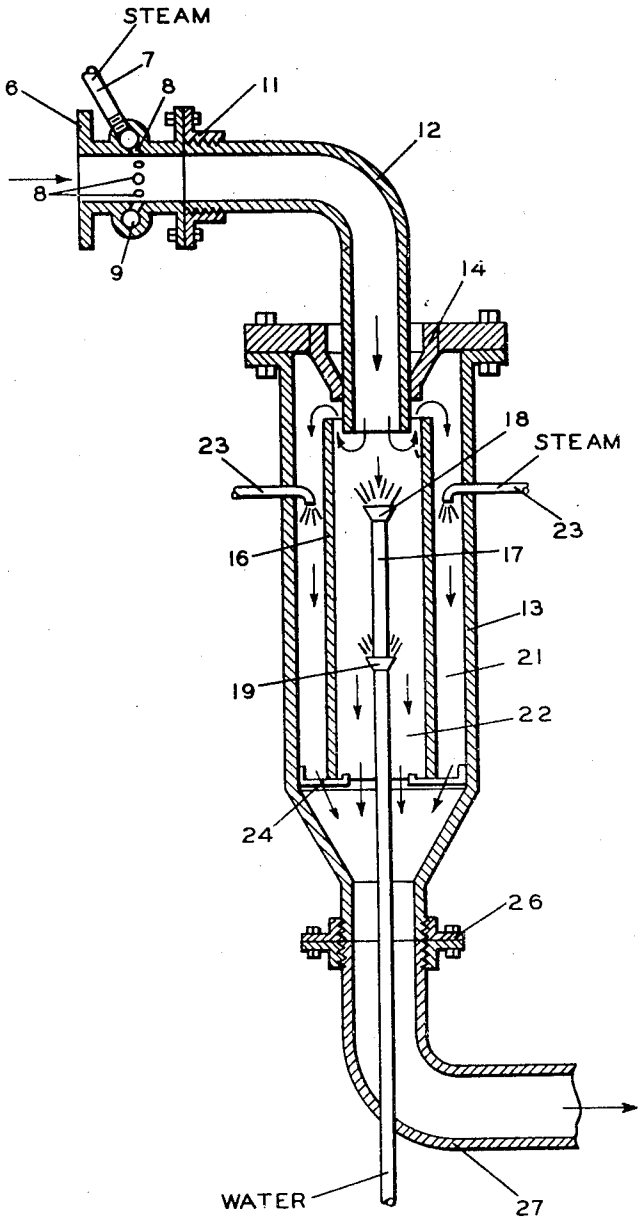
July 11, 1950 L. J. WEBER 2,514,529

FLUID COOLING APPARATUS

Filed July 16, 1946



INVENTOR
L. J. WEBER

BY Hudson and Young

ATTORNEYS

Patented July 11, 1950

2,514,529

UNITED STATES PATENT OFFICE

2,514,529

FLUID COOLING APPARATUS

Louis J. Weber, Bartlesville, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware

Application July 16, 1946, Serial No. 683,905

6 Claims. (Cl. 261—117)

1

This invention relates to apparatus for reducing the temperature of fluids. One aspect of this invention relates to apparatus for quenching high temperature gases. Another aspect of this invention relates to a method for preventing the coking or accumulation of carbon in a transfer line. Still another aspect of this invention relates to a flexible joint.

In various hydrocarbon conversion processes especially those processes using pebble heater type furnaces and reaction chambers, the effluent gases must be colled quickly in order to stop the reaction and to minimize the deterioration of subsequent equipment. In conventional equipment for cooling hot gases, the direct contact of the hot gases with the apparatus results in severe stresses because of the variations of temperature in the metal. These stresses eventually cause failure of the apparatus. Especially in the cracking of hydrocarbons in pebble heater type furnaces or reaction chambers, the hot gases entering the cooling apparatus are often at a temperature above 1600° F. and as a result of the injection of the cooling medium therein the cooling apparatus is heated and cooled spot-wise causing severe deformation.

It is therefore an object of this invention to provide a quenching apparatus which will reduce the temperature of hot gases without imposing undue thermal stresses in the quenching apparatus.

Another object is this invention is to provide a novel apparatus for the quenching of hot gases.

Still another object of this invention is to prevent the accumulation of carbon in the gas transfer line to the quenching chamber.

A further object of this invention is to provide apparatus for the quenching of hot gases which is relatively less susceptible to deterioration at higher temperatures.

It is another object of this invention to provied a flexible member for the passage of a conduit therethrough.

Various other objects and advantages will become apparent to those skilled in the art from the accompanying description and disclosure.

