

March 20, 1951

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2,545,686

INTERNALLY LINED AND INSULATED CHAMBER

Filed April 21, 1948

Fig. 1.

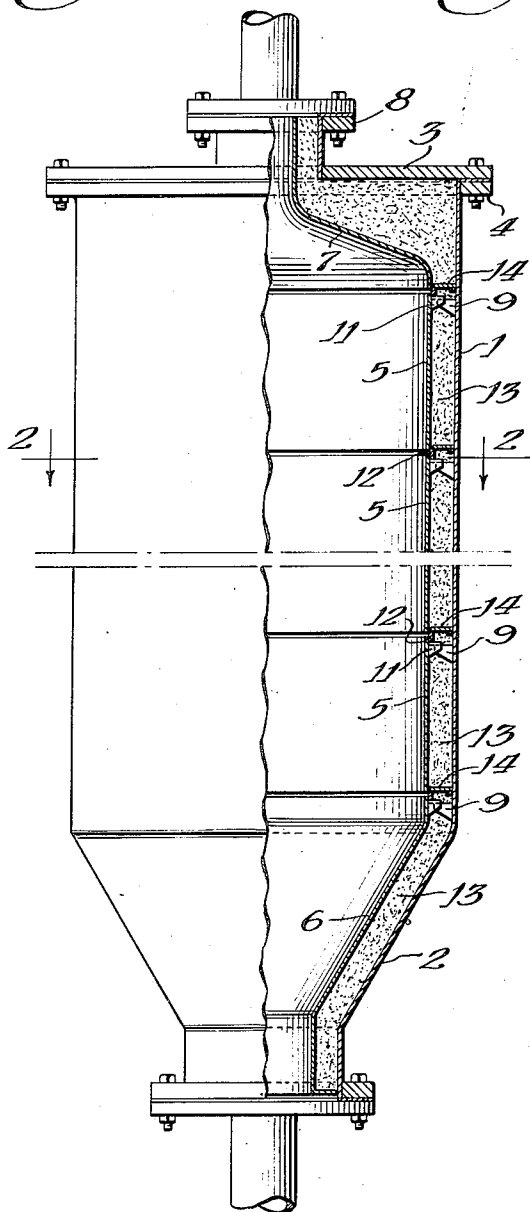


Fig. 2.

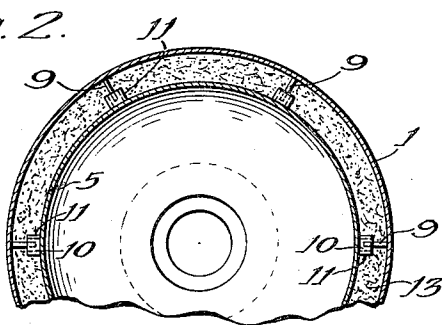


Fig. 3.

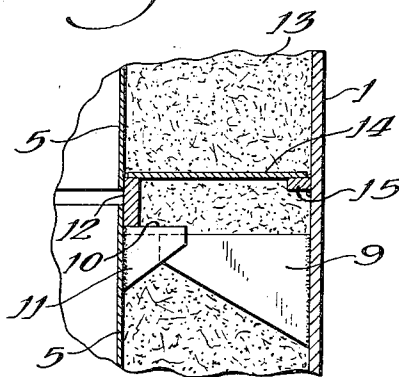
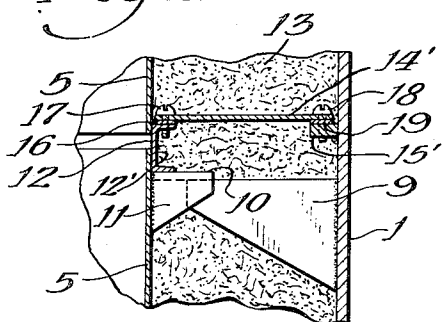


Fig. 4.



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UNITED STATES PATENT OFFICE

2,545,686

INTERNALLY LINED AND INSULATED CHAMBER

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Application April 21, 1948, Serial No. 22,441

5 Claims. (Cl. 220-9)

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This invention relates to an internally lined and insulated chamber which is particularly adapted to maintain a catalytic contact material therein for use in a high temperature conversion operation.

