

Jan. 24, 1950

L. WILSON
METHOD OF AND APPARATUS FOR
HEATING COILED STRIP METAL

2,495,561

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2 Sheets-Sheet 1

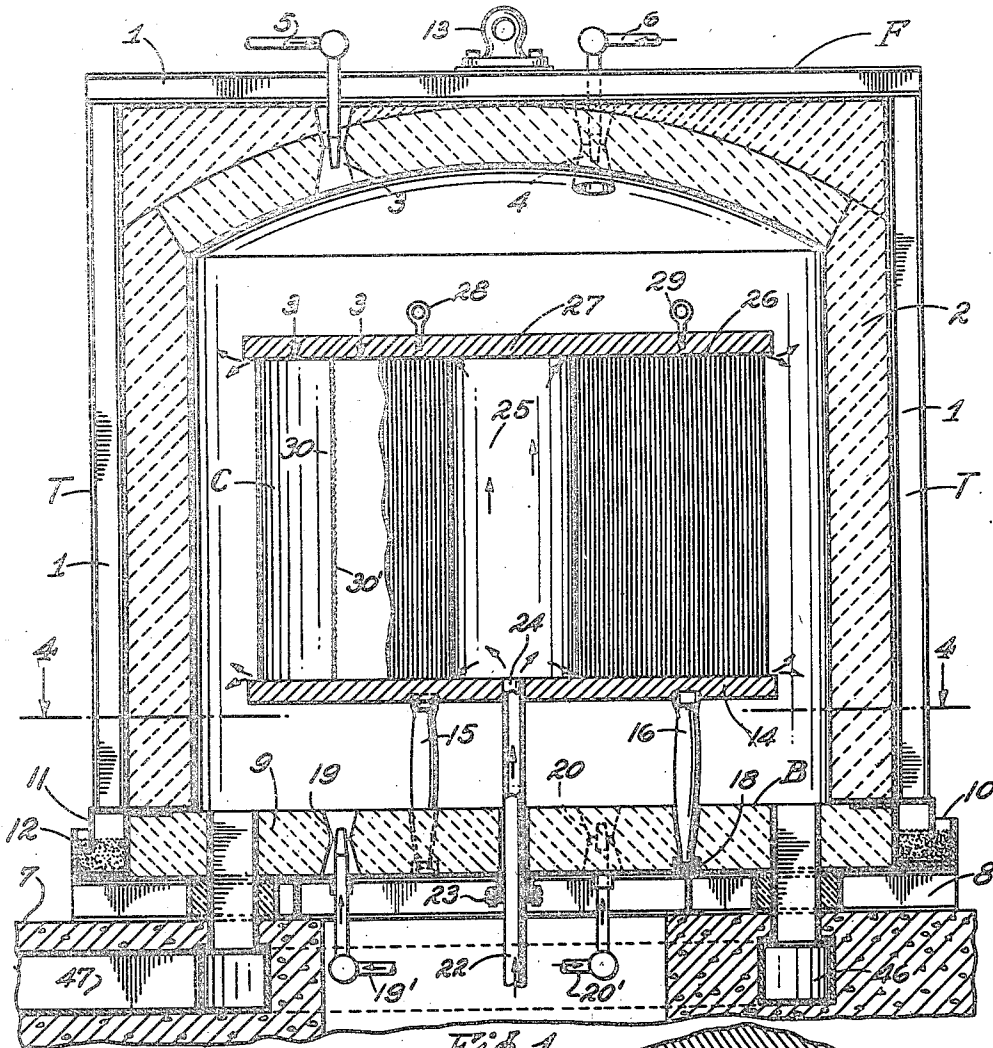


Fig. 1