In the drawing

The drawing diagrammatically illustrates in cross-section apparatus according to this invention for the quenching of hot gases. Element 6 comprises a hollow cylindrical casting open at both ends with an annular passageway 9 circumferentially disposed around the casting with perforations 8 leading from the annular passageway

2

9 into the hollow interior of casting 6. A conduit 7 is provided for introducing steam or other vapor into annular passageway 9. Casting 6 is connected to an L-shaped metal conduit 12 by means of flange 11. Conduit 12 passes through a conical shaped or annular tapered member 14 into an outer casing 13, preferably of a cylindrical shape. Conical shaped member 14 comprises an inverted truncated cone or annular tapered member having a flat lip or rim through which conduit 12 extends and adjoins the lower or small end of the inverted cone. The conical portion of member 14 is generally constructed of similar material and of similar thickness to conduit 12. Conduit 12 is usually welded to member 14 but conduit 12 may merely be inserted in conical member 14 to form a gas-tight fit without departing from the scope of this invention. The lip or rim of member 14 is welded or bolted to outer casing 13. The lower portion of outer casing 13 is of a restricted cross-sectional area and is usually of a conical shape. A cylindrical shell 16 is positioned, preferably concentrically, within casing 13 in such a manner that conduit 12 extends a short distance into shell 16. Shell 16 is supported by suitable supports 24. The shape of shell 16 is preferably cylindrical and has a larger diameter than conduit 12 so that conduit 12 may extend a short distance into shell 16. Inner shell 16 forms an outer annular passageway 21 between outer casing 13 and inner shell 16 and also forms an inner passageway 22 within shell 16. A conduit 27 is attached to the lower portion of casing 13 by means of flanges 26. A conduit 17 and nozzles 18 and 19 provide means for injecting a spray of water or other liquid into inner shell 16. Conduits 23 provide means for introducing steam or other vapor into annular space 21.

For high temperature work shell 16 and casing 13 are constructed of chrome-nickel-iron alloy of about 25% chromium and 20% nickel. Flange 14 may conveniently be constructed of 18–8 stainless steel.

Although the apparatus shown is illustrated in a vertical position the apparatus may be placed in a horizontal position without departing from the scope of this invention. Also steam injection means 23 may be omitted if desired.

Operation

In the drawing hot gases to be quenched are passed through hollow casting 6 into conduit 12. Steam is introduced into annular passageway 9 through line 7 and is injected into the flowing

gaseous stream through perforation or orifices 8. The steam forms a protective film on the inner surface of conduit 12 and prevents the accumulation of carbon and carburization of the metal surface. Hot gases from conduit 12 into passageway 22 formed by shell 16. These gases pass in two directions, through outer passageway 21 and through inner passageway 22 to the lower portion of casing 13 where they are admixed and recombined. The coefficient of expansion of the conical tapered member 14 and conduit 12 are the same, and therefore, as a result of temperature changes, the member 14 and conduit 12 expand and contract together. Annular tapered member 14 is flexible transversely and, therefore, tends to decrease the stress on conduit 12. In this manner the joint of conduit 12 and member 14 is considerably more flexible than the conventional joints. Steam is injected through conduit 23 to aid in forcing the gaseous mixture through outer passageway 21 and prevents stagnation of the mixture therein. Water is injected through line 17 and nozzles 18 and 19 into space 22 as a result of which the hot gases are rapidly cooled. The gases in the annular space 21 are cooled when they contact the gases from space 22 in the lower portion of casing 13. Cooled gases are then passed from casing 13 through conduit 27 to subsequent equipment (not shown) for further cooling or treatment of the gases.

Casting 6 may form the outlet from a pebble heater type reaction chamber and is so constructed as to facilitate the injection of steam through a number of orifices into the reaction chamber effluent. Steam injection aids in the quenching operation and tends to provide a protective film of steam on transfer line 12.

At the point of connection of conduit 12 with annular tapered member 14 a special expansion feature is provided, as previously discussed, by the conical or tapered shape of the flange. It has been found to be very undesirable to weld a conventional flange directly to such a conduit as 12 because of the expansion or movement of the conduit 12 directly against the flange itself. The coefficient of expansion of the flange and the conduit are not the same and large stresses are set up. By means of the conical shape of member 14, the effect is similar to that of another conduit which is capable of expanding and moving approximately the same as conduit 12.

Inner shell 16 shields outer casing 13 from the water spray. It is well known that when alloy steels are either heated or cooled spot-wise that severe stresses occur in the metal. By placing the shield, such as shield 16, to protect outer casing 13 the life of the casing is greatly increased. When inner shield 16 becomes deformed or otherwise incapable of further use, it may be easily removed by removing member 14.