There are various ways of lining chambers and processing vessels whereby the internal lining and insulation may provide one or more advantages. An internal insulation may be desired to reduce the metal temperature of the chamber wall and thereby permit higher design stresses, or to make possible the use of a carbon steel chamber where otherwise a high temperature resistant alloy steel would be necessary. Another advantageous use of an insulating type of liner is to prevent chemical attack or penetration into a chamber wall, where such attack occurs rapidly under high temperature and pressure conditions, but to a lesser extent, or not at all, at a reduced temperature condition.

The present liner is particularly constructed to prevent the effect of hydrogen on carbon steel at a high temperature and at the same time to accommodate a bed of catalyst material through which is passed a vaporous stream containing hydrogen. Those familiar with metal corrosion and hydrogen attack at high temperatures, are cognizant of there being critical conditions of temperature and pressure above which carbon steel is attacked. Further, that where the steel is subject to a long time exposure to hydrogen, then less severe conditions of temperature and pressure may be critical.

Briefly, the lined chamber of the present invention comprises a pressure retaining outer housing or shell having a removable upper head, a segmental inner liner spaced from the outer housing, the liner comprising a plurality of ring shaped sections adapted to be inserted into the housing through the upper head, spaced supporting members attached to the housing wall, opposing supporting members attached to each of the liner sections which are spaced to engage and rest on the members attached to the outer housing, a continuous strip attached inside the top edge of the ring sections and extending a short distance above so that the next higher ring section overlaps the strip and forms therewith a slip type of expansion joint, an insulating material positioned between the inner lining and the outer housing, an annular shaped insulation supporting plate positioned between the outer housing and the inner liner at each of the slip joints, and inlet and outlet openings at each end of the chamber suitable to pass a fluid stream there-through.

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The inner liner normally may be made of a relatively thin alloy metal which is resistant to hydrogen or chemical attack and to high temperature conditions of the particular process for which the chamber may be employed. The segmental construction of the liner is such that the internal pressure may pass through the slip joint at each section and exert pressure behind the sheet lining and on the outer housing. Therefore, the alloy liner need only be of a nominal thickness and have suitable stiffness to maintain its shape and to hold an insulating material in place between it and the outer wall. Also the method of supporting each of the segments independently on a sliding type of lug or bracket allows each to accommodate longitudinal and radial expansion from high temperature processing conditions within the chamber.

The insulation between the lining and wall is preferably a soft resilient type of material such as mineral or slag wool which may be in pellet or blanket form. In each case, the insulating material is placed after inserting each ring shaped liner section and the annular plate which extends between the two walls is put in place and serves to support the next layer of insulating material. This insulating support plate is in turn supported by a rib extending around the outer housing and a stiffening rib around the top of each inner lining section. It may also be noted that this annular plate serves a dual purpose, not only does it support the insulating material in a series of superimposed sections, so that there will be little or no settling of the insulation throughout the height of the column, but each of the plates serve as vapor stops throughout the height of the chamber. Vapor stops or seals in a lined chamber are particularly necessary where there is a considerable pressure drop from one end of the chamber to the other and there would normally be a tendency for a portion of the vapor stream being treated to by-pass the contact bed and flow through the insulated portion of the chamber.

In a special embodiment of the liner, the insulation supporting ring may be held in place between the inner liner and the outer housing so as to form a pressure tight vapor seal between vertical sections. However, normally, it has been found that the weight of the annular plate and the superimposed packed insulation serves to hold the plate in place on its supporting rings and to form an adequate vapor barrier which will effect a pressure drop in the insulated section that is adequate to prevent vapor by-passing therethrough.

Further construction features and advantages will be apparent upon reference to the accompanying drawing and to the following description thereof.

Figure 1 of the drawing is an elevational view partially in section of a lined chamber having an improved segmental type of construction and placement for the inner liner.

Figure 2 is a partial sectional plan view through the chamber as indicated by line 2--2.

Figure 3 is an enlarged view of one of the liner supporting members and the joint construction between the vertical sections.

Figure 4 is also an enlarged sectional view indicating an alternate construction and assembly for the insulating support plate in a manner forming a tight vapor seal.

Referring now to Figures 1, 2 and 3 of the drawing, there is shown a lined chamber having an outer housing or shell 1 which in turn has a tapered or conically shaped lower head 2 and a flat removable upper head 3. This upper head may be bolted to a flange 4 at the upper end of the chamber wall. Thus, when the head is removed, the housing 1 is open for the insertion or removal of the internal lining sections and insulating material.

