March 17, 1959 K. EGGE 2,878,005

COIL SUPPORT FOR BOX ANNEALING FURNACE

Filed Dec. 15, 1955

3 Sheets-Sheet 1

FIG. 1.

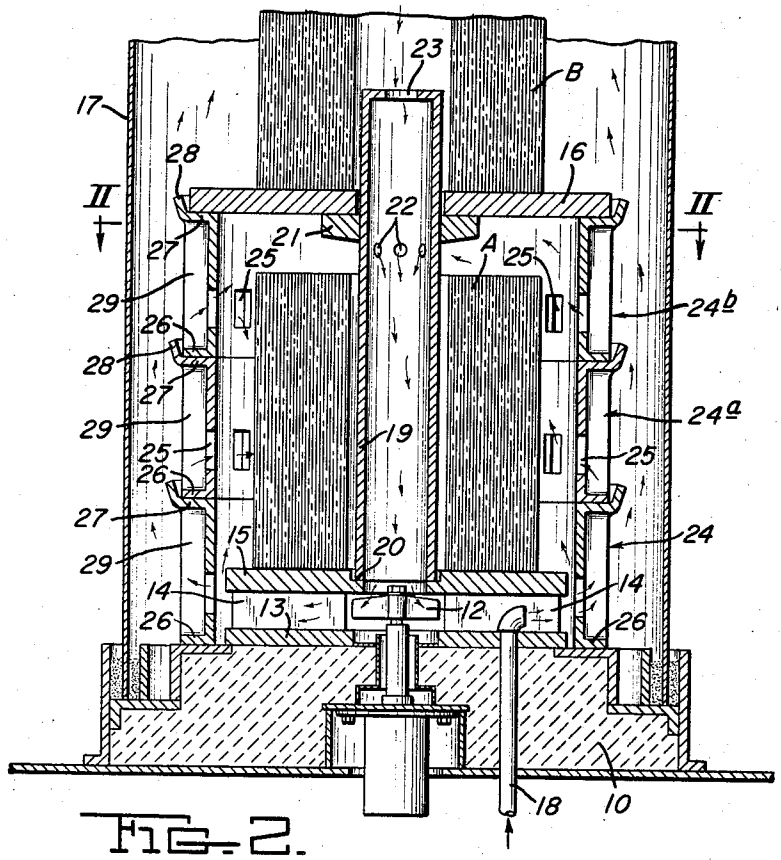
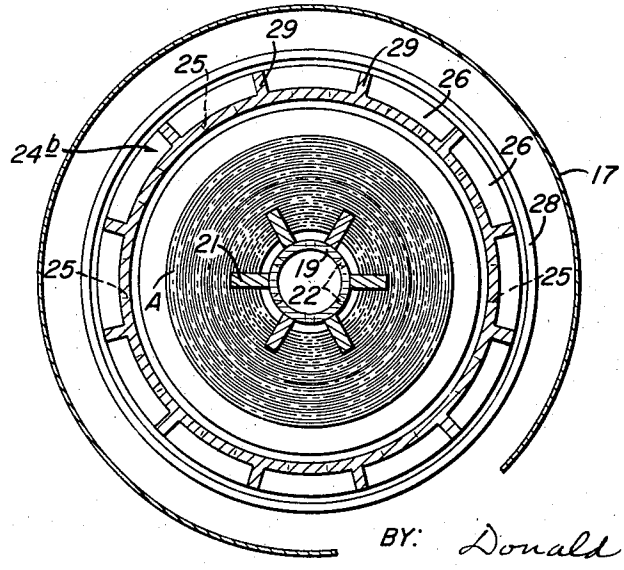


FIG. 2.



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Filed Dec. 15, 1955 3 Sheets-Sheet 2

FIG. 3.

