

United States Patent

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[54] **COOLING TUBE FERRULE**
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[58] Field of Search165/178, 134; 285/213

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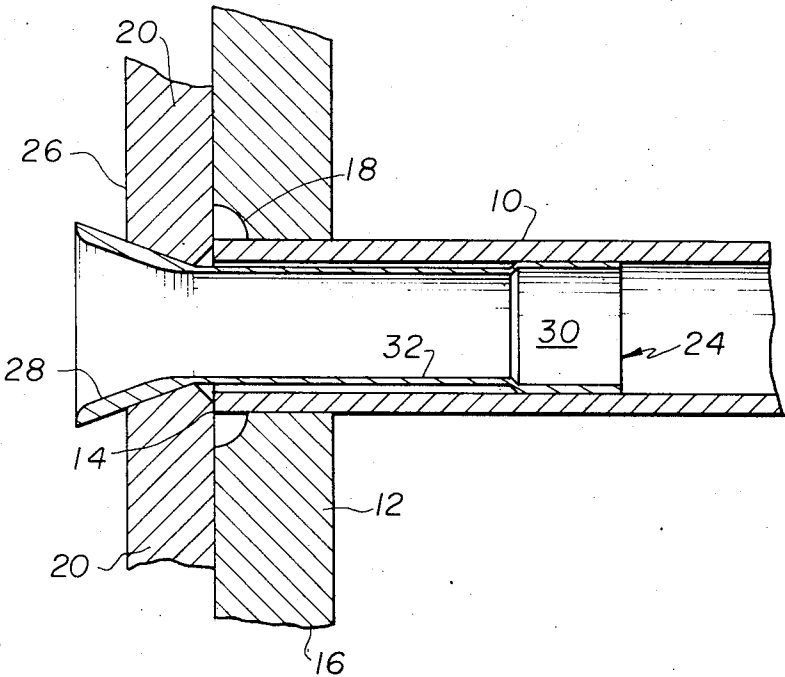
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[57] **ABSTRACT**

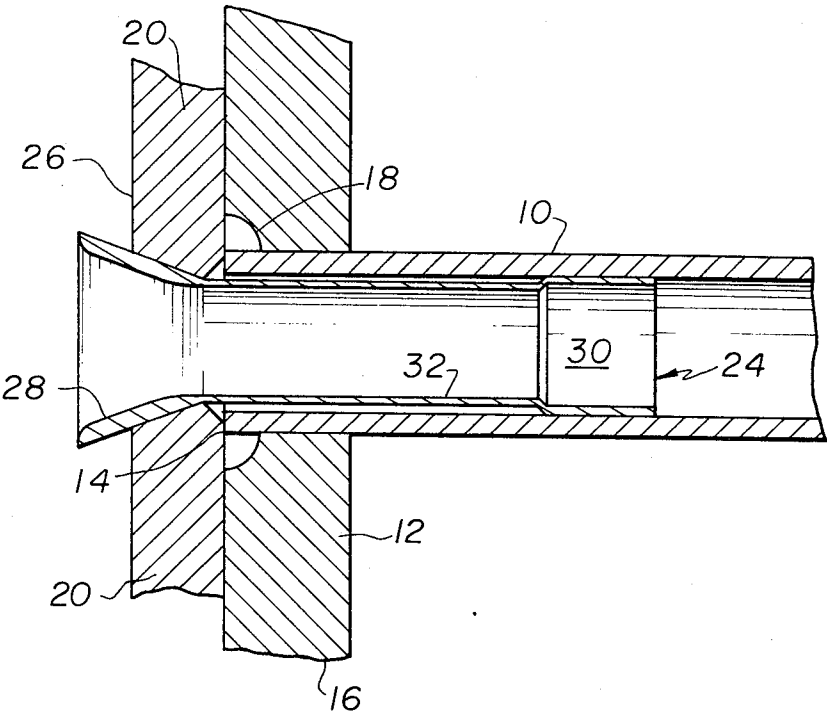
Erosion due to coke in a heat exchanger which cools
hot hydrocarbon gas is reduced. A ferrule is mounted
on the inlet end of a cooling tube, the ferrule having a
flared inlet end to reduce turbulence and having over
most of its length an annular space between the fer-
rule and the tube to prevent the ferrule from becom-
ing cool enough to induce carbon formation.

