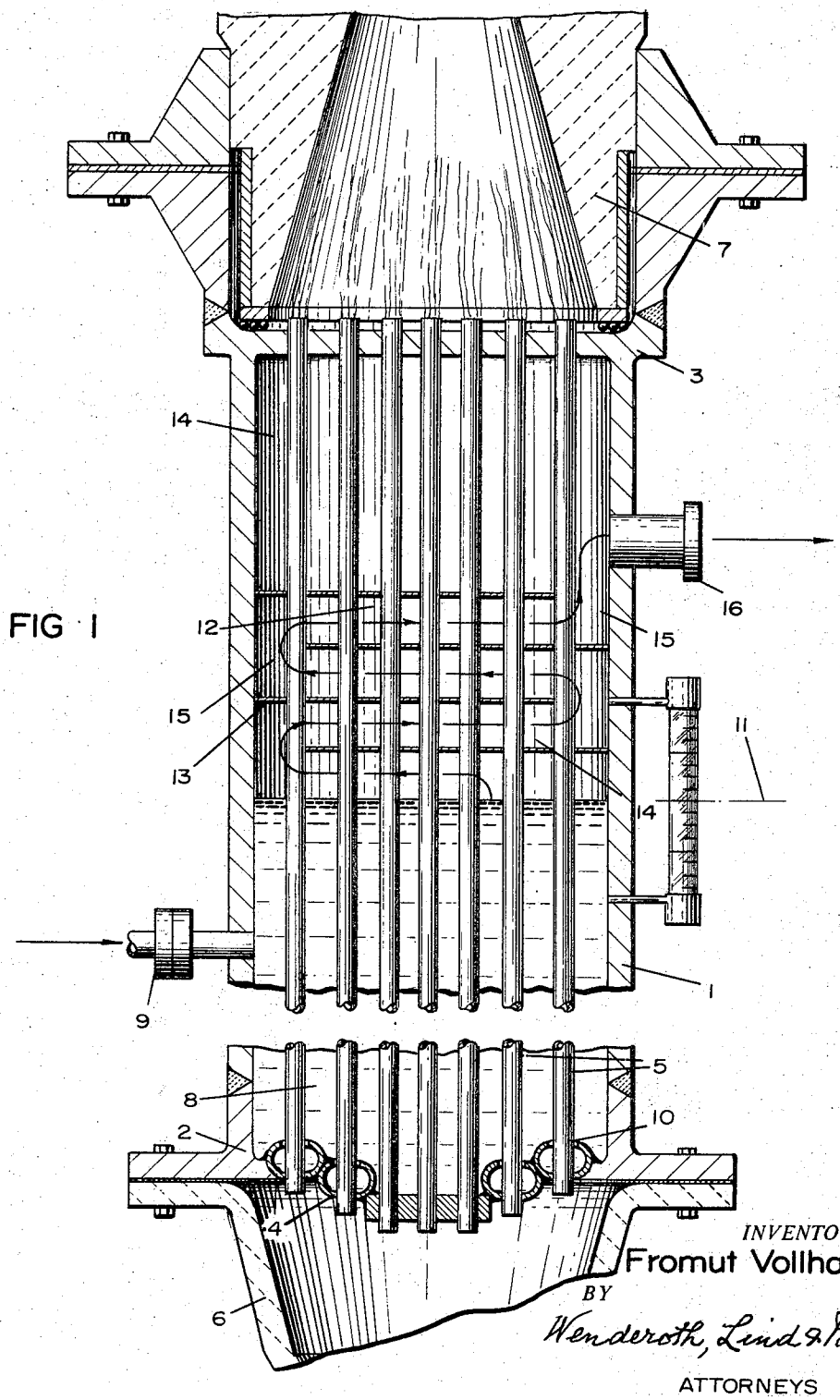
Oct. 24, 1967 F. VOLLHARDT 3,348,610

HEAT EXCHANGERS FOR COOLING FRESH CRACKED GASES OR THE LIKE