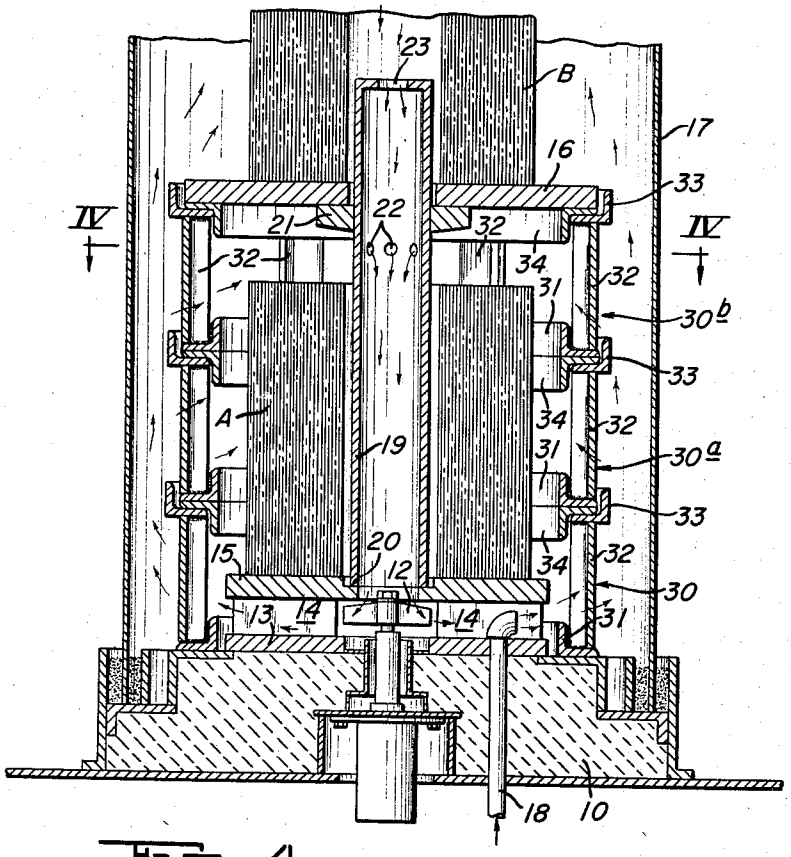
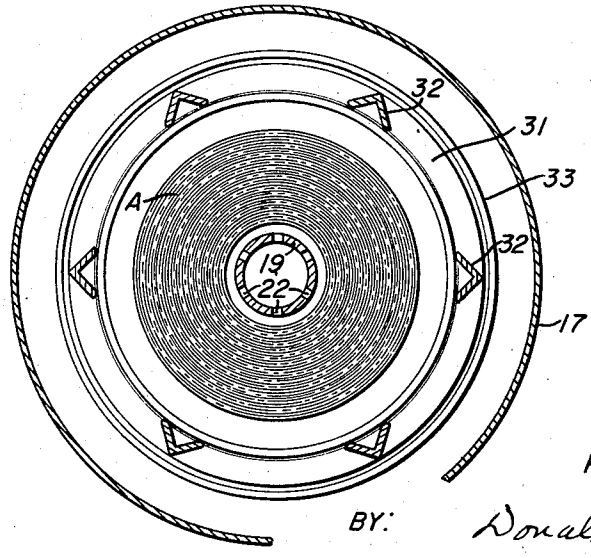


FIG. 4.



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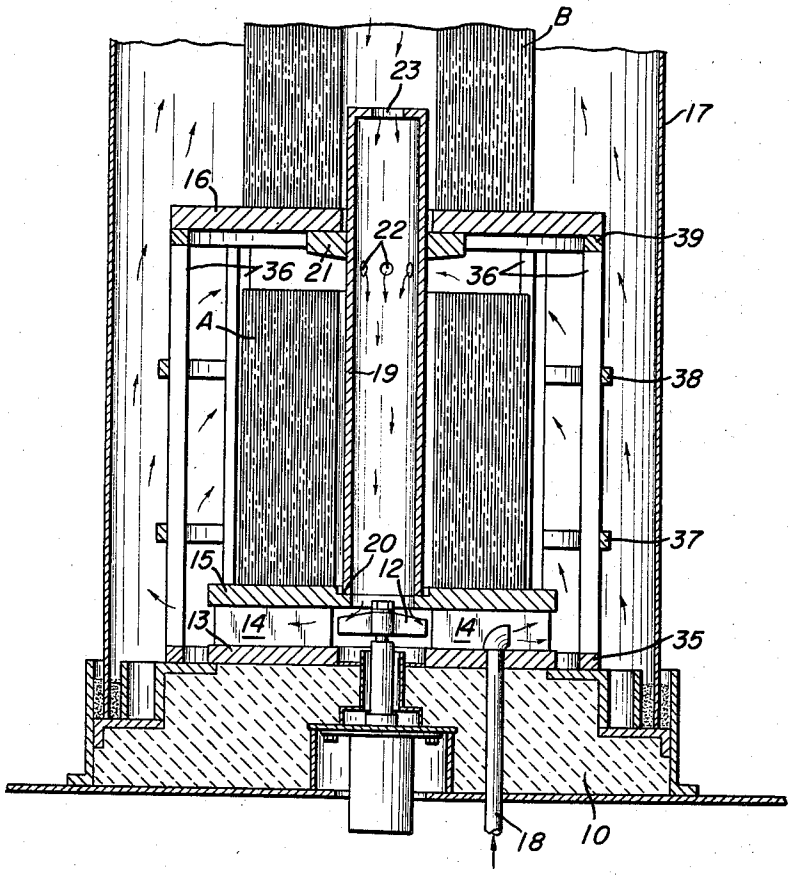
3 Sheets-Sheet 3

