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Kitchel

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[54] **ANNEALING FURNACE SEAL**

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[73] Assignee: **United States Steel Corporation**

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[52] **U.S. Cl.** ..... **432/257,** 34/242, 277/235 R

[51] **Int. Cl.** **F26b 25/00,** F26d 23/00, C21d 1/12

[58] **Field of Search** ..... 263/41, 49, 5, 40, 263/42, 43; 34/242; 266/5; 277/235 R, 235 B, 235 A

[56] **References Cited**

UNITED STATES PATENTS

3,471,137	10/1969	Kitchel	263/40 R
3,476,370	11/1969	Ashbaugh	263/40 R
3,481,824	12/1969	Poltorak	277/235
3,438,617	4/1969	Gordon et al.	263/49 R
3,179,394	4/1965	Sims et al.	34/242

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Assistant Examiner—Henry C. Yuen
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[57] **ABSTRACT**

A seal for eliminating or reducing air infiltration into an inner cover of a steel annealing furnace includes a tube of stainless steel mesh filled with a woven ceramic blanket, preferably arranged in a roll. The bottom of the inner cover rests on the tube.

15 Claims, 6 Drawing Figures

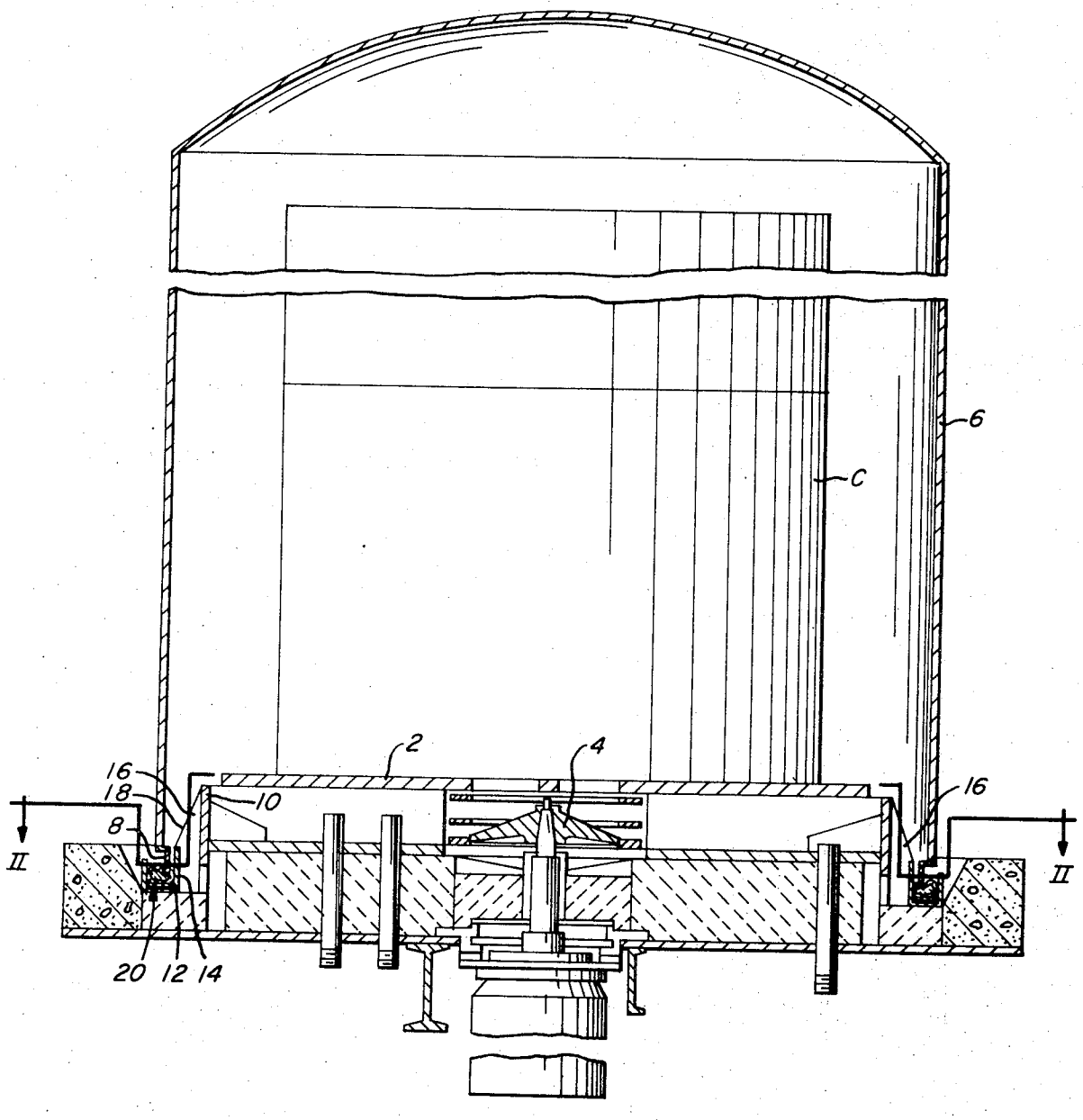


FIG. 2

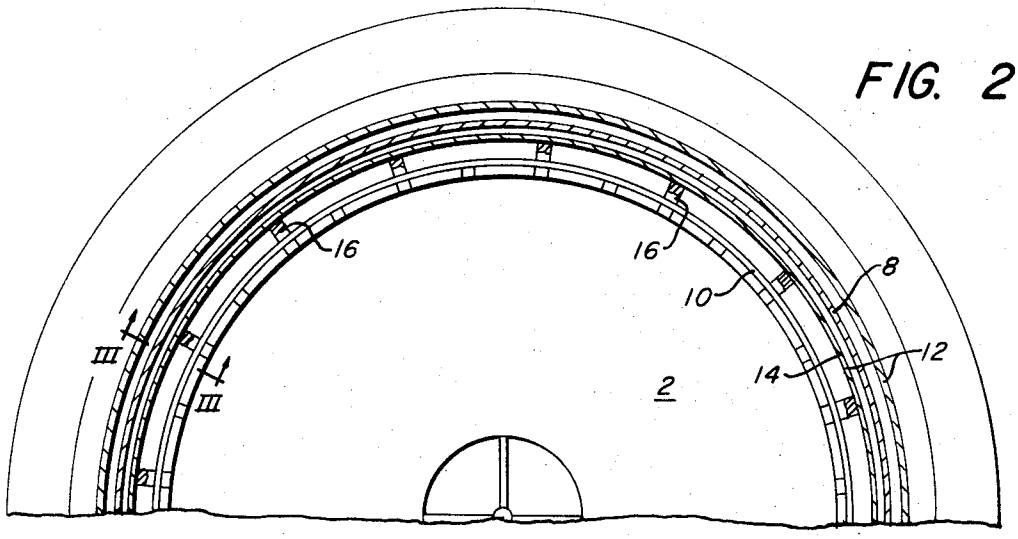


FIG. 1

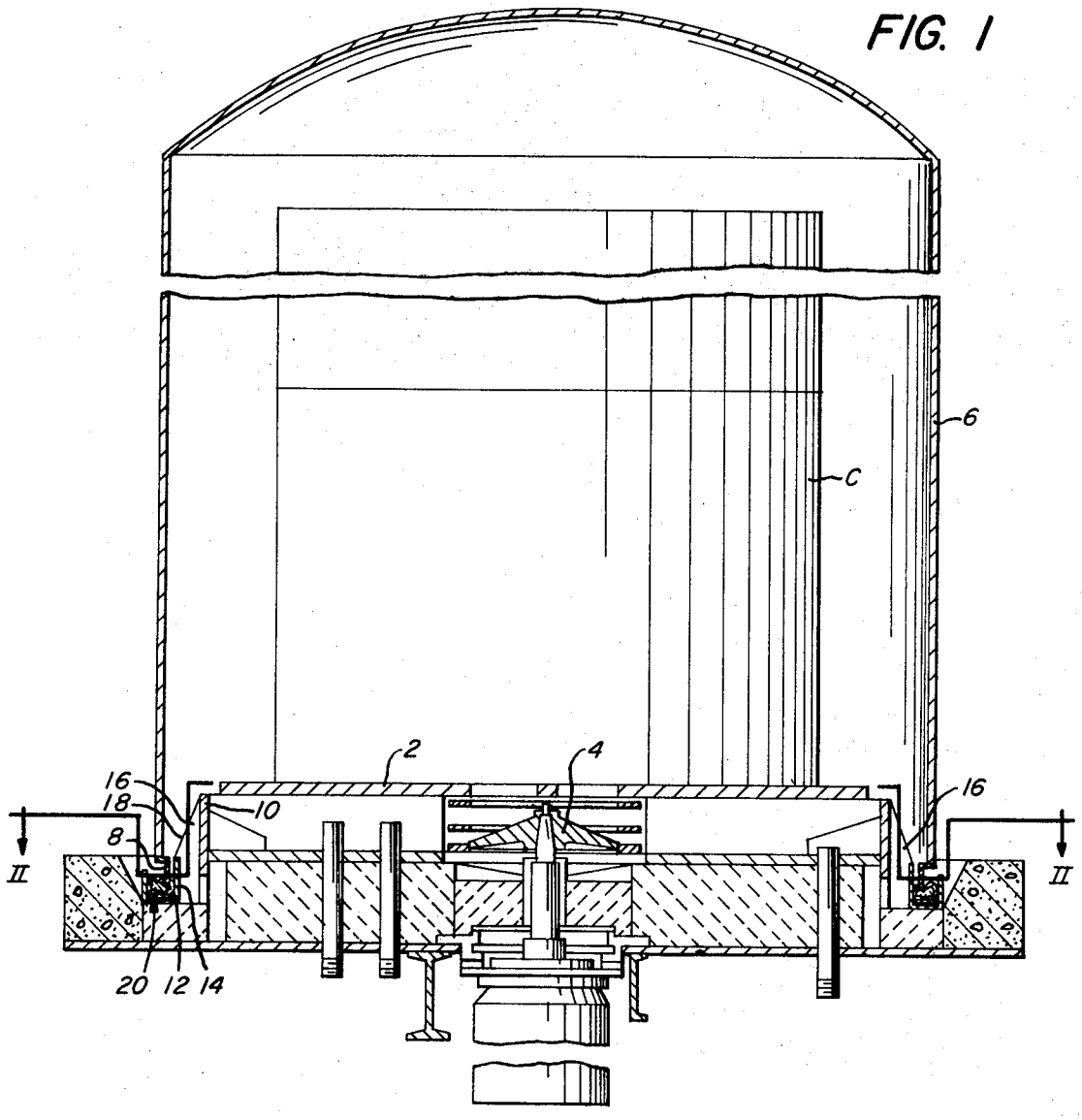


FIG. 3

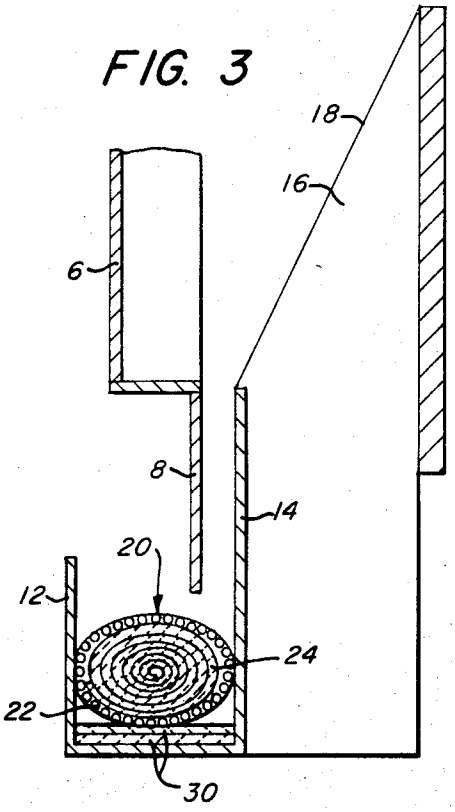


FIG. 4

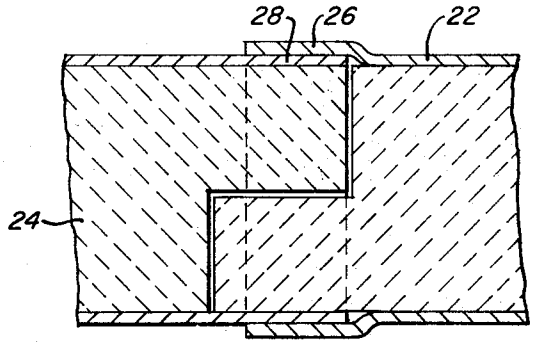


FIG. 5

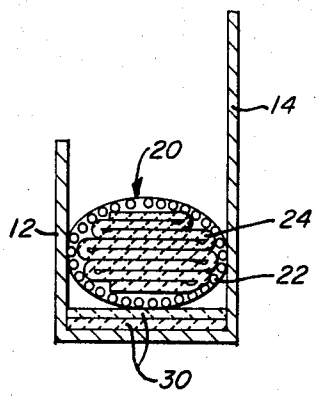
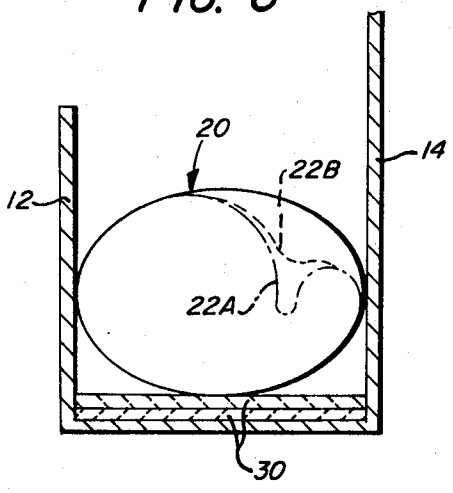


FIG. 6



ANNEALING FURNACE SEAL

BACKGROUND OF THE INVENTION

This invention relates to a seal and more particularly to a seal for preventing infiltration of air into the inner cover of a batch type annealing furnace. Such furnaces, sometimes called bell annealing furnaces, include a base upon which coils of steel strip are stacked and a removable inner cover on the base. One or more such bases are arranged beneath a removable outer cover carrying heating means thereon. An annealing atmosphere is circulated within each inner cover by means of a fan and it is necessary to provide a seal to prevent infiltration of air into the inner