Filed March 14, 1966 3 Sheets-Sheet 1

FIG 1



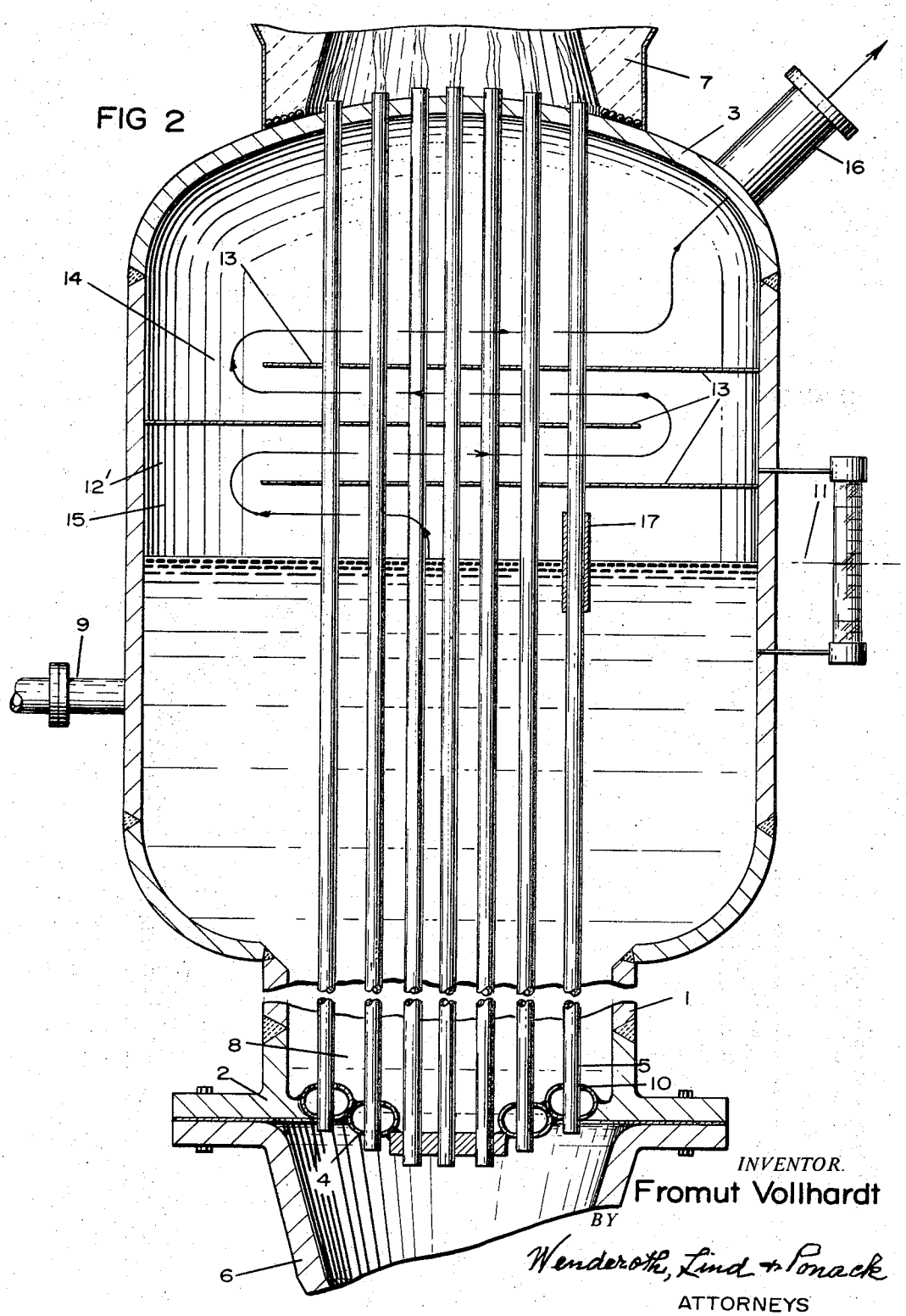
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FIG 2