FIG. 5.



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United States Patent Office 2,878,005 Patented Mar. 17, 1959

2,878,005

COIL SUPPORT FOR BOX ANNEALING FURNACE

Klaus Egge, Pittsburgh, Pa., assignor to United States Steel Corporation, a corporation of New Jersey

Application December 15, 1955, Serial No. 553,288

11 Claims. (Cl. 263—47)

This invention relates to an improved support for strip metal coils in a two-high box annealing furnace.

The present application is a continuation-in-part of my three earlier applications Serial No. 384,615 filed October 7, 1953, Serial No. 465,277 filed October 28, 1954, and Serial No. 467,267 filed November 8, 1954, all now abandoned.

Certain types of steel (for example that of high silicon content) require annealing at temperatures exceeding 2000° F. while in the form of coiled strip. At such temperatures steel is mechanically weak, and in a two-high furnace the bottom coil cannot sustain the weight of the top coil without becoming damaged. Consequently it is necessary to equip the furnace with a support which carries the top coil independently of the bottom coil. In actual practice I have encountered a further problem in that most top coil supports tend to sag at the annealing temperature. If sagging occurs, portions of the top coil telescope downwardly to produce a defective coil. I have also observed that the furnace requires internal means for distributing the atmosphere over the coils to anneal them properly.

An object of the present invention is to provide an improved support which carries the weight of a top coil independently of the bottom coil, prevents telescoping of any portion of the top coil, and also assists in distributing the furnace atmosphere.

A further object is to provide an improved support which includes an annular upper hearth plate and cooperating columns supporting this plate at both its inner and outer circumferences to assure that it does not sag under the weight of a top coil.

A further object is to provide an improved support which has the foregoing features and in which the inner column serves to distribute the furnace atmosphere as well as support the upper hearth plate at its inner circumference.

A further object is to provide an improved support which has the foregoing features and in which the outer column can be made up of superposed annular sections to facilitate installation and afford a more stable structure.

In accomplishing these and other objects of the invention, I have provided improved details of structure, preferred forms of which are shown in the accompanying drawings, in which:

Figure 1 is a vertical sectional view of a box annealing furnace equipped with a preferred form of top coil support constructed in accordance with my invention;

Figure 2 is a horizontal section on line II—II of Figure 1;

Figure 3 is a vertical section similar to Figure 1, but showing a modified outer column;

Figure 4 is a horizontal section on line IV—IV of Figure 3; and

Figure 5 is another vertical section similar to Figure 1, but showing a further modified outer column.

Figures 1, 3 and 5 show somewhat diagrammatically a portion of a conventional box annealing furnace which

includes an annular refractory pedestal or base **10**, a fan **12**, and a metal stool **13**. The upper face of the stool carries a plurality of upstanding ribs **14** on which an annular metal lower hearth plate **15** rests. An annular metal upper hearth plate **16** rests on a support constructed in accordance with my invention and hereinafter described. The lower and upper hearth plates respectively carry bottom and top coils A and B of strip metal for annealing. A removable cylindrical inner cover **17** rests on the pedestal **10** and can be lifted for charging the furnace. A gas inlet **18** extends upwardly through the pedestal **10** and stool **13** and discharges into the space between said stool and the lower hearth plate **15**. The furnace also includes an outer cover and appropriate means for heating the coils to the annealing temperature, but not shown since they are conventional.