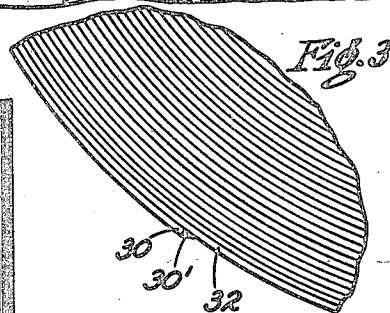


Fig. 3

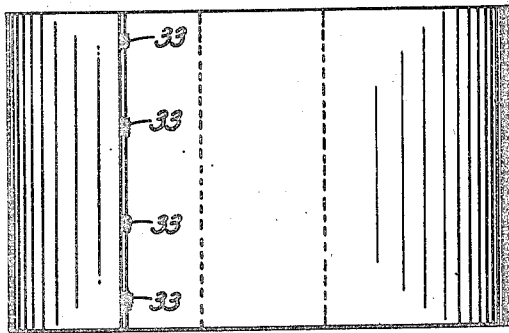


Fig. 2

INVENTOR
LEE WILSON
BY
Rosenath & Sessions
ATTORNEYS

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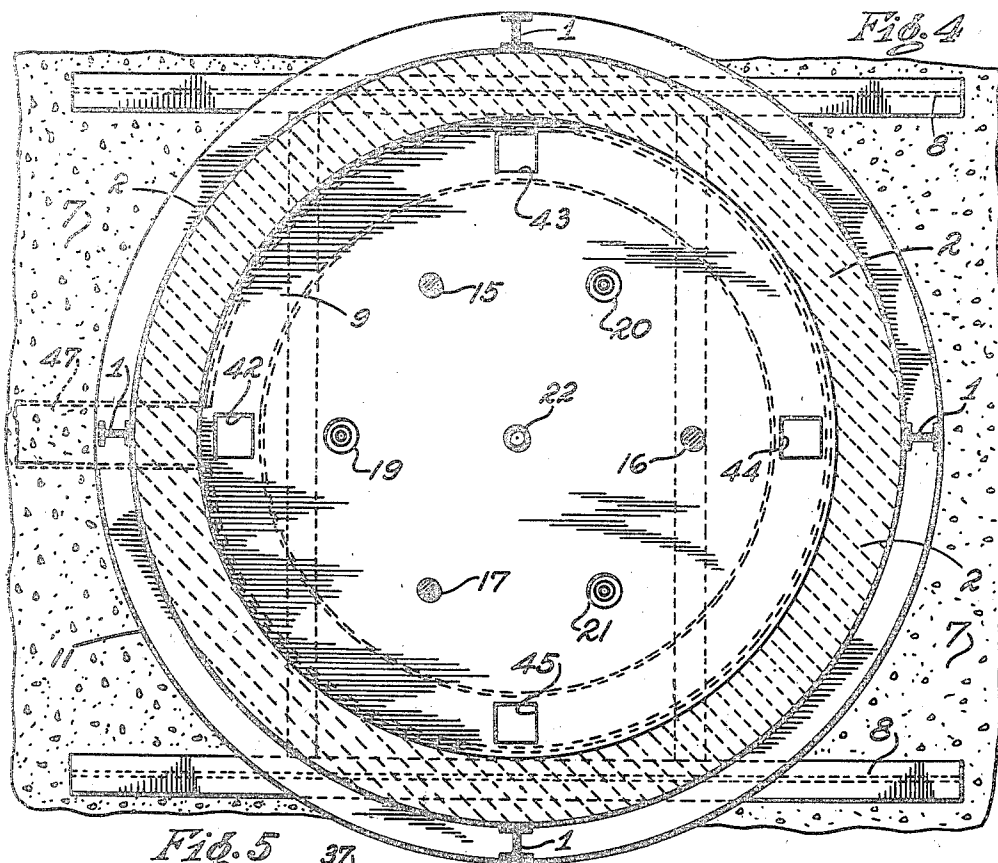