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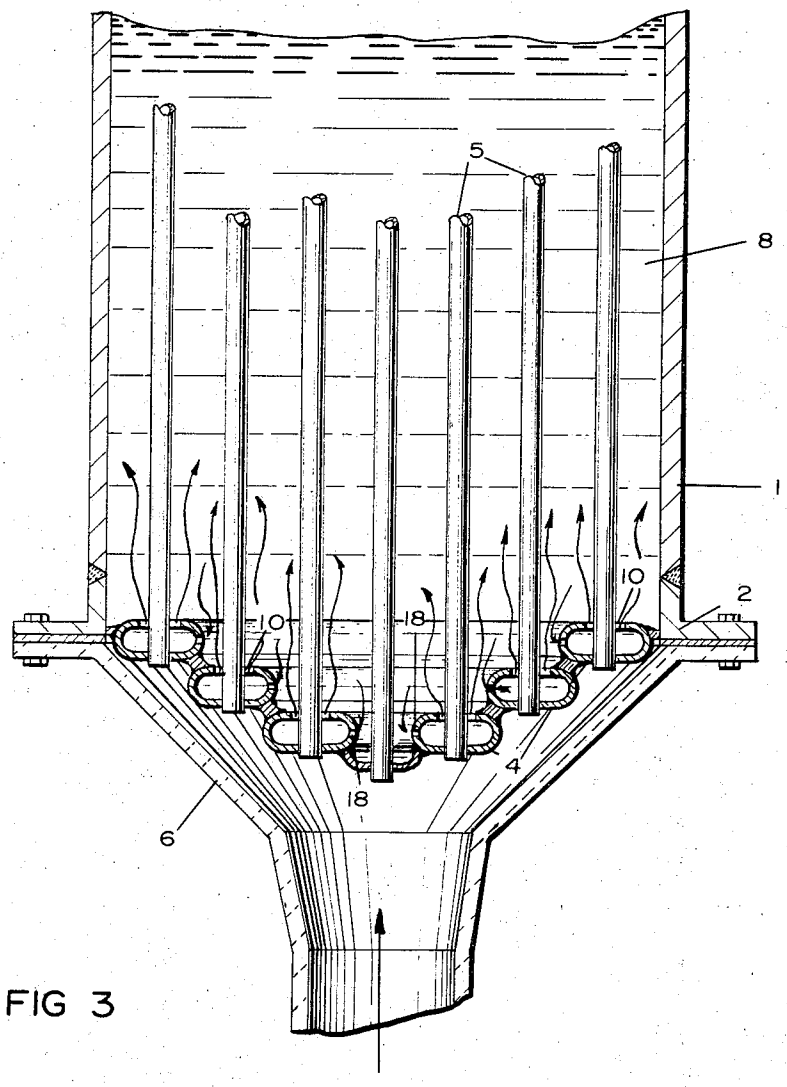


FIG 3

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3,348,610

HEAT EXCHANGERS FOR COOLING FRESH CRACKED GASES OR THE LIKE

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4 Claims. (Cl. 165—158)

This invention relates to a heat exchanger for the cooling of fresh cracked gases or the like.

An object of the invention is to provide a construction which consists of tube plates closing the two ends of an upright pressure jacket, one for the gas inlet head and the other for the gas outlet head, with at least that tube plate located at the gas inlet side consisting of stepwise arranged chambers interconnected with each other in gas-tight manner, the stepwise arrangement ascending from the interior outwardly with the interior of said chambers connected with the interior of the pressure jacket by openings in the chamber wall, and groups of essentially rectilinear heating tubes extending through the interior of the pressure jacket having their ends fixed in the tube plates.

