May 21, 1957 E. E. SCHOESSOW 2,792,965

PRESSURE VESSEL CONSTRUCTION

Filed Nov. 22, 1954

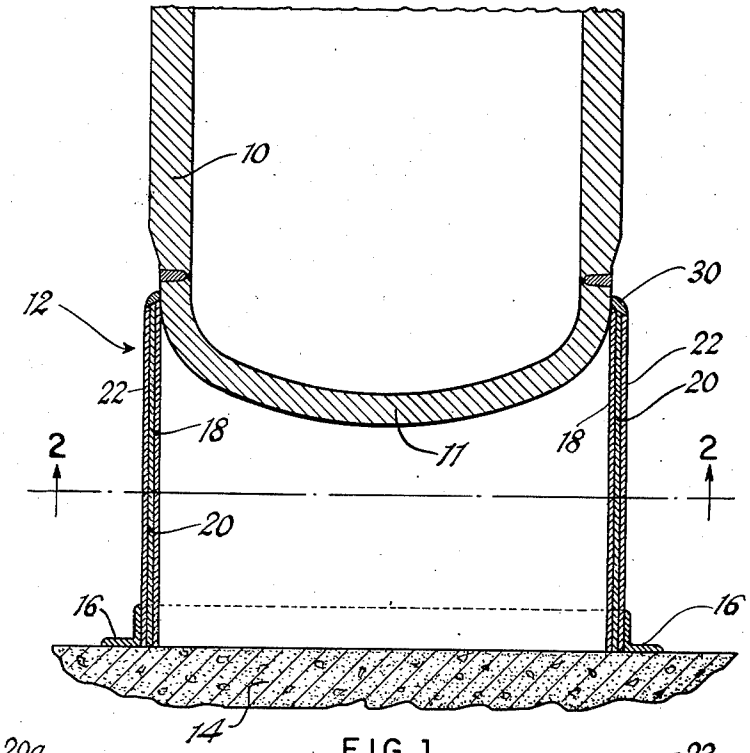


FIG. 1

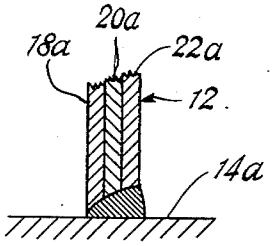


FIG. 4

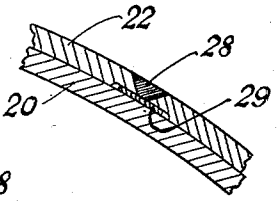


FIG. 3

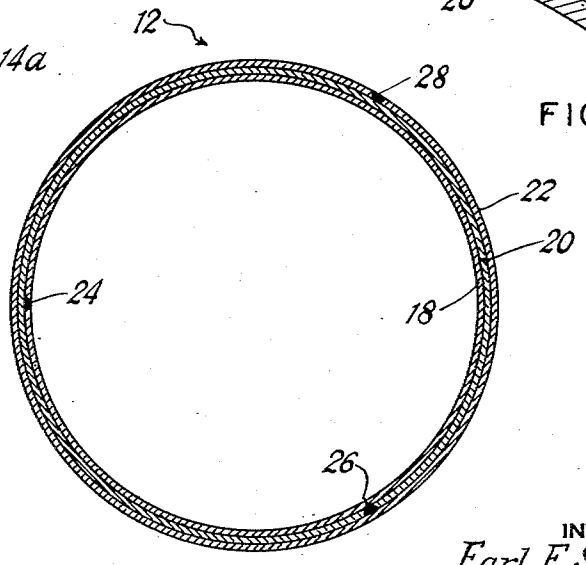


FIG. 2

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United States Patent Office 2,792,965
Patented May 21, 1957

2,792,965

PRESSURE VESSEL CONSTRUCTION

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Application November 22, 1954, Serial No. 470,410

6 Claims. (Cl. 220—69)

This invention relates to a pressure vessel construction having a laminated support skirt.

Pressure vessels of circular cross section are often supported by a cylindrically shaped skirt support on a fixed foundation. In such a construction there may exist large differences between the temperature of the shell and of the foundation, thus subjecting the skirt to a longitudinal temperature gradient. Such temperature conditions will cause the higher temperature portions of the skirt to expand to a diameter proportional to the thermal coefficient of expansion of the metal, and this diameter is different at all of the longitudinal positions of the skirt. This induces longitudinal bending stresses into the metal of the skirt. If the mechanical integrity of the skirt is to be maintained under any given conditions of longitudinal temperature gradient, these bending stresses must be at a safe value, and such value must be well within the elastic limit of the metal. The skirt is usually required to sustain the dead weight loading of the pressure vessel, the dynamic or shock loading of the vessel and the piping reactions transmitted to it through the vessel. In many of the advanced engineering applications in use by industry today, the skirts are required to sustain very high temperature gradients, shock loads, and piping reactions and the problem of obtaining a proper skirt design is compounded when there is added the usual condition that the vessel and its support means must occupy a minimum volume. In this case the conventional skirt design, wherein the skirt is made of a single thick plate, becomes inadequate because the bending stresses are prohibitively high.

The present invention solves this problem by providing a cylindrically shaped skirt support made of a number of thin shells placed concentrically and coextensively one within another so as to present a laminated structure. For any given temperature conditions this structure is subject to much lower bending stresses than a solid plate of the same thickness. It is well known in the field of mechanics that for any given length of a member subjected to longitudinal temperature gradient, that a thin member will develop less bending stress than a thicker member. However, such thin sections will not carry as large a compressive load as thick members. The present invention involves a number of thin members placed together in a laminated structure and thus acting in conjunction to carry the required compressive load with the result that the composite structure develops less bending stress than a single plate of the same dimensions. Thus there is provided a high temperature pressure vessel construction facilitating its support with a minimum of thermally created stresses.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described preferred embodiments of the invention.

In the drawings:

Fig. 1 is a partial sectional elevation of a pressure vessel supported by a laminated skirt in accordance with the invention;

Fig. 2 is a plan section on line 2—2 of Fig. 1;

Fig. 3 is a partial section of the lamina weld; and

Fig. 4 is a partial section of an alternate attachment of the skirt to a foundation.

A high temperature and high pressure vessel **10** having a closed end **11** is supported by a cylindrically shaped skirt **12** which rests on a foundation **14**. The lower end of the skirt **12** is fixed to the foundation **14** by a number of circumferentially spaced angle irons **16**.

The skirt **12** comprises the thin lamina plates **18, 20** and **22**. The inner plate **18** is formed from a rectangular plate into a circular shell and its edges joined by the longitudinal weld **24**. The second plate **20**, is similarly formed into a circular shell and snugly fitted around plate **18** with its longitudinal ends joined by a weld **26**. Similarly the outside plate **22** is formed into a circular shell and snugly fitted around plate **20** and its edges joined by the longitudinal weld **28**. Each of the longitudinal welds are made as in Figure 3 where the edges of the plate **22** are shaped to receive a backing strip **29**. This construction precludes any of the plates from being joined by the welds. The skirt is then attached to the pressure vessel **10** by a large weld **30** which unites all of the plates **18, 20** and **22** to the pressure vessel.

Fig. 4 is an alternate construction to that of Fig. 1 for attaching the lower edge of the skirt **12** to a foundation **14A** by a common weld joining the plates **18A, 20A** and **22A**. Such a construction would be used in cases where the pressure vessel **10** would have a large overturning moment.

The lamination plates are assembled in such a way that they act in conjunction for supporting the vessel but are free to individually and independently distort in bending. It is important that in the assembly of the laminations that they not be preshunk into place or that they not be joined at any point except at the ends of the skirt. They should be simply in surface to surface contact so as to give mutual support to each other to withstand the compressive loading.

The present invention provides a support for a pressure vessel which is of the shortest longitudinal length for any given set of load and temperature conditions.

While in accordance with the provisions of the statutes, I have illustrated and described herein a specific form of the invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of the other features.

I claim:

1. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt having its laminations integrally secured to the pressure vessel and to each other by a common securement in heat transfer relationship and extending beyond one end of said vessel for the support thereof.

2. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt secured to the pressure vessel in heat transfer relationship and extending beyond one end of said

vessel for the support thereof, said skirt formed by a plurality of concentric metal laminae arranged in surface to surface contact and joined to each other only at their end portions and free for relative movement intermediate their ends.

3. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt secured to the pressure vessel in heat transfer relationship and extending beyond one end of said vessel for the support thereof, said skirt formed by a plurality of concentric coextensive metal laminae arranged in surface to surface contact and joined to each other only at their end portions and free for relative movement intermediate their ends.

4. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt secured to the pressure vessel in heat transfer relationship and extending beyond one end of said vessel for the support thereof, said skirt formed by a plurality of concentric metal laminae arranged in surface to surface contact and joined to each other only at their end portions, said laminae being joined to each other and to said vessel by a common weld at one edge of said skirt.

5. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt secured to the pressure vessel in heat transfer relationship and extending beyond one end of said vessel for the support thereof, said skirt formed by a plurality of concentric metal laminae arranged in surface to surface contact and joined to each other only at their end portions, said laminae being joined to each other and to the lower portion of said vessel by a common weld at one edge of said skirt.

6. A high temperature pressure vessel construction comprising a vertically elongated pressure vessel subject to a high temperature and having a circular horizontal cross section and a metallic laminated cylindrically shaped skirt secured to the pressure vessel in heat transfer relationship and extending beyond one end of said vessel for the support thereof, said skirt formed by a plurality of concentric metal laminae arranged in surface to surface contact and joined to each other only at their end portions, said laminae being joined to each other and to the lower portion of said vessel and said foundation structure by common welds at opposite edges of said skirt.

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