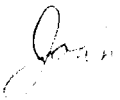
4 Claims, 1 Drawing Figure



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COOLING TUBE FERRULE

BACKGROUND OF THE INVENTION

In many industrial processes, it is necessary to flow hot hydrocarbon gases through conduits. Unfortunately, this can cause particles to accumulate. The deposition of carbon on the surface of the conduit, a phenomenon sometimes called "coking", occurs over a fairly wide temperature range and is aggravated when the hydrocarbon gas becomes turbulent, such as when eddy currents are induced in the area contiguous to the surface.

The formation of carbon deposits often necessitates shutdowns for cleaning. An example is found in the cracking of ethane where the hydrocarbon is treated with steam at high temperature and pressure and the resulting hot gas is passed in indirect heat exchange with water to cool the gas and generate steam for the process. The cooling will fractionate the hot gas into the products and usually takes place in an apparatus consisting of a tube bundle with a large number of cooling tubes through which the hot gases pass. The tubes extend between two parallel tube sheets which form the ends of a chamber into which the cooling water is directed. Gas impinging against the tube sheet will undergo abrupt changes in velocity and direction before passing through the tubes. This turbulence in the gas adjacent to the tube sheet causes the accumulation of carbon on the surface of the tube sheet. Eventually, enough carbon will accumulate that the mouths of the tubes are bridged to adversely affect the flow of gas and the performance of the heat exchanger. Another problem is erosion at the tube sheet and inside of the tubes caused by carbon particles which are carried by the moving gas and abrade these surfaces.

It is a common practice to either use a tube sheet of special alloy or to insulate the tube sheet with a metallic shroud which is placed over a layer of refractory which lines the outer surface of the tube sheet. The use of a tube sheet of special alloy is expensive, while the use of a metallic shroud requires a high degree of maintenance since coke forms behind the shroud and causes it to pull away from the refractory. In either case, erosion of the tube in the vicinity of the tube sheet is generally considerable.

SUMMARY OF THE INVENTION

It is the object of the present invention to overcome the drawbacks found in the prior art, such as those discussed above. In accordance with the present invention, a ferrule is positioned in an end of a tube to project beyond the outside surface of a tube sheet and is flared outwardly to prevent the formation of eddy currents and thus inhibit the formation of carbon within the ferrule, while at the same time providing a space for carbon to accumulate on the tube sheet without bridging the ferrule and interfering with the flow of gases therethrough.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a side view, partly in section, showing a structure made in accordance with the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

As shown in the figure, a cooling tube 10, which may be one of a number used to cool hot hydrocarbon gases, passes through a tube sheet 12 so that the end 14 of the tube is flush with the tube sheet surface 16. The tube 10 is welded to the tube sheet 12 by an annular weld 18. The tube sheet surface 16 is covered with a refractory material 20 to withstand the heat of the incoming hot gas.

A ferrule 24 is placed in the end of the tube 10 to project beyond the refractory 20. The outer surface 26 of the refractory 20 will accumulate carbon because it will be constantly bombarded by hot gases, which will slow before passing through the ferrule 24 and tube 10. However, since the ferrule 24 projects outwardly beyond the refractory surface 26, a space will be provided for the accumulation of carbon before the open mouth of the ferrule is bridged to necessitate shutting down the heat exchanger for cleaning. The outer end of the ferrule 24 is flared outwardly at 28 so that there is no abrupt change in direction of incoming gases. This prevents slow moving gas within the ferrule, which could cause the accumulation of carbon. The outward flare 28 also streamlines the ferrule 24 so that any carbon particles coming off of the refractory surface 26 will not be likely to strike the side wall of the ferrule at an angle acute enough to cause excessive abrasion.

