Jan. 5, 1965 K. A. DE GHETTO ETAL 3,164,644

LIQUID COOLED PORT

Filed May 7, 1962 2 Sheets-Sheet 1

FIG. I.

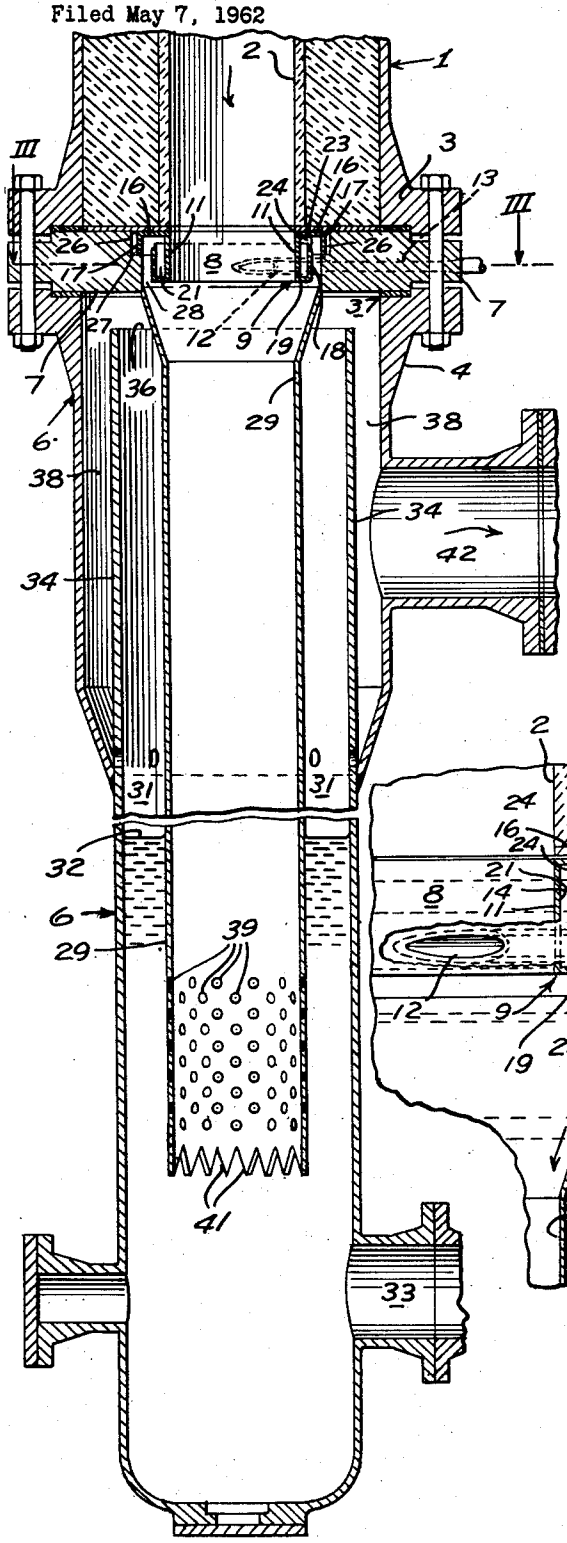


FIG. II.

INVENTORS
KENNETH A. DEGHETTO
EDWARD J. LANSING
ROBERT A. McCALLISTER

BY Charles F. Barclay
ATTORNEY

Jan. 5, 1965 K. A. DE GHETTO ETAL 3,164,644

LIQUID COOLED PORT

Filed May 7, 1962 2 Sheets-Sheet 2

FIG. III.