Fig. 4

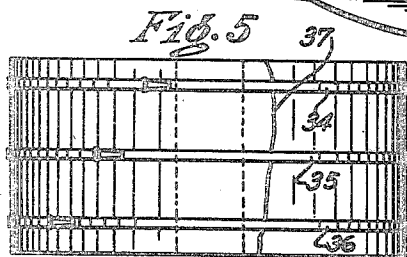


Fig. 5

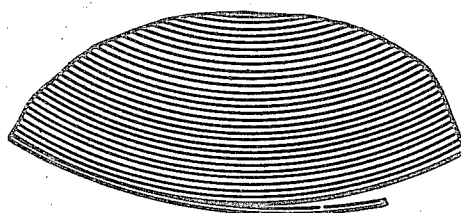


Fig. 7

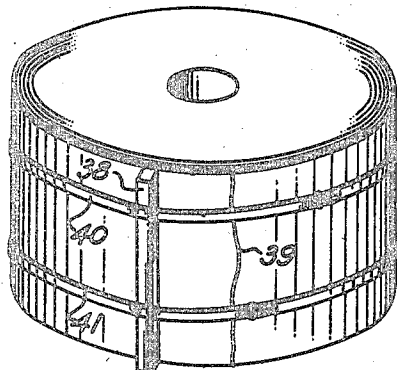


Fig. 6

INVENTOR.
LEE WILSON

BY
Brown & Sessions
ATTORNEYS

UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR HEATING
COILED STRIP METAL

Lee Wilson, Rocky River, Ohio

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9 Claims. (Cl. 263-43)

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This invention relates to heating coiled strip metal, and more particularly to an improved method of and apparatus for annealing or otherwise heat treating strip steel or the like in coils while protecting the surfaces of the strip from corrosion, scaling, de-carburization, or other undesirable effects.

It is a usual practice to anneal strip steel in coils and frequently, such as in bright annealing, it is desirable to protect the coil from contact with atmospheres which may harmfully affect the strip surfaces during the annealing operation. Furnaces of the well-known bell or cover type are particularly well adapted for this type of heat treating and various means have been proposed for protecting the coils by maintaining an atmosphere of a protective gas around the coil while it is being raised to the desired temperature and cooled. One arrangement which has been successfully and extensively used for this purpose in cover type furnaces includes an inner shell or cover of relatively light gauge metal which is placed over a coil, or stack of coils, as the coil rests upon the furnace base with its axis vertically disposed. These protective covers fit loosely over and are spaced from the coil and means are provided for directing a protective atmosphere up through the furnace base into the hollow center of the coil and permitting it to fill the space within the cover and escape around its bottom edge. However, although such protective covers achieve excellent results they constitute an item of continuing expense as they are relatively short lived because of the repeated handling in normal use and continued exposure to high temperatures for long periods of time in direct contact with the furnace atmosphere with resulting warping and corrosion.

It is, therefore, among the objects of my present invention to provide a method of and apparatus for heating coiled strip metal in a furnace, while protecting the strip from contact with harmful atmosphere, in which the use of the usual coil covers is eliminated and in which heat may effectively be applied to the ends of the coil for most efficient heating thereof.

Other objects of my invention include: the provision of heating apparatus for coiled strip metal in which the outer layer of the coil itself serves as a protective sheath for the inner coil layers or convolutions; the provision of a coil heating apparatus in which the contact of undesirable gas atmospheres with the surfaces of the strip in the coil may effectively be prevented without the use of special coil enclosures or the like and in which

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a minimum volume of protective gas is required; the provision of a furnace and coil support combination for heating coiled strip metal which obtains high heating efficiency at low first cost and operating expense, permits rapid heating and cooling of the coils, and produces a uniform high quality product; the provision of a simple and rugged structure for supporting and protecting coils against harmful atmospheres which may be employed either in direct or indirectly heated furnaces; and the provision of heating apparatus of the type described which reduces to a minimum the time and labor involved in setting up a coil prior to placing a furnace bell thereover.

The above and other objects of my invention will appear from the following description of several embodiments thereof, reference being had to the accompanying drawings in which:

Figure 1 is a vertical cross sectional view through a bell type furnace in which my improved coil supporting and protecting arrangement is incorporated.

Figure 2 is a detached side elevation of a coil of strip metal, the free outer end of the coil being secured to the adjacent surface of the coil in a somewhat modified manner from that shown in Figure 1.

Figure 3 is an enlarged fragmentary top view of the coil shown in Figure 1, taken on line 3-3 of Figure 1.

Figure 4 is a horizontal cross sectional view taken on line 4-4 of Figure 1.