All three embodiments of my support comprise an inner tubular metal column **19** which rests on a shoulder **20** formed around the inner circumference of the lower hearth plate **15**. This column carries a plurality of rigidly affixed radial brackets **21** which are spaced above the height of the bottom coil A and whose upper faces constitute a ledge. The portion of the upper hearth plate **16** adjacent its inner circumference retsts on this ledge. The inner column contains a plurality of gas circulation openings **22** located between the bottom coil A and the upper hearth plate **16**. This column terminates intermediate the height of the upper coil B and its upper end is partially closed to form a restricted orifice **23** of smaller area than the total area of the openings **22**. The column has an outside diameter of a size to fit loosely within the central openings of the coils and leave some clearance, as illustrated.

My support also comprises a cooperating outer column, the preferred embodiment of which is shown in Figures 1 and 2. This outer column is made up of a plurality of similar superposed cylindrical sections **24**, **24***a* and **24***b*, each formed as an integral metal casting. The lowermost section rests on the pedestal **10** immediately outside the stool **13**. Each section includes an upright barrel which contains gas circulation openings **25**. The lower edge of the barrel has a horizontal flange **26** which affords a relatively wide supporting surface. The upper edge of the barrel has a horizontal ledge or flange **27** which is surrounded by an upstanding rim **28**. The upper flange and rim are adapted to receive the section thereabove, or the uppermost to receive the upper hearth plate **16** and thus furnish support thereto adjacent its outer circumference. The inner and outer columns are, of course, proportioned so that the brackets **21** of the former and the uppermost flange **27** of the latter are at the same height. Preferably the outside of the barrel has stiffening ribs **29**. The outer column has an inside diameter of a size to fit loosely over the coils A and B and leave some clearance as illustrated.

Figures 3 and 4 show a modified construction of sectional outer column made up of a plurality of similar superposed cylindrical fabricated metal sections **30**, **30***a* and **30***b*. The lowermost section again rests on the pedestal **10** outside the stool **13**. Each section includes a bottom angle iron ring **31**, a plurality of circumferentially spaced uprights **32**, and a pair of reversely disposed top angle iron rings **33** and **34**. The uprights **32** are welded at their lower ends to the inside of the bottom angle iron **31**, and the horizontal leg of the latter thus affords a relatively wide supporting surface. The uprights **32** are welded at their upper ends to the outside of the horizontal leg of the top angle iron **33**. The vertical leg of this top angle iron forms an upstanding rim around the column section for receiving the section thereabove, or the uppermost for receiving the upper hearth plate **16** and thus furnishing support thereto adja-

cent its outer circumference. The other top angle iron 34 is placed over the angle iron 33 with its vertical leg extending downwardly inside the uprights 32 to afford increased rigidity. The spaces between the uprights allow gas circulation. Again the column is of a size to fit loosely over the coils.

Figure 5 shows a further modified outer column which is of one-piece fabricated metal construction. This column includes a bottom ring 35, a plurality of circumferentially spaced uprights 36, a pair of intermediate reinforcing or binder rings 37 and 38 and a top ring 39. The uprights 36 are welded at their lower ends to the upper face of the bottom ring 35 and at their upper ends to the underface of the top ring 39. The intermediate rings 37 and 38 encircle the uprights and are welded to the outside faces thereof. The column rests on the pedestal 10 immediately outside the stool 13 and supports the upper hearth plate 16 adjacent its outer circumference, and loosely receives the coils A and B.

In each embodiment of my invention the inner and outer columns cooperate to support the upper hearth plate 16 at both its inner and outer circumferences independently of the bottom coil A. At the annealing temperature this hearth plate is structurally weak and would sag if supported at only one of its circumferences. The resulting unevenness would allow portions of the top coil B to telescope downwardly and thus produce a defective coil. In each embodiment gas which forms the furnace atmosphere enters the inlet 18 and flows outwardly beneath the lower hearth plate 15. A portion flows over the bottom coil A and into the interior of the inner column 19 via the openings 22. Another portion flows through the openings in the outer column, over the top coil B and into the interior of the inner column 19 via the orifice 23. The fan 12 draws gas downwardly from the inner column and recirculates it outwardly beneath the lower hearth plate. Proper proportioning of the areas of the openings 22 and orifice 23 distributes the circulating atmosphere between the two coils.

In the embodiments shown in Figures 1 to 4 each section of the outer column is of relatively low height and provides a substantial bearing surface on which the section above can rest. Consequently each section has a low slenderness ratio to resist buckling. Different levels of the furnace may be at different temperatures, and hence thermal expansion of the support may not be uniform. The sectional construction enables different parts of the support to expand independently and thus overcomes any tendency of the support to buckle because of non-uniform expansion. The number of sections of the outer column can vary with the height of the bottom coil A as long as the height of the inner column corresponds.