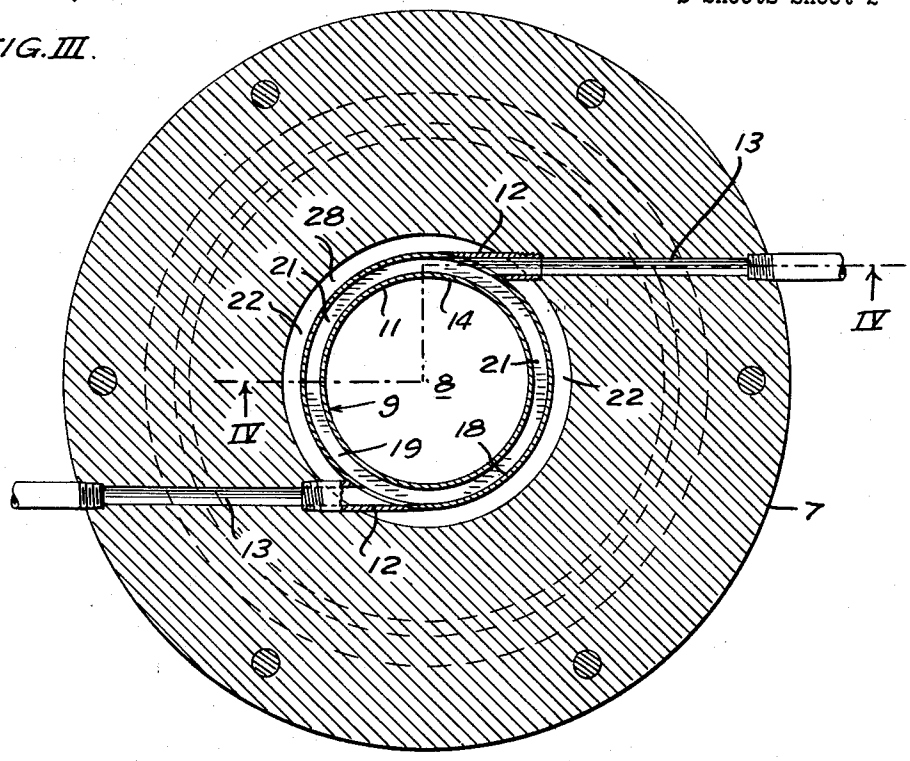
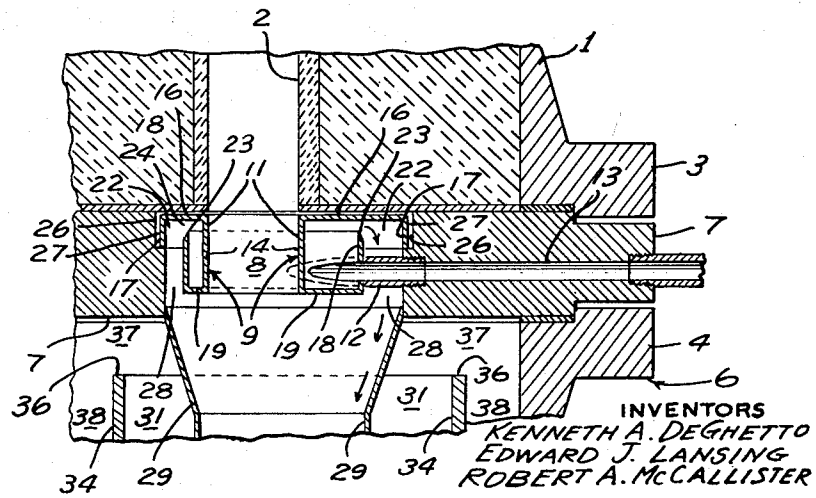


FIG. IV.



INVENTORS
KENNETH A. DEGHETTO
EDWARD J. LANSING
ROBERT A. McCALLISTER

BY Charles E. Bailey
ATTORNEY

United States Patent Office 3,164,644 Patented Jan. 5, 1965

3,164,644

LIQUID COOLED PORT

Kenneth A. De Ghetto, Glen Rock, N.J., Edward J. Lansing, Lockport, Ill., and Robert A. McCallister, Hackensack, N.J., assignors to Foster Wheeler Corporation, New York, N.Y., a corporation of New York

Filed May 7, 1962, Ser. No. 192,643
9 Claims. (Cl. 261—159)

This invention relates to the protection of a metal port structure against a high temperature fluid flowing therethrough. It is a metal port structure of novel fluid cooled design adapted to prevent burn out or loss of structural integrity under severe operating conditions.