The inner liner comprises a plurality of ring shaped sections 5 positioned throughout the cylindrical portion of the chamber, a tapering section 6 that is especially constructed to conform with the shape of the lower head 2, and an upper section 7 which is especially constructed to hold insulating material above it and to project into an inlet or outlet nozzle 8 connecting with the upper head 3.

Spaced both vertically and horizontally around the outer housing 1 are rows of supporting plates or lugs 9 which serve to support each of the inner liner sections. The vertical spacing of these lugs will of course depend upon the length of the ring shaped inner liner sections; while the horizontal spacing will in general depend upon the diameter of the chamber and the weight of the section being supported. Attached to each of the inner liner sections, near their upper ends, are a plurality of spaced supports which are positioned to engage and rest upon each of the supporting members 9 that attach to the outer housing. In the embodiment illustrated, each of the supporting members on the liner sections have a top plate 10 and side plates or ribs 11 which form a socket or pocket type of support that will rest on the various wall lugs 9 and serve to support each of the segmental sections. At the top end of each of the inner liner sections and around the outer periphery thereof is a stiffening rib 12. Each of the ribs 12 is preferably welded or otherwise fixedly attached to each of the inner sections and are placed to extend above the top edge of each section so that the lower end of the section just above will overlap it and form a slip joint therewith.

The size of the stiffening rib and the spacing between the inner lining sections is governed by the amount of longitudinal expansion which will take place within the particular chamber and the expansion in turn is of course determined by the conversion temperatures to be encountered and the coefficient of expansion of the particular alloy or material being used for the inner segments. Where the supporting members are at the top of each of the inner sections, the longitudinal expansion will be primarily downward for each section. The radial expansion is accommodated by

the slipping of the inner supports over the outer supporting lugs 9. In view of the fact that there will be some radial expansion and movement of the inner liner sections toward the outer housing, under high temperature conditions, the insulating material 13 is preferably a compressible or resilient type of material which can be packed between the inner lining and the outer wall and which will permit the slight radial expansion of the inner lining wall, and at the same time being a material that will not settle appreciably between the sections.

At each of the slip joints or expansion joints between vertical liner sections there is positioned the insulation supporting plate 14 which is of an annular shape extending around the entire chamber between the inner and outer walls. On the outer wall 1, a continuous relatively narrow ring 15 is fixedly attached thereto to support the outer edge of the plate 14, while the inner edge of each of the plates 14 rests on the upper surface of each of the stiffening and joint forming ribs 12. Each of the continuous strips 15 are therefore necessarily placed and attached to the outer wall 1, opposite the upper edge of the strips 12 that are attached to each of the ring shaped liner sections, so that the plate 14 may rest in a substantially horizontal position.

In assembling the liner within the chamber, the lower liner section, section 6 in this embodiment, is lowered into the outer housing through the upper head and is brought to rest and into position on the lower row of supporting lugs 9. The insulating material 13 is then filled in to the space between the liner section and the outer wall of the chamber beginning at the lower end and filling it up to the top edge of the strip 12. The lower of the insulation supporting plates 14 is then lowered into place over the lower section of insulation, the plate resting on the lower outside strip 15 and the stiffening rib 12 of the lower section 6.

The lower of the ring shaped liner sections 5 is then dropped into place, it being supported by the plurality of supporting plates 10 attached thereto and the accompanying supporting lugs 9 projecting from the outer wall at that level. The lower end of the section is fitted inside the strip 12 of the lower section 6 and forms a lapped type of expansion joint. The insulating material 13 is then packed between the inner ring section and the outer wall up to the upper end of that section, as with the lower head section. The additional ring shaped sections 5 and the upper head section 7 are inserted into the chamber in like manner and the insulating material placed between them and the outer wall of the chamber. After replacing the upper liner section 7 and the insulating material thereabove, the flat head 3 is brought into position and bolted in place to the flange 4 of the outer housing 1 and the assembly is completed.

The segmental construction serves to cut the magnitude of the longitudinal expansion for a long chamber by providing for a plurality of smaller expansions at each slip joint between the superimposed sections. Also, as noted hereinabove, the internal pressure from the fluid stream passing through the chamber will pass through each of the slip joints or expansion joints and be exerted behind each of the inner liner sections so that only nominal thickness liner sections need be used. However, by the use of a substantial thickness of insulating material 13, the tem-

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perature at the outer wall can be lowered sufficiently such that the outer shell 1 may be designed to withstand the particular operating pressure without resorting to excessively low design stresses and a normal steel thickness used as a result.

