lift the tubes from the furnace or replace them.

With the construction shown, the manifolds for the group of tubes in the furnace are retained in the furnace chamber and subjected substantially to the heat of the chamber. This means that as the furnace temperature changes the manifolds will expand and contract. Since the lower ends of the tubes are resting on these manifolds, the tubes themselves will be moved according to temperature changes in the furnace. This relatively small movement will be transmitted through their entire length and thus reduce appreciably, if not entirely, the strain that is placed on the tubes as a result of their fairly rigid connection with the manifolds. In ordinary construction, when the manifold is out of the furnace chamber, the tubes themselves are subjected to considerable strain due to the differential expansion between the manifolds and the tubes. In addition, the material being heated is cooled more rapidly and less uniformly when the lower end of each tube projects through the furnace before being connected to the manifold. It is noted that while the manifolds and the lower ends of the tubes are in the furnace chamber, they are at a location below the burners and therefore will not be subjected to as extreme temperature changes as would otherwise be the case if the manifolds were on a level floor. Also, trough 5 can, if desired, be filled with a granular or fibrous insulating material. This may or may not be of advantage in some cases but in other cases it permits the use of a lower alloy steel for the connections 16 and manifolds, which could substantially reduce construction and welding costs.

In some types of hydrocarbon treatment it is necessary to use catalyst filled tubes. A construction in which catalyst could be used is shown in FIG. 4. In this figure it will be noted that the lower ends of tubes 41 extend through suitable sleeves in the bottom of the furnace and are capped as shown at 42. Thus the caps can be removed in order to remove the catalyst without interfering with the location of the tubes or their connections with the manifolds. In this case the tubes are slightly to one side of manifolds 15, but for supporting purposes may be said to be above the manifolds. Each tube is connected to a manifold by a connecting pipe 43. The weight of the tubes is supported on the manifolds by a support 45 attached to the tube with each support having a shoe 46 that rests on the manifolds. In this embodiment of the invention the lower ends of tubes 41 extend through sleeves 47 that are provided with slightly elongated openings so that the lower ends of the tubes can move as the manifolds 15 expand. Infiltration of air into the furnace chamber through the openings in sleeves 47 is prevented by plates 48 which surround the tubes and slide on the floor as the manifolds expand. This arrangement makes the lower ends of the tubes accessible while still retaining the features of the embodiment of FIGS. 1 to 3 in which the weight of each tube is supported by and the lower ends of the tubes are moved in accordance with the expansion of the manifolds.

While in accordance with the provisions of the statutes we have illustrated and described the best form of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. A tube heater comprising in combination a vertically extending chamber having a top and a bottom, a manifold extending horizontally along the bottom of said and within said chamber and subject to the heat thereof, a plurality of vertically extending tubes in said chamber, the upper ends of said tubes extending through said top, a support projecting from the lower end of each tube, a saddle attached to each support, said saddles resting on said manifold whereby expansion of said manifold will move said saddles and the lower ends of the tubes connected therewith, means above said chamber attached to the upper end of each tube, and mechanism to exert an upwardly directed force on each of said means attached to said tubes.

2. A tube heater comprising structure forming a chamber having side walls, a top wall and a floor, said chamber extending horizontally and being substantially rectangular in section, a plurality of horizontally extending rows of burners in each of said side walls, a pair of horizontally extending manifolds in said chamber parallel and adjacent to said floor, a row of vertically extending tubes with alternate tubes being located above one of said manifolds and the other tubes being located above the other of said manifolds, a support extending from the lower end of each tube, a saddle on each support, each saddle resting on the manifold above which the tube to which it is attached is located, a connecting pipe extending from the lower end of each tube to the manifold on which it is not resting, and means attached to the upper end of each tube above said top wall exerting an upwardly directed force thereon sufficient to take up any expansion of the tube and support a portion of the weight thereof.

3. The combination of claim 2 in which said floor is provided with means forming a depression extending lengthwise of said chamber, said manifolds being located in said depression.

4. The combination of claim 3 in which said means forming said depression is in sections whereby sections may be removed to give access to various groups of tubes.

5. The combination of claim 2 in which the lower end of each of said tubes extend through said floor below and to one side of the manifold on which it rests.

6. The combination of claim 2 including a discharge outlet extending through said floor from each manifold, said outlets being intermediate the ends of said manifolds.

References Cited

UNITED STATES PATENTS

2,898,892	8/1959	Campbell et al.	122—356
3,062,197	11/1962	Fleischer	122—510
3,195,989	7/1965	Ryzel	122—356 X
3,267,915	8/1966	Ghetto et al.	122—510

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