A further object is to provide heat exchangers which are especially suitable for the cooling of fresh cracked gases wherein consideration is given not only to the high temperature and to the high pressure at which the cracked gases to be cooled are supplied in considerable amount, but also to their tendency to re-form, i.e., to coke precipitation and thus to undesired coke deposits in the heating tubes of the cooler. This last-mentioned property of cracked gases has been limited to a minimum after the cause of this behavior of cracked gases was discovered, and a correlation between the dwell time of the cracked gases being cooled in the gas inlet head of the cooler and the threshold of re-formation of the cracked gases in the heating tubes of the cooler established. It was found that the threshold of undesired coke separation could be controlled by reducing the time of dwell of the cracked gases in the gas inlet head.

A still further object is to provide a construction wherein an effective decrease of the time of dwell of the cracked gases in the gas inlet head is realized by a special construction of the latter and of the appurtenant tube plate of the cooler, which makes it possible to limit the coke precipitation to a tenable minimum.

Normally the vapor (steam) developed from the cooling water is led directly to a steam drum. Because of the high pressure, about 140 atmospheres excess pressure, at which such a cracked gases cooling plant, consisting of a plurality of coolers which give off the therein-developed steam to a common steam drum, must be operated, the steam drum walls have to be inconveniently large and thick.

A further object is to provide a simplification which consists in subdividing the pressure jacket interior into a lower water chamber and a steam chamber located at the gas outlet side and in arranging the steam chamber above the highest water level and locating between the latter the steam discharge conduits of the cooler by means of guiding plates in such a manner as to form interconnected sections through which the heating tubes extend and in which the steam passing therethrough to the steam discharge outlets is forced to impinge on the heating tubes.

A further object is to provide a construction which makes it possible to eliminate a common steam drum, since the separate guiding plates in the steam chamber make it possible to realize dry and slightly superheated steam which can then be directly conducted to the corresponding point of steam consumption by way of a steam collecting conduit.

A further object of the invention consists in so constructing the pressure jacket of the cooler that it is widened at its upper end, adjacent the gas outlet, relative to the lower portion of the pressure jacket, thereby forming an enlarged steam chamber. This object presents not only the possibility of an increased steam volume capacity in the steam chamber of the cooler, but it further also appreciably enlarges the water space and thereby the water content of the cooler, since the lower part of the steam chamber constructed according to the invention is filled with water as in a normal steam drum.

As a result of the shortening of the time of dwell at the gas inlet end of the heating tubes in the vicinity of the chambers, the available heat from the highly heated cracked gases exceeds the heat transfer conditions prevailing in the said vicinity, so that insupportable and injurious overheating can take place. To counteract this, a further object is to construct the chambers forming the tube bottoms at the gas inlet side with openings which interconnect the interior of the pressure jacket with the interior of the chambers, these openings being situated at the upper side of the chambers and in the side walls below said upper side. By this expedient, a natural secondary circulation of the cooling water is established in the vicinity of the chamber interior and thus in the vicinity of the ends of the heating tubes, which assures improved direct heat flow-off (discharge) to the cooling medium from the here especially large amount of available heat of the cracked gases.

With the above and other objects in view which will become apparent from the detailed description below, several modifications are shown in the drawings, in which:

FIG. 1 shows a longitudinal sectional view with parts in elevation of a heat exchanger with uniformly extending pressure jacket,

FIG. 2 shows a similar view of a modified heat exchanger with a widened upper end portion of the pressure jacket, and

FIG. 3 shows a similar view of the lower part of a heat exchanger at the gas inlet side.

The heat exchanger, shown in FIGS. 1 and 3, consists of an outer pressure jacket **1**, the ends of which are tightly closed by tube plates **2** and **3**. At least one of these two tube plates, and particularly plate **2** located near the gas inlet end, comprises chambers **4**. The chambers **4** are annular and concentrically and stepwise arranged relative to each other.

The tube plate **3** closing the gas outlet end of the pressure jacket **1** can be constructed as a flat plate, or as an arched plate, or, as tube plate **2**, can be composed of chambers **4**. Chambers **4** of the tube plate **2** as well as tube plate **3** are traversed by heating tubes **5** welded thereto and these tubes **5** extend through the interior of the pressure jacket **1** from plate to plate.