Figure 5 is a view generally similar to Figure 2 but illustrating another modified arrangement for maintaining the outer end of the strip in close engagement with the adjacent surface of the coil.

Figure 6 is a view generally similar to Figure 5 but illustrating a third modification of the means for closing or sealing the outer free end of the coil.

Figure 7 is a fragmentary top view of a coil with the outer end of the strip free.

My present invention, in its preferred embodiment, contemplates the employment of a removable bell or cover type furnace having a stationary supporting base. Preferably supported above the furnace base structure, and in spaced relation thereto, I provide a coil carrying plate having a generally flat upper surface of slightly larger area than the end area of the largest coil to be supported thereon. Means are provided for directing a protective atmosphere up through a centrally located inlet port in this plate. The coil to be heated is placed on this supporting plate

or carrier in up-ended position with its axis extending vertically and substantially aligned with the center of the plate so that the outer edge of the plate extends beyond the outer edge of the end of the coil. Next an upper cover plate is placed on the top of the coil. This plate extends beyond the outer edge of the top end of the coil and the outer end of the metal strip is preferably substantially sealed against the adjacent outer layer of the coil to prevent circumferential flow of the outside atmosphere into the coil convolutions. Thus, when the coil is supported as described and a protective gas is discharged into the center of the coil and permitted to escape between the top and bottom end surfaces of the coil and their respective cover plates, access of harmful gases to all parts of the coil is prevented except to the outer side surface thereof. After the annealing or other heat treating operation is completed the outer convolution of the coil may, of course, be oxidized but the remaining strip in the coil will be in the desired condition having been protected during the heating operation and it is only necessary to cut off and discard from the outer end of the coil a length equal substantially to the outer circumference of the coil.

Referring to the accompanying drawings, a furnace bell or cover is indicated at F and includes a supporting frame structure 1 and a refractory lining 2. It will be understood that the furnace is diagrammatically illustrated and that, although a relatively small unit adapted to heat only a single coil is illustrated, the furnace might be enlarged to accommodate any desired and practical number of coils in a single charge. Fuel burners 3 and 4 discharge downwardly through the top of the furnace bell structure toward the top of the coil C and are supplied with fuel from the feed lines 5 and 6 respectively. Although the illustrated furnace is provided with three top burners arranged symmetrically around the vertical center line of the bell (the third burner not being shown in the drawings) it will be understood that any desired number of burners may be employed and that the location of the burners in the furnace may be varied to achieve the most efficient heating results.

Supported above the foundation line 7 on suitable structural members 8 is the stationary furnace base generally indicated at B. In the apparatus illustrated this base is circular in form and is provided with a refractory section 9 and an annular sealing trough 10. A corresponding annular sealing flange 11 is carried by the bottom of the furnace bell F and a suitable sealing material 12, such as sand or water, is disposed in the trough 10 in well-known manner. When the bell is in operating position as shown in Figure 1 the flange 11, in cooperation with the trough 10 and sealing material 12, provides a substantially gas tight seal between the furnace base B and the bell F while permitting the bell F readily to be lifted from and replaced onto the base. An eye or lifting ring 13 secured to the top of the frame structure 1 facilitates handling of the furnace bell.

The bottom coil supporting and end covering plate 14 is supported on stanchions 15, 16, and 17 which, as is best seen in Figure 1, preferably have their lower ends mounted in socket members 18. Bottom burners 19, 20 and 21 extend upwardly through the base B and are supplied with fuel through suitable pipes as indicated at 19' and 20'. These burners are preferably

symmetrically spaced around the vertical center line of the base B in the same manner as the top burners previously described and the discharge with the bottom burners 19, 20 and 21 is directed upwardly against the under side of the coil supporting plate 14.

A suitable source of supply of protective gas is connected to the supply pipe 22 which extends up through packing gland 23 and the base B into the center gas inlet port 24 in the plate 14. It will be observed that the plate 14 is recessed on its under side to provide sockets for the upper ends of the stanchions 15, 16 and 17 and that the bottom coil supporting plate can be removed by merely lifting it off of the supporting stanchions. Although the pipe 22 has a substantially gas tight connection with the plate 14 it is not securely attached thereto.