cover and escape of atmosphere from the inner cover. The present seal is an improvement over those shown in Gordon et al., U.S. Pat. No. 3,438,617 dated Apr. 15, 1969; and my prior U.S. Pat. No. 3,471,137 dated Oct. 7, 1969. In one particular plant the Gordon seal was originally used and was found to provide a satisfactory seal when first installed. However, after an average of 10 to 12 heats the top layers of the seal deteriorated to such an extent that these layers had to be removed and replaced by new material. Eventually the entire seal had to be discarded. Even before removal of these top layers their gradual deterioration resulted in contaminating the charge more than was desirable. As a result, these seals were replaced by the seals of my prior patent which proved more satisfactory than the Gordon seals. However, I found that the ceramic fibers of the tube tended to break down and separate from the tube. The breakdown first occurs on that portion of the tube within the inner cover and the ceramic fibers were picked up by the stream of annealing gases within the inner cover. This resulted in contaminating the charge, but to a lesser extent than with the Gordon seal. The filler material also tended to break up into smaller pieces and worked out through the tube. The smaller particles were compressed to a greater degree than the larger particles and the resiliency of the seal decreased so that it did not provide as good a seal. Therefore, the seals had to be discarded after 30 to 35 heats. The bulk filler tended to pack and after every 5 or 10 heats the seal was fluffed to redistribute the filler.

As a result of my experience with the seals of the two patents, I sought to find a seal having better properties than the prior seals. While I originally believed that the tube had to contain both metal and ceramic material, much to my amazement I found that I could use a tube made of less expensive stainless steel mesh with better results. I also found that a ceramic blanket filler gave better results. Seals of this type have been in use for as many as 31 heats without repair or replacement and still appear to be in very good condition.