Situations frequently arise wherein high temperature fluids are to pass through ports at conduction flux rates sufficient to burn out bare metal.

In reaction vessels growth must be accommodated and there is usually a desire for positive sealing. To attain these goals, supporting flanges are often arranged about a port. In the face of structural and process requirements, space devoted to the cooling of port structures is grudgingly allotted. Metal is often used for these port structures because of a need of versatility and resistance of thermal shock.

Protection of port structures can be aggravated by plant start ups and shut downs which occasion differential expansions and contractions.

Various liquid cooled metal port structures have been attempted. But these attempts were frustrated by one or a combination of the following:

Uneven contact of cooling fluid with the metal surface exposed to hot gas. This difficulty has generally been attributed to pulsations or to swirling of cooling fluid supply.

Differential thermal expansion or contraction of the port structure relative the parent structure, especially at plant start ups and shut downs.

Inadequate supply of cooling fluid.

The present invention overcomes these difficulties by a novel port structure. More particularly, the interior of the port is lined with a protective conduit divided along its length by a weir into an inward chamber, inward relative the port, and an outward chamber. Cooling fluid is introduced into the inward chamber. Overflow cooling fluid is delivered from the inward chamber to the outward chamber. Exhaust means accommodate the removal of cooling fluid from the outward chamber.

Basically this advance offers improved contact of cooling fluid against the conduit even in the event of erratic cooling fluid supply.

In vertical protective conduits, if the pressure of the cooling fluid supply accidentically drops, cooling fluid still remains in the critical inward chamber.

Another facet of this invention is the mounting of the conduit on a flexible member spaced from the parent structure and capable of deflecting to accommodate differential contraction or expansion of the conduit relative the parent structure.

A port structure defining the entrance to a quench boot is particularly suited to this invention. The presence of a cooling liquid for direct contact heat exchange with a gas makes a metal the obvious material choice for the port structure. Also, in this application the cooling liquid can be discharged from the outward chamber of the protective conduit to cool the inner tube of the quench boot.

The foregoing has been interested predominantly in the physical heat sink capacity of the cooling fluid. But application of this invention to quench boots offers an opportunity of adding a vapor to the gas. In a synthesis gas generator system the use of water as a cooling fluid

introduces steam into a CO and H_2 stream at the quench boot. The resulting mixture is cooled for economical piping. Also the steam is subsequently employed in the presence of a suitable catalyst for the water gas shift reaction wherein carbon monoxide reacts with the water to yield hydrogen and carbon dioxide.

The use of this invention for introduction of fluids for chemical reactions with a hot gas stream in a quench boot has not been overlooked. For example, it is sometimes desirable to react a liquid hydrocarbon with hot gases. This can be accomplished in a quench boot with the liquid hydrocarbon serving as the cooling fluid.

These and other advantages will appear more fully from the accompanying drawings wherein:

FIGURE I is a fragmented vertical section of a quench boot with a port structure according to the present invention.

FIGURE II is an enlarged section of the flange and port structure of FIGURE I.

FIGURE III is a section taken along line III—III of FIGURE I.

FGURE IV is a section taken along line IV—IV of FIGURE III.

In the shown embodiment the hot fluid is a gas which exits reaction vessel **1** by way of throat **2** formed in open base **3**. Throat **2** is generally fabricated of a heat resistant material such as a ceramic. Reaction vessel **1** has its open base bolted to casing **4** of quench boot generally designated **6**. Flange **7** defines port **8** arranged to receive hot gas from throat **2**. The illustrated quench boot is used to cool hot synthesis gas by direct contact with water.