The cracked gases to be cooled are supplied through the gas inlet head **6** which covers plate **2** and is distributed to the heating tubes **5**. After passing through the heating tubes **5**, the cooled cracked gases are withdrawn through the gas discharge head **7** which covers plate **3** and the cooled gases are then led to a point of consumption therefor.

Cooling water is supplied to the interior **8** of the pressure jacket through cooling water inlet **9**. In order that the cooling water be available to the interior of the chambers **4** of plate **2**, openings **10** are provided in their walls facing the interior **8** of the pressure jacket. These openings can also be formed by providing bores in the walls of chambers **4** facing the interior **8** of the pressure jacket,

with an inside diameter which is somewhat larger than the outer diameter of heating tubes **5**.

Further openings **18** are arranged below the openings **10**, i.e., at a lower level. This assures a separate natural circulation of the cooling medium through the interior of chambers **4**. The course of the thus-produced flow is indicated by arrows on FIG. 3.

In the pressure jacket interior **8**, a cooling water level **11** is maintained so that a steam chamber **12** of sufficient size remains thereabove. The steam chamber **12** thus arranged in the pressure jacket interior **8**, between the tube plate **3** and cooling water level **11**, is subdivided into individual sections **14** by the guide plates **13** or similar built-in parts. The guide plates **13** are provided at one side thereof with an opening **15** adjacent the inner wall of the pressure jacket **1**, so that a connection is established between the individual successive sections **14**. The successive guide plates **13** are arranged so that they are opposed with respect to each other. As a result, the steam developed from the cooling water and rising from the cooling water level **11** is forced to traverse, at times transversely of the longitudinal axis thereof, all of the successively arranged sections **14** through which the heating tubes **5** pass vertically, after which the steam leaves the steam chamber **12** through the steam discharge outlet **16** arranged in the topmost section **14**.

In the modification of FIG. 2, the steam chamber **12'** is widened relative to the lower part of the cooler.

As a result, the cracked gas cooler has increased steam receiving capacity and greater cooling water content.

With water of poor quality, which would otherwise be rejected because of undesirable influence on the heating surfaces, it is possible to provide tube sections **17** in the transition area from water chamber to steam chamber, which sections **17** are drawn over the heating tubes **5** to provide protection against corrosion. An example is shown in FIG. 2.

It is thought that the invention and its advantages will be understood from the foregoing description and it is apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing its material advantages, the forms hereinbefore described and illustrated in the drawings being merely preferred embodiments thereof.

I claim:

1. A heat exchanger for cooling fresh cracked gases or the like comprising a vertical pressure jacket, means for supplying water to the interior of said jacket, tube plates located at the ends of said jacket, a gas inlet head located at the lower end of said jacket and a gas outlet head located at the top of said jacket, the tube plate at the lower end of said jacket comprising step-wise arranged chambers interconnected with each other in gas tight relation, said chambers having openings in the chamber wall communicating with the interior of said pressure jacket, rectilinear heating tubes extending through the interior of said jacket and having their ends fixed to said tube plates, the interior of said pressure jacket being subdivided into a lower water chamber and an upper steam chamber, said jacket having a steam discharge outlet from said steam chamber, guide plates located in said steam chamber above the highest water level forming interconnected sections through which said heating tubes extend so that steam passing through said section to said steam discharge outlet are forced into contact with said heating tubes.

2. A heat exchanger as set forth in claim **1** wherein said guide plates are located in spaced horizontal relationship with staggered intercommunicating openings.

3. A heat exchanger as set forth in claim **1** wherein said pressure jacket is widened at its upper end adjacent said gas outlet head relative to the lower part of said pressure jacket to provide an enlarged steam chamber.

4. A heat exchanger as set forth in claim **1** wherein said stepwise arranged chambers are provided with additional openings located below said first named openings also communicating with the interior of said jacket.

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