OBJECTS OF THE INVENTION

It is therefore an object of my invention to provide a furnace seal which is cheaper to manufacture and/or has a substantially longer life than previous seals of the same general type.

Another object is to provide such a seal which results in less contamination of the charge.

DESCRIPTION OF THE DRAWINGS

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIG. 1 is a horizontal sectional view of an inner annealing cover and supporting structure with my seal incorporated therein;

FIG. 2 is a view taken on line II—II of FIG. 1, but showing only one half of the furnace;

FIG. 3 is an enlarged view taken on line III—III of FIG. 2;

FIG. 4 is an enlarged view of the connection between the ends of the seal member;

FIG. 5 is a view similar to FIG. 3 showing a second modification of my invention; and

FIG. 6 is a schematic view showing the shape of the seal member at various stages in its use.

DETAILED DESCRIPTION

Referring more particularly to the drawings, reference numeral 2 (FIGS. 1,2) indicates the base of an annealing furnace for supporting a coil C (FIG. 1) of steel strip. A fan 4 (FIG. 2) is used to circulate annealing atmosphere through and around the coil C beneath a corrugated inner cover 6 (FIG. 1,3) which is preferably made of stainless steel. A vertical skirt 8 (FIG. 1,3) is provided at the lower end of the cover 6. The base 2 includes a circumferential vertical steel plate 10 (FIG. 1). A trough 12 (FIGS. 1–3,5,6) surrounds the circular base 2 below the top thereof. Inner leg 14 (FIGS. 1–3,5,6) and outer leg 15 of the trough 12 extends upwardly parallel to the plate 10 and a plurality of gusset plates 16 (FIGS. 1-3) extend between and are welded to the plates 10 and 14 in spaced apart relationship. The top of each gusset plates 16 tapers downwardly and outwardly to form guides 18 (FIGS. 1,3) for the cover 16.

Sealing Member 20

Sealing member 20 (FIGS. 1,3,5,6) of my invention consists of a flexible tube 22 (FIGS. 3–5) with a deformable blanket 2 (FIGS. 3–5). The tube 22 must be made of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little or no permanent set. I have found that a tube 22 made of Grade No. 430 stainless steel 100 mesh is very satisfactory. It is preferred that the mesh be between 80 and 120. The blanket 24 must also have the ability to resist permanent set and to be relatively impermeable to the annealing atmosphere. I have found that a woven fibre blanket 24 made of aluminate sicate or the like and rolled into a cylindrical shaped solid having a plurality of convolutions as shown in FIG. 3 is particularly satisfactory. The blanket 24 is preferably composed of ceramic fibre one inch thick of 8 pound density. The material must be able to withstand annealing temperatures without substantial deterioration. Most ceramic materials would be satisfactory. It is preferred that the blanket 24 be made of one piece beacuse it eliminates joints and also makes for a better seal. However, it is obvious that it could be made in more than one piece.

Instead of being rolled, the blanket 24 may be folded into a plurality of layers as shown in FIG. 5, but this results in poorer sealing and also exposes more of the blanket 24 to the hot annealing gases which will cause faster deterioration.

The sealing member 20 extends completely around the periphery of trough 12 and has its ends joined in any suitable manner. For example, as shown in FIG. 4, the ends of the filler 24 may have opposed halves re-

moved and overlapped and the tube **22** may have one end **26** surrounding the other end **28.**

Other combinations of tubes and filler material may be used. A bulk filler **24** may be used with a metal tube **22.** This combination is both cheaper and better than the seal of my patent, but probably does not have as long a life as the preferred seal described above. A blanket filler **24** may be used with the tube of my prior patent. This combination is better than the seal of my patent and its cost is about the same as that seal.