The coil being annealed, generally indicated at C, is positioned on the bottom plate 14 with its central axis substantially aligned with the center of the plate 14. Thus, as is clearly seen in Figure 1, the hollow center 25 of the coil C will receive the protective gas discharged through the port 24. To control and restrict the flow of protective gas through the port 24 and to protect the strip edge surfaces which make up the upper end 26 of the coil C, I provide a top cover plate 27 which is preferably substantially the same size and shape as the bottom plate 14 except that it is imperforate and may be provided with lifting rings 28 and 29 to facilitate handling. Top and bottom plates 14 and 27 are preferably made of a suitable high temperature alloy and are sufficiently thick to prevent excessive and undesirable warping when repeatedly subjected to furnace temperatures.

In operating the apparatus described above the desired protective gas is discharged through the pipe 22 and the port 24 into the hollow center 25 of the coil C. This gas is maintained under greater pressure than that which exists outside of the coil C. Due to normal variations in strip width and in winding the coil, a completely gas tight fit between the bottom end of the coil C and the substantially flat upper face of plate 14 and between the upper end of coil C and the substantially flat bottom face of plate 27 is not practicable. Thus the protective gas is permitted to escape across the ends of the coil, as indicated by the small arrows in Figure 1, and effectively prevents the entry of undesirable atmosphere between the cover plates and the ends of the coil.

In order to prevent or limit the entry of outside atmosphere into the convolutions of the coil C at the outer end 30 of the strip I preferably provide means for maintaining the outer end of the strip sealed to or in close engagement with the adjacent surface of the coil. I have illustrated several ways in which the end of the strip may be maintained in the desired position, Figures 1 and 3 showing a continuous weld 30' between the end 30 of the coil and the adjacent outer layer 32. In Figure 2 a series of spot welds 33 secure the outer end of the strip in place during the heating operation while Figure 5 illustrates a coil which has been bound by metal bands or straps 34, 35, and 36 which hold the end 37 of the coil in close engagement with the coil body. A modification of the arrangement shown in Figure 5 is illustrated in Figure 6 in which a pressure distributing bar 38 extends between the top and bottom ends of the coil adjacent the outer end 39 of the strip and the ten-

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sion bands 40 and 41 hold the bar 38 against the outer surface of the strip to prevent substantial entry of outside atmosphere between the outer layer of the coil and the next adjacent inner layer.

When welding is employed to seal the end of the strip against the body of the coil, as shown in Figures 1, 2 and 3, it is necessary to cut through the outer layer of the coil in order to permit it to be unwound and cut off after the heating operation is completed. With the banding arrangement shown in Figures 5 and 6, it is only necessary to cut the bands and then unwind and cut off the exposed outer layer of the strip. By securing the outer end of the strip against the body of the coil, entry of harmful gases into the coil convolutions is substantially prevented and the amount of protective atmosphere which is required to prevent oxidation of the coil is maintained at a minimum. However it will be understood that in some cases it may be practical to leave the outer end of the strip free as is indicated in Figure 7 and to depend entirely on supplying enough protective gas to the interior of the coil to prevent damage to the strip surfaces during heating. When the outer end of the strip is left free it is possible that the outside atmosphere will work into the coil for a limited distance, but with some types of material the outer layer will hug the body of the coil sufficiently tightly to restrict the entry of outside atmosphere enough to prevent excessive scrap. Therefore the determining factor in deciding whether the end of the strip should be welded or otherwise secured in position will be the relative cost of the welding or banding operation as compared to the additional scrap loss which may be incurred if the welding or banding is omitted.

In the illustrated furnace arrangement I have provided a plurality of outlet flues 42, 43, 44 and 45 which extend downwardly through the base B to the header 46 which in turn connects with a discharge flue 47. The top burners 3 and 4 and the third burner of the top set (not shown) discharge downwardly against the top plate 27 and thus this plate is heated directly by convection as well as by radiation from the furnace walls, etc. The products of combustion from the top burners move downwardly around the outer surface of the coil C and, together with the products of combustion from the bottom burners 19, 20 and 21, flow out through the flues 42, 43, 44 and 45.