Referring now to Figure 4 of the drawing, there is indicated a slightly different embodiment of the liner in that the insulation supporting plate 14' is bolted into place to insure its maintaining its proper position between the various sections of the liner and to serve as a vapor stop in the insulation zone. Where there is a compact contact bed maintained within the chamber and there is a high pressure drop through the bed it may be advisable to have substantially pressure tight vapor seals between each of the vertical sections of insulating material so that there will be no by-passing of vapors in the insulation from one end of the chamber to the other. In this embodiment the stiffening rib 12' is formed from a small size channel having an upper flange suitable to hold a gasket 16 between it and the support plate 14'. The upper flange of the rib 12' is tapped to accommodate a plurality of spaced bolts 17 which will hold the plate and gasket rigidly thereto. The outer supporting strip 15' is likewise tapped to accommodate a plurality of bolts or machine screws 18 which hold the outer periphery of the annular plate 14'. Also, a continuous gasket 19 is placed between the strip 15' and the bolted edge of the plate 14' to provide a substantially pressure tight connection thereto. In each case holes at the inner and outer edges of the annular plate 14' for the bolts 17 and 18, may be provided slightly oversize, or slotted radially with respect to the center of the chamber, so that radial expansion of the inner liner sections with respect to the outer shell of the chamber may be accommodated.

The foregoing description refers to the inner liner sections as an alloy metal liner suitable for resisting high temperatures or corrosive attack from chemicals, however, it is not intended to limit this invention to a liner utilizing only an alloy metal for in some instances, the same construction and form of liner may be accomplished by utilizing a resinous or plastic material or a porcelain covered sheet which will have suitable strength and stiffness to maintain the insulating material in place and where necessary support the pressure from a contact bed of material housed within the interior of the chamber. Also, it is not intended to limit the lining to any particular form of insulating material other than one which is capable of withstanding the temperature condition from the gaseous or vaporous reactant streams. In addition the material must be of a resilient type that will not settle over a period of time.

I claim as my invention:

1. A lined chamber comprising in combination a pressure retaining outer housing having a removable upper head, a segmental liner within and spaced from said outer housing, said liner comprising a plurality of ring-shaped sections of a size adapted to be inserted into said housing through said removable head, spaced supporting members attached to the inner wall of said housing, other supporting members attached to each of said liner sections and spaced to engage and rest on said supporting members of said housing wall, a continuous strip attached outside the top

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of each ring section and extending a short distance thereabove, said strip providing a slip joint with the adjacent ring section, an insulating material between said liner and said outer housing, an annular shaped insulation supporting plate resting on each of said continuous strips and positioned between said housing wall and said liner at each of said slip joints, and inlet and outlet openings to said lined chamber at the ends thereof.

2. The lined chamber of claim 1 further characterized in that said inner liner is a heat resistant metallic alloy and that said insulating material between said liner and said outer housing is of a resilient nature.

3. A lined chamber for hot fluid streams comprising a vertically positioned pressure tight outer housing of a substantial thickness, a removable upper head to said housing, a segmental alloy metal liner comprising a plurality of relatively thin ring-shaped sections each being adapted to be placed into said housing through said upper head, horizontally and vertically spaced supporting lugs attached to the interior of said housing wall and spaced supporting members on each of said ring shaped liner sections arranged to engage and rest on said supporting lugs, a continuous channel-shaped rib attached around the upper end of each of said ring-shaped sections and extending a short distance thereabove, each of said ribs forming a slip joint with the lower end of the section thereabove, a plurality of relatively narrow continuous ribs attached to and extending around the inside wall of said outer housing, last said ribs being positioned in a manner to be opposite the upper flange of each of said channel shaped ribs that are attached to said liner sections, annular shaped plates positioned between said housing wall and said inner liner at each of said slip joints, said plates resting on said continuous ribs which attach to said outer wall and on the upper flanges of each of said channel shaped ribs attached to the ring shaped liner sections, a high temperature resistant insulating material packed between said outer housing and said liner, said insulation being vertically supported by said annular shaped plates, an inlet and outlet means to said lined chamber at the ends thereof.

4. The lined chamber of claim 3 further characterized in that said insulating material between said inner liner and said outer housing is of a resilient nature.

5. The lined chamber of claim 4 still further characterized in that said annular shaped insulation supporting plates are removably bolted to said continuous ribs, and heat resisting gaskets are placed between said plates and ribs providing thereby a plurality of substantially pressure tight vapor stops of said plates that are spaced throughout said insulating material.

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