The following example is illustrative only of an application of the present apparatus and should not be considered unnecessarily limiting to the invention:

Example

A cracked hydrocarbon effluent was passed from a pebble heater type conversion chamber into cooling apparatus constructed according to this invention. The gaseous effluent at atmospheric pressure and at a temperature of about 1650° F. was passed at a rate of about 11,000 cubic feet per minute into the cooling apparatus. A gaseous effluent at a temperature of about 600° F. was removed from the cooling apparatus and passed to a second cooling zone for further cooling.

Having described my invention, obviously various alterations and modifications of the apparatus will become apparent to those skilled in the art without departing from the scope of this invention.

I claim:

1. Apparatus for quenching hot gases comprising in combination an elongated outer casing having an inlet end closure member comprising an annular tapered member forming a flexible joint at its smaller end with an inlet conduit extending through said tapered member into said chamber; an inner elongated tubular member of lesser width than said casing and of greater width than said inlet conduit, extending lengthwise of said casing in spaced-apart relation thereto throughout the length of said tubular member so as to provide an annular chamber between said casing and said tubular member communicating at both ends with the cylindrical chamber within said tubular member, said tubular member surrounding said inlet conduit for a small portion of its length in spaced-apart relation thereto; support means for holding said tubular member in position; conduit means communicating with said cylindrical chamber for injecting a cooling fluid therein; and an outlet conduit connecting with the outlet end of said casing for withdrawing quenched gases from both of said chambers.

2. The apparatus of claim 1 including conduit means extending through said casing into said annular space for introduction of a cooling fluid thereto.

3. Apparatus for quenching hot gases comprising in combination an outer cylindrical casing having a closure member at the inlet end thereof; an inner cylindrical shell of lesser diameter than said casing axially positioned within said outer casing in spaced-apart relation thereto throughout its length providing an outer annular quenching chamber between said outer casing and said inner shell and an inner cylindrical quenching chamber within said inner shell each in communication with the other at both ends; an annular tapered member attached to said closure member and forming a gas-tight flexible joint with an inlet conduit extending therethrough axially of said casing, said conduit being of lesser diameter than said inner shell and extending thereinto a short distance in spaced-apart relation thereto; an eduction conduit connecting with the outlet end of said casing for withdrawing quenched fluid from both of said chambers; support means for holding said shell in position; conduit means for injecting cooling fluid into said inner quenching chamber; and means for injecting a cooling fluid into said inlet conduit around the periphery thereof so as to provide for a protective fluid film on the walls of said conduit.

4. Apparatus for quenching hot gases which comprises in combination an outer elongated cylindrical casing having an inlet end closure member comprising an annular axially positioned tapered member surrounding an inlet conduit and forming a gas-tight expansion joint therewith at the smaller end of said tapered member, said inlet conduit extending axially into the interior of said casing a short distance; an inner tubular member of lesser diameter than said outer casing and of greater diameter than said inlet conduit extending axially of said casing to the proximity of the outlet end thereof and surrounding said inlet conduit at the inner end thereof

in spaced-apart relation thereto so as to provide an inner cylindrical primary quenching chamber and an outer annular secondary quenching chamber each in communication with the other at the inlet end between said inlet conduit and said tubular member and also at the outlet end; support means for holding said tubular member in position; liquid injector means communicating with said primary quenching chamber; fluid injector means communicating with said secondary quenching chamber; and a tapered member connecting the outlet end of said casing with a conduit of lesser diameter for mixing of quenched gas from the primary and secondary quenching zones and eduction of the same.

5. The apparatus of claim 4 including means for injecting a cooling fluid into said inlet conduit around the periphery thereof so as to provide for the formation of a protective fluid film on the walls of said conduit.

6. Apparatus for quenching hot gases which comprises in combination an outer elongated upright cylindrical casing having a top closure member; an inner axially positioned cylindrical shell of lesser diameter spaced apart from said casing throughout its length and from said closure member and extending to the proximity of the lower end of said casing, providing an inner cylindrical quenching chamber and an outer annular quenching chamber in communication with each other at both the upper and lower ends; support means for holding said shell in position; an inlet conduit extending axially in gas-tight arrangement through said closure member into said inner quenching chamber a short distance, said conduit being of lesser diameter than said shell so as to provide an annular passageway between said conduit and said shell connecting said inner and outer chambers; a tapered member connecting the lower end of said casing with an eduction conduit of lesser diameter; and injector means for introducing a cooling fluid into said inner chamber.

LOUIS J. WEBER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
958,752	Mackensen	May 24, 1910
1,699,424	Brdar	Jan. 15, 1929
1,875,130	Peck	Aug. 30, 1932
1,966,859	Heinrich	July 17, 1934
2,212,288	Decker	Aug. 20, 1940
2,321,879	Valdez	June 15, 1943
2,421,761	Rowand et al.	June 10, 1947