Of course, it is to be appreciated that some abrasion will take place within the ferrule 24 but abrasion of the tube 10 is prevented, and when the ferrule 24 is no longer serviceable it can be removed and replaced with another. Another advantage of the present invention is that the outward flare 28 will cause incoming gas to urge the flared portion of the ferrule against the refractory. This prevents separation of the ferrule and the refractory, which would provide a crevice in which carbon could accumulate to cause damage. In order to insure heat transfer between the ferrule 24 and the tube 10, the inside end portion 30 of the ferrule is of an outside diameter equal to the inside diameter of the tube 10. In other words, the inside end portion 30 is of a diameter which is larger than the central portion 32 of the ferrule 24 which extends between the end portion 30 and the outwardly flared portion 28. Since the central portion 32 is of a smaller diameter than the inside of the diameter of the tube 10, the enlarged portion 30 serves the additional purpose of preventing an appreciable abrupt increase in diameter of the flow stream which could cause coking due to an appreciable sudden decrease in flow velocity.

The foregoing describes but one embodiment of the present invention. It will be apparent to one of ordinary skill in the art that other embodiments are possible without exceeding the scope of the present invention as defined in the following claims.

What is claimed is:

1. A heat exchanger for cooling a gas containing hot hydrocarbon comprising:
 - a tube sheet;
 - a refractory on one side of said tube sheet;
 - a plurality of holes in said tube sheet;
 - a plurality of holes in said refractory, said refractory holes each being coaxial with one of said holes in

said tube sheet and flared outwardly away from said tube sheet;

a plurality of tubes, the inlet end of each being positioned within one of said holes, said tubes extending beyond the other side of said tube sheet and through a cooling chamber to the outlet ends of said tubes;

a ferrule positioned within the inlet end of each of said tubes, each of said ferrules having a portion at its inlet end which is gradually flared outwardly and which projects beyond the inlet ends of said tubes and beyond said refractory, the outside surface of each of said flared portions engaging flat against the side wall of one of said holes in said refractory, each of said ferrules having an outlet end portion between the other side of said tube sheet and said outlet ends of said tubes, said outlet end portion being of an outside diameter approximately equal to the inside diameter of said tubes and a central portion connecting said outlet end portion and said flared portion, said central portion having an outside diameter less than the inside diameter of said tube.

2. The heat exchanger defined in claim 1 wherein said flared portions of said ferrules have thicker side walls than said central portions and said outlet end portions of said ferrules.

3. A ferrule for use in a heat exchanger for cooling a gas containing hot hydrocarbon, said heat exchanger

having a tube sheet covered on one side by a refractory with a plurality of holes in said refractory flared outward away from said tube sheet, said holes in said tube sheet being coaxial with a plurality of holes in said tube sheet, a plurality of tubes, the inlet end of each tube being positioned within one of said holes in said tube sheet with each tube extending beyond the other side of said tube sheet and through a cooling chamber to the outlet ends of said tubes, said ferrule comprising a portion of its inlet end which is gradually flared outward and which is adapted to project beyond said one side of said tube sheet and said refractory, the outside surface of each of said flared portions adapted to engage flat against the side walls of one of said holes in said refractory, and each of said ferrules having an outlet end portion of an outside diameter approximately equal to the inside diameter of said tubes and a central portion connecting said outlet end portion and said flared portion, said central portion having an outside diameter less than the inside diameter of said tubes, said ferrule being of sufficient length so that said outlet end portion engages against the inside wall of said tube between said other side of said tube sheet and said outlet ends of said tubes.

4. The ferrule defined in claim 3 wherein said flared portion of said ferrule has a relatively thick side wall, and said central portion of said ferrule has a relatively thin side wall.

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