The port structure generally designated **9** is metal. So, for protection from burn out, continuous conduit **11** lines the interior of port **8**. In the shown embodiment port **8** is circular in cross section so protective conduit **11** is cylindrical . However, if other than circular port configurations were selected, they would be lined accordingly.

Protective conduit **11** is water cooled. Water is introduced to conduit **11** by inflow means shown as pipes **12** screwably connected to flange **7** to communicate with lateral bore **13** formed therethrough. Bore **13** communicates with a source of water (not shown) so that water is maintained in contact with inner wall **14** top **16** and outer wall **17**.

To prevent separation of water from the conduit, swirl in protective conduit **11** must be controlled. Toward this objective knife edge weir **18** is connected to bottom **19** to divide the conduit into inward chamber **21** and outward chamber **22**. Pipes **12** introduce water into the lower portion of inward chamber **21**. Weir **18** retains water in inward chamber **21**. Knife edge **23** is spaced from top **16** to define passage means for passing overflow water from the upper portion of inward chamber **21** to outward chamber **22**. Due to flow obstruction by weir **18** the water is unable to attain substantial angular velocity normal to the axis of conduit **11** so swirling is reduced. Passage **24** is not large enough to accommodate a swirl flow, but it communicates with the lower pressure of outward chamber **22** thereby providing a means for attenuating surges in the inward chamber.

The tendency toward swirling is more severe with less viscous cooling fluids. Pulsations are more meaningful at higher specific gravities.

The protection of vertical port structure **9** is illustrated in this embodiment, but it should be realized by those skilled in fluid mechanics that this teaching is also applicable to inclined or horizontal ports with protective conduits operated at pressures sufficient to reduce the significance of elevation. In the application of this invention to inclined or horizontal conduits the passage

means might be varied in size about protective conduit 11 to account for elevation differences.

Under various operations conditions, especially shut down and start up, thermal gradients may exist between protective conduit 11 and its parent structure. To relieve such stresses, conduit 11 is connected to flange 7 by a flexible member shown as cylindrical outer wall 17. Outer wall 17 is arranged to deflect, thereby relieving stresses occasioned by differential contraction of conduit 11 relative flange 7. To accommodate expansion of conduit 11 relative flange 7 outer wall 17 is spaced from inner rim 26 of flange 7 to define clearance 27.

For a closed system the exhaust means would most likely be a pipe similar to pipes 12 but communicating with outward chamber 22. However, it is preferred that exhaust means be an exhaust outflow 28 defined by conduit 11 to communicate with outward chamber 22 for exhausting cooling fluid to quench boot 6. Fluid in outward chamber 22 is substantially at the pressure of the quench boot. Thus the open system here shown improves the surge attenuation of passage 24.

In the shown embodiment, effluent from outward chamber 22 joins the hot gas stream passing through inner tube 29 which is suspended from flange 7. The cooling fluid protects the upper portion of inner tube 29. Inner tube 29 is spaced from casing 4 of the quench boot to define first annulus 31. Level 32 of water is maintained by a source of water (not shown) which communicates with the first annulus by way of opening 33. Baffle 34 is connected to casing 4 at its lower extent. The upper extent 36 of baffle 34 projects upward into the vicinity of flange 7 to define pass 37. Baffle 34 is spaced from casing 4 to define second annulus 38 therebetween.

Gas from reaction vessel 1 exits inner tube 29 via ports 39 and serration grooves 41. The gas bubbles upward through water in first annulus 31 and is further cooled thereby. Suspended water is removed from the gas by centrifugal action induced by angular acceleration. Flow through pass 37 from first annulus 31 to second annulus 38 imparts angular acceleration to the gas.

Gas is collected by second annulus 38 for exit through opening 42.

It will be understood that wide changes may be made in the details of the design here shown without departing from the scope of invention defined in the claims.