In the preferred method of charging the furnace, the outer column is positioned and the bottom coil inserted with a crane. Next the inner column is inserted in the central opening of the bottom coil and the upper hearth plate placed on the two columns. Finally the top coil is placed on the upper hearth plate.

While I have shown and described certain preferred embodiments of my invention, it is apparent that other modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. In a two-high box annealing furnace which includes a base, a lower hearth plate supported on said base and adapted to support a bottom coil, said base and plate having aligned central openings, and a fan positioned below the opening in said plate, the combination therewith of a support for a top coil comprising a cylindrical outer column of greater inside diameter than the outside diameter of said plate, said column resting on said base surrounding said plate and adapted to surround the bottom coil, a tubular inner column open at its lower end resting on said plate in alignment with said openings and adapted to extend through the central opening of the bottom coil, said columns having respective supporting surfaces at the same height above the height of a bottom coil, and an annular upper hearth plate removably resting on the supporting surface of said outer column adjacent its outer circumference and on the supporting surface of the inner column adjacent its inner circumference and adapted to support a top coil, said columns cooperating to provide positive support for said upper hearth plate adjacent both its outer and inner circumferences, thereby preventing the upper hearth plate from sagging under the weight of a coil at annealing temperatures, said outer column having gas circulation openings, said inner column extending above the supporting surface thereon and having gas circulation openings located beneath the supporting surface thereon, the upper end of said inner column being partially closed to form a restricted orifice of smaller area than the area of the circulation openings in the inner column enabling said fan to move gas vertically through said inner column via both the restricted orifice and the circulation openings therein and thus distribute gas between the two coils.

2. A combination as defined in claim 1 in which said fan draws gas downwardly through said inner column.

3. A support as defined in claim 1 in which said outer column is made up of a plurality of superposed sections each having a relatively wide horizontally extending supporting surface at its bottom, a second horizontally extending supporting surface at its top and an upstanding rim surrounding said last named supporting surface and adapted to receive the section thereabove.

4. A support as defined in claim 3 in which each of said sections is formed as an integral casting including a barrel and flanges on the top and bottom thereof.

5. A support as defined in claim 3 in which each of said sections is formed of uprights and top and bottom angle irons welded to said uprights, said uprights being spaced to provide the gas circulation openings in the outer column.

6. A support as defined in claim 1 in which said outer column is of one-piece construction and includes bottom and top rings, a plurality of spaced uprights welded at their respective ends to said rings, and intermediate reinforcing rings welded to said uprights.

7. Apparatus for supporting coils in a box annealing furnace having a base with a center opening therethrough, which aparatus comprises a lower hearth plate having a center opening therethrough supported on said base with its center opening in communication with the center opening in said base and being adapted to support a coil disposed thereon, an inner column having a circumferential supporting ledge affixed thereon intermediate its ends removably disposed on said lower hearth plate over the center opening therein, said supporting ledge being spaced above said lower hearth plate a distance exceeding the height of a coil, an outer column having an inside diameter greater than the outside diameter of said lower hearth plate and projecting upwardly therefrom surrounding said lower hearth plate, the top of said outer column being in the same horizontal plane as the top of said supporting ledge, and an upper hearth plate having a center opening therethrough disposed on the top of said outer column and said supporting ledge with its center opening fitted around said inner column, said inner column projecting upwardly a distance above said upper hearth plate.

8. Apparatus for supporting coils in a box annealing furnace as defined by claim 7 characterized by said inner and outer columns having a plurality of openings through the walls thereof.

9. Apparatus for supporting coils in a box annealing furnace as defined in claim 7 characterized by said inner column including a tubular member having gas circulation openings beneath said ledge, and means forming a

restricted orifice of smaller area than said openings at the upper end thereof.

10. Apparatus for supporting coils in a box annealing furnace as defined by claim 7 characterized by the periphery of said outer column including a plurality of spaced-apart vertically disposed bars, a ring attached to and spanning the tops and bottoms of said bars, and at least one binder ring attached to and extending concentrically around said outer column.

11. Apparatus for supporting coils in a box annealing furnace as defined in claim 7 characterized by said outer column including a plurality of superposed cylindrical sections.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,878,005 March 17, 1959

Klaus Egge

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 32, claim 3, after "thereabove" and before the period insert -- and the uppermost to receive said upper hearth plate --.

Signed and sealed this 30th day of June 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents