Oct. 28, 1958 C. W. PARRIS 2,858,114

HEATING MEANS FOR LIQUID STORAGE TANKS

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Fig. 1.

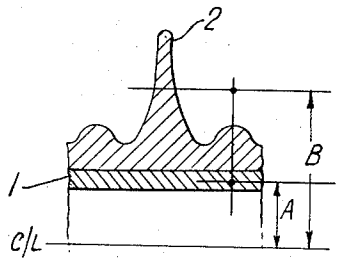


Fig. 2.

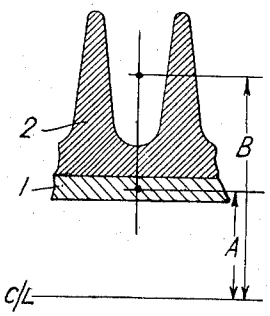
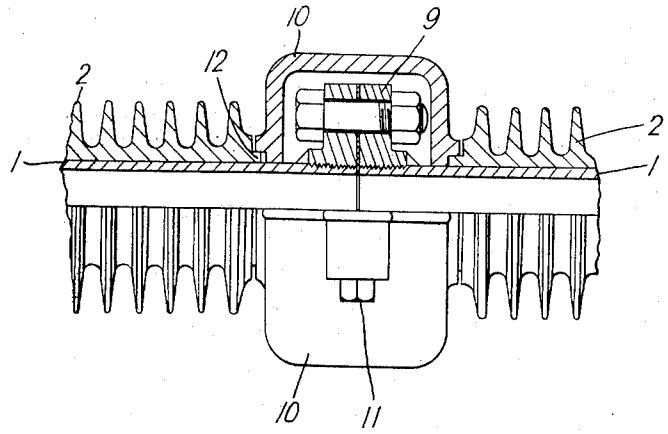


Fig. 3.



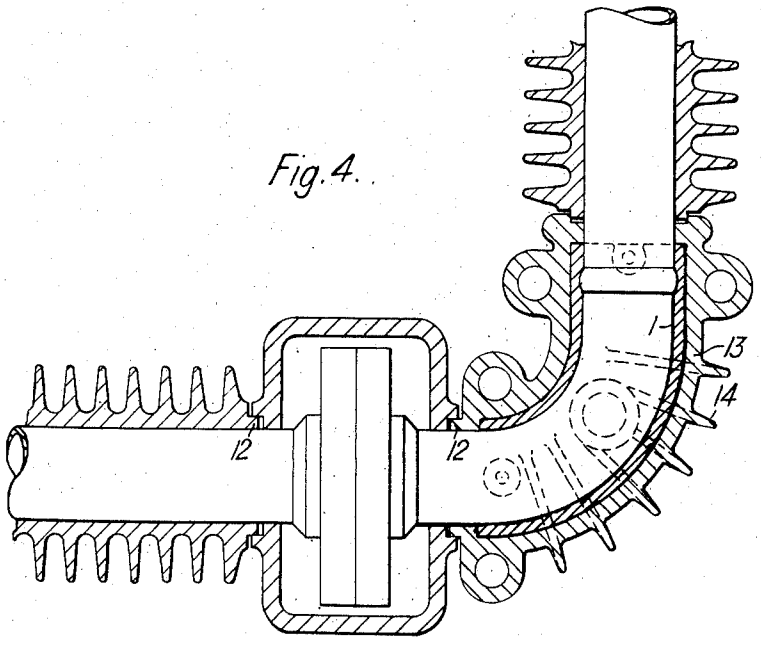
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Fig. 4.



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HEATING MEANS FOR LIQUID STORAGE TANKS

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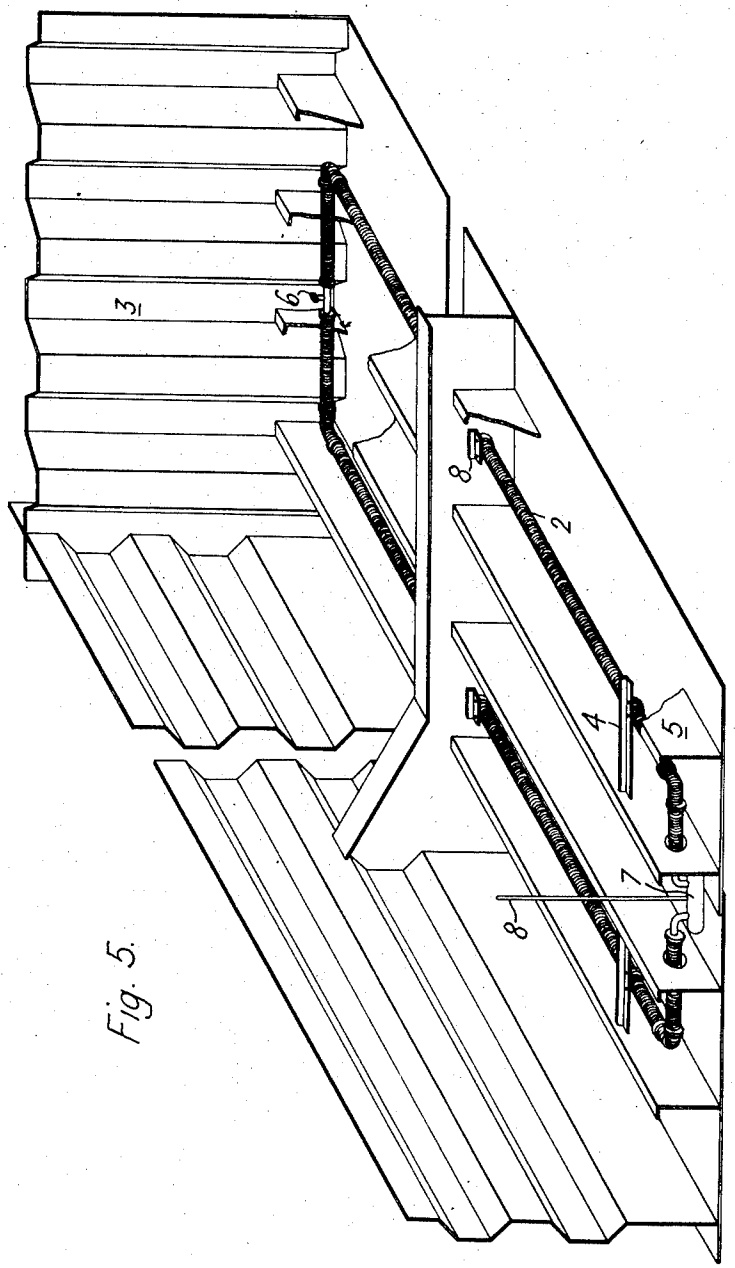


Fig. 5.

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HEATING MEANS FOR LIQUID STORAGE TANKS

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Application September 9, 1954, Serial No. 454,913

Claims priority, application Great Britain December 17, 1953

2 Claims. (Cl. 257—262.16)

This invention relates to heating means used in connection with storage or conveying tanks for viscous liquids, which require to be heated to facilitate evacuation of the tank or holder. Well-known examples of such tanks are the compartments of oil-carrying ships and the fuel tanks of ships in general, though the invention may be applied to any similar purpose whether the holder be stationary or mobile.

The usual heating means employed up to the present is an arrangement of steel tubes in the form of a continuous looped grid, placed as near the bottom of the tank or holder as may be practicable. These steel tubes are found in practice to suffer severely from external corrosion, particularly when the tanks have to be periodically washed out with water, whether fresh or salt water; although steel pipes are well adapted to resist the stresses from water hammer or the movement of the holder to which the pipes or tubes are attached.

To overcome the difficulty of short life resulting from external corrosion, it has been proposed to employ cast iron pipes either with plain cylindrical exterior surface, or with longitudinal ribs or fins. But the practical objections to the use of cast iron pipes or tubes are many. The length of tube which can be cast is limited by practical considerations, and therefore gives rise to a multiplicity of flanged joints, in which the bolts are vulnerable to corrosion. Also the pipes tend to become fastened or locked in their supports if even a small amount of corrosion occurs, and then the pipes are apt to fracture if movement of the structure takes place, as it must of necessity when the tank of holder is in motion. Fractures in the pipe are a source of danger, as the condensing of the fluid used for heating the pipe, such as steam or water vapour, causes a partial vacuum and the liquid external to the fractured pipe is then sucked inside it. The inevitable result is the fouling of the steam or vapour generator with foreign matter. Alternatively, noxious vapours may be exuded from the fractured pipes while men are inside the tank or holder for cleaning purposes.

Also the material employed, namely cast iron, is too weak and brittle to withstand the shock stresses arising from water hammer when slugs of condensate are blown through the tubes.

According to this invention, the advantages of corrosion-resisting cast iron and the flexibility and shock resistance of the steel tubes are combined, by shrinking-on or otherwise attaching cast iron protecting sleeves on the exterior surface of steel inner pressure tubes. Since the heat transfer from the exterior surface to the liquid being heated is much less than the heat transfer from the condensing liquid inside the tube which provides the source of heat, it is advantageous to increase the external surface in proportion to the internal surface, by the addition of gills or fins, preferably of circular form when the pipes are placed horizontally, or axially with the pipe when the pipes are placed vertically. In this way

the fins are always vertical and tend to free themselves from sludge or deposit.

As one example of carrying the invention into effect reference is made to the accompanying drawings, in which:

Figure 1 is a sectional view of part of a tube showing one example of gill or fin. Figure 2 is a similar view of another type of gill or fin. Figure 3 is a part sectional view showing a cast iron cover fixed over coupling flanges. Figure 4 is a view showing a cast iron cover over a bend, and Figure 5 is a view of a tank.

In the example shown in the accompanying drawings, steel inner tubes **1** are protected by cast iron sleeves **2** shrunk or otherwise affixed to the external surfaces of the inner tubes **1**. The tubes are arranged in a tank **3** supported by any suitable means so as to be flexible, such as by suspension from bars **4** supported by plates **5** in the tank **3**.

The steam or heating medium is admitted to the tubes through an inlet **6**, passing through the tubes into a header or manifold **7** having an exhaust pipe **8**.

There is also, according to this invention, an optimum ratio between the amount of external surface and the corresponding internal surface of the steel tube, as well as an optimum ratio for the projection of the surface from the body of the tube. Since the film co-efficient inside the tube may have average values ranging from 75 to 110 B. t. u. per square foot, per degree Fahrenheit mean temperature difference, while the external transmission to the liquid may range between 10 and 14 in corresponding units, subject of course to variation according to the liquids used, it follows that the ratio of external to internal surface must lie between 5.5 and 7.5. And also to secure the optimum heat gradient through the tube and external covering it is necessary to limit the projection of the exterior gills or fins in the following manner. Taking the radial distance B (Figures 1 and 2) from the longitudinal axis of the tube **1** to the centre of gravity of the peripheral curve bounding the gill or fin in longitudinal section as the criterion, this distance must not be more than 2.2 times the radial distance A from the centre of the tube to a point midway between the inner and outer surfaces of the steel tube **1** to secure the optimum heat gradient, or less than 1.8 times if the material is to be economically disposed.

To protect the flanged joints **9** between the tubes from corrosion, cast iron covers **10** in halves secured together by bolts **11** over the flanges **9** may be employed, arranged in such a manner that slight relative movement is permitted, such as by ring projections **12** on the ends of the sleeves **2** engaging in circular recesses in the covers **10**.

Where the steel tubes or pipes have to be bent, cast iron covers **13** in halves or sections may be bolted over the bends as protection against corrosion, see Figure 4, and the interior clearance space between the cover **13** and the steel bend **1** may be filled with molten lead or other heat conducting material which solidifies in position and acts as a transmitter of heat from the bend to the cover **13**, which may be provided wholly or partially with exterior fins or gills **14**.

By use of these means, heating coils or grids may be provided for tanks or holders, which will be completely protected against corrosion while yet possessing the flexibility of steel tubes.

What I claim as my invention is:

1. A tubular heating means for storage tanks for viscous liquids, comprising steel inner tubes, and cast iron sleeves shrunk on the exterior surfaces of the steel inner tubes, flange joints connecting adjacent ends of inner tubes, and cast iron covers secured over the flange joints and slidably engaging adjacent ends of said sleeves to

form joints therewith and permit slight relative axial movement between said sleeves.

2. A tubular heating means for storage tanks for viscous liquids, comprising steel inner tubes, and cast iron sleeves shrunk on the exterior surfaces of the steel inner tubes, the inner tubes having bends, cast iron covers secured over said bends, and a casting of lead filling the interior clearance space between the covers and the steel inner tubes.

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