As both the bottom and top coil cover plates 14 and 27 are subjected to direct heat from the burners and are in direct contact with the coil ends, the coil is most advantageously heated because the major heat input is through the ends of the coil. It is now recognized that such application of heat to a coil provides more efficient heating than the application of heat through the outer side surface of the coil.

It will be understood that, although I have illustrated and described a direct fired furnace in which my top and bottom coil cover plates and the outer surface of the coil are exposed directly to the products of combustion, my invention is equally applicable to use with furnaces employing radiant tubes, electrical heating elements, or muffle arrangements in which the products of combustion are prevented from directly contacting the coil. Furthermore, my coil protecting apparatus may be used with box type furnaces in which the coil is moved into and out of the furnace heating chamber. In such an

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application the coil is assembled with top and bottom cover plates and placed on suitable supports in the furnace and connections made to a source of protective gas.

By providing top and bottom end covers for the coil and maintaining a flow of inert or protective gas into the center of the coil and out between the ends of the coil and the covers, I have completely eliminated the necessity for separately enclosing the coils in a separate sheath or cover in which the protective atmosphere is maintained. My arrangement not only substantially reduces operating costs by saving the expense of maintaining and renewing the coil covers but also reduces the time required for loading and unloading the furnace and, by improving the heating efficiency by more direct application of heat to the coil, reduces the heating time cycle and substantially increases the possible output of a given furnace installation.

Although I have described the illustrated embodiments of my invention in considerable detail, it will be understood by those skilled in the art that variations and modifications may be made in the arrangement and proportions of the parts making up my improved apparatus and in the procedure employed in carrying out my method without departing from the spirit of my invention. I do not, therefore, wish to be limited to the method and apparatus herein particularly disclosed but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

1. Apparatus for protecting coils of strip metal during annealing or other heat treatment comprising two end covers, each having a substantially flat coil engaging face, said faces having greater area than the ends of the coil to which they are to be applied whereby they will completely cover said ends, means for substantially sealing the outer free end portion of said coil against the next below layer of said coil, and means for discharging gas under pressure into the hollow center of said coil.

2. In combination with a coil of strip metal having its outer free end portion held in close engagement with the next below layer of said coil, a cover plate in engagement with and substantially completely covering one end of said coil, a second cover plate in engagement with and substantially completely covering the other end of said coil, and means for discharging gas under pressure into the hollow center of said coil, said cover plates preventing the escape of said gas from said hollow center except between said coil ends and the inner coil engaging surfaces of said cover plates.

3. Apparatus for protecting a coil of strip metal during annealing or other heat treatment thereof comprising a pair of end cover plates for said coil, one of said plates being adapted to support said coil in up-ended position and cover the bottom end thereof and the other of said plates being adapted to rest upon and cover the top end of said coil, one of said plates having an aperture therethrough, and means for discharging gas under pressure through said aperture into the hollow center of said coil, said plates having non-sealing engagement with the ends of said coil whereby gas discharged into the center of said coil may escape between the ends of said coil and said plates thereby preventing the entry of outside atmosphere between said plates and the ends of said coil.

4. In combination in apparatus for heating coils of strip metal, a bottom coil supporting and end covering plate, a top end cover plate adapted to rest upon and cover the top end of a coil when said coil is supported on its bottom end on said bottom plate, said bottom plate having a gas port extending therethrough, said plates having non-sealing engagement with the ends of said coil, means for discharging a protective gas through said port into the hollow center of a coil disposed on said bottom plate, and furnace means for heating said plates and a coil disposed therebetween.

5. In apparatus for heating coils of strip metal, the combination of a furnace base, a bottom coil supporting and end covering plate having a substantially horizontal top surface of larger area than the coil supported thereon, said bottom plate having a gas port extending therethrough, means for supporting said plate above and in spaced relation to said furnace base, means for conducting gas under pressure to said gas port, a top coil covering plate adapted to rest