What is claimed is:

1. In a flow arrangement, a parent structure defining a port suitable for passing a hot fluid therethrough and comprising

a protective conduit which lines the interior of the port, the conduit having a high temperature surface exposed to the temperature of the hot fluid,

means dividing the conduit along its length into a trough-like inward chamber inward relative the port and an outward chamber, the inward chamber being adjacent the high temperature surface,

inflow means for introducing cooling fluid to the inward chamber, whereby a flow of fluid is maintained in substantially uniform contact with said high temperature surface,

passage means for passing overflow cooling fluid from the inward chamber to the outward chamber,

exhaust means for removing the cooling fluid from the outward chamber.

2. The combination of claim 1

with a flexible member connecting the protective conduit to the parent structure, arranged to deflect in a manner to accommodate differential contraction of the conduit relative the parent structure.

3. The combination of claim 2 with the conduit disposed in spaced relationship relative the parent structure so that it can accommodate expansion of the conduit relative the parent structure.

4. In a flow arrangement, a parent structure defining a port suitable for passing a hot gas from a reaction zone to a quench zone, with the reaction zone above the quench zone, and comprising

a continuous protective conduit having along one side a higher temperature surface which defines the interior lining of the port,

the conduit having a bottom and a top,

a weir disposed in the conduit and connected thereto along the bottom to divide the conduit into a trough-like inward chamber inward relative the port and adjacent the high temperature surface and an outward chamber,

the inward chamber having a lower portion and an upper portion continuous therewith,

inflow means for introducing cooling fluid to the lower portion of the inward chamber,

the weir spaced from the conduit top to define a restricted passage in proximity with the top for passing the cooling fluid from the upper portion of the inward chamber to the outward chamber,

the conduit defining an exhaust outflow communicating the outward chamber with the quench zone to exhaust cooling fluid from the outward chamber thereto.

5. In combination

a quench vessel having a flange,

a reaction vessel defining an open base connected to the flange of the quench vessel,

the flange defining a port therethrough having a longitudinal axis,

the port communicating with the open base for passing a hot gas to the quench vessel and comprising,

a continuous circular protective conduit rectangular in cross section taken along a plane aligned with the port longitudinal axis, the conduit having a high temperature surface which defines the interior lining of the port,

the conduit also having a bottom and a top,

a cylindrical weir disposed in the conduit and connected thereto along the bottom to divide the conduit into a trough-like inward chamber inward relative the port and adjacent the high temperature surface and an outward chamber,

the inward chamber having a lower portion and an upper portion continuous therewith,

an inflow pipe communicating with a source of cooling liquid and connected to the conduit to introduce cooling liquid to the lower portion of the inward chamber,

the weir spaced from the conduit top to define a restricted passage in proximity with the top for passing overflow cooling liquid from the upper portion of the inward chamber to the outward chamber,

the conduit defining an exhaust outflow communicating the outward chamber with the quench vessel to exhaust cooling liquid from the outward chamber thereto,

and means for exhausting gas from the quench vessel.

6. The combination of claim 5

with the quench vessel having a vertical inner tube arranged to receive hot gas from the port,

the inner tube depending from the flange and having an interior surface,

the inner tube being positioned relative the conduit whereby exhaust cooling liquid from said exhaust out-flow flows onto said interior surface.

7. The combination of claim 6

with the conduit having a resilient vertical cylindrical outer wall,

the outer wall connected to the flange to support the conduit, disposed relative the flange and conduit whereby the resiliency thereof accommodates for differential contraction of the conduit relative the flange.

8. The combination of claim 7 with the outer wall in

spaced relationship relative the flange to accommodate expansion of the conduit relative the flange.

9. The combination of claim 8 with the weir defining a knife edge.

References Cited by the Examiner

UNITED STATES PATENTS

511,516	12/93	Dean	61—26
1,720,912	7/29	McCabe et al.	165—81
2,721,065	10/55	Ingram	261—124
2,896,927	7/59	Nagle et al.	261—112 XR

FOREIGN PATENTS

7064/27	11/27	Australia.

CHARLES SUKALO, *Primary Examiner.*