I have found it desirable to place at least one and preferably two 1 inch thick layers **30** of a ceramic blanket in the bottom of trough **12** as shown in FIGS. **3, 5** and **6.** The blanket **30** is preferably of the same material as blanket **24.** These bottom layers **30** protect the metal shell of the base **2** from heat thus preventing oxidation and warpage and it is believed that this material **30** cushions the shear effect between the inner cover **6** and the base shell **2** when the cover **6** is set in place. The member **20** is placed in the trough **12** on the layers **30** and preferably compressed into oval shape as shown schematically in full lines in FIG. **6.** After the charge is placed on the base **2,** the inner cover **6** is lowered into the trough **12** with the guides **18** positioning the inner cover **6** in the desired position on member **20.** The diameter of leg **8** of the inner cover **6** is generally equal to the diameter of trough **12** at the center thereof, but may vary therefrom. The variation preferably should not exceed 2 inches. When the leg **8** of the inner cover **6** is lowered onto the member **20** it will depress the upper part of it approximately to the broken line position **22A** shown in FIG. **6.** When the inner cover is removed the member **20** will expand somewhat upwardly to approximately the dash-dot line **22B** shown in FIG. **6.** When the inner cover **6** is lowered a second and subsequent time the guides **18** will return the inner cover **6** to relatively the same position so that a better seal and longer life is provided. I have found that the member **20** has sufficient strength to support the full weight of the inner cover **6,** that it has sufficient resiliency to provide a very good seal and that it will not contaminate the charge. It will also be understood that the seal **20** will not assume the exact shape shown, but will contact the walls and bottom of the trough **12.**

While several embodiments of my invention have been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible tube consisting of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable filler in said tube, said filler resisting permanent set and being relatively impermeable to the annealing atmosphere, the length and cross section of said filled tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, said deformable filler being a ceramic woven fibre blanket, and said filler being in the form of a roll having a plurality of convolutions.

2. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible tube consisting of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable filler in said tube, said filler resisting permanent set and being relatively impermeable to the annealing atmosphere, the length and cross section of said filled tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, said deformable filler being a ceramic woven fibre blanket, said tube being a stainless steel mesh, and said filler being in the form of a roll having a plurality of convolutions.

3. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible tube consisting of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable filler in said tube, said filler resisting permanent set and being relatively impermeable to the annealing atmosphere, the length and cross section of said filled tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, and having a ceramic woven fibre layer on the bottom of said trough on which said tube rests.

4. The combination of claim **3** in which said deformable filler is a ceramic woven fibre blanket and said filler being in the form of a roll having a plurality of convolutions.

5. The combination recited in claim **3** wherein said deformable filler is folded into a plurality of layers.

6. The combination recited in claim **3** wherein one end of said flexible tube is lapped over the other end of said flexible tube in sealing engagement.

7. The combination of claim **4** in which said tube is a stainless steel mesh, and said filler being in the form of a roll having a plurality of convolutions.

8. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible woven tube which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable ceramic woven fibre blanket, the length and cross section of said flexible woven tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough and said deformable ceramic woven fibre blanket being in the form of a roll having a plurality of convolutions.

9. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible woven tube which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable ceramic woven fibre blanket, the length and cross section of said flexible woven tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough and having a ceramic woven fibre layer on the bottom of said trough on which said flexible woven tube rests.

10. The combination of claim 9 in which said deformable ceramic woven fibre blanket is in the form of a roll having a plurality of convolutions.

11. The combination recited in claim 9 wherein said deformable ceramic woven filler blanket is folded into a plurality of layers.

12. The combination recited in claim 9 wherein one end of said flexible woven tube is lapped over the other end of said flexible woven tube.

13. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible tube consisting of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable filler in said tube, said filler resisting permanent set and being relatively impermeable to the annealing atmosphere, the length and cross section of said filled tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, said filler being in the form of a roll having a plurality of convolutions.

14. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible tube consisting of metal which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable filler in said tube, said filler resisting permanent set and being relatively impermeable to the annealing atmosphere, the length and cross section of said filled tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, said filler being folded into a plurality of layers.

15. In a furnace having a base, a peripheral trough surrounding said base, said trough having inner and outer sides, and a cover adapted to surround said base with its lower end in said trough, the improvement comprising a flexible woven tube which resists decomposition at annealing temperatures in annealing atmospheres and which has little permanent set, and a deformable ceramic woven fibre blanket, the length and cross section of said flexible woven tube being such as to extend completely around the periphery of the trough in bearing engagement with the sides of the trough, said deformable ceramic woven fibre blanket being folded into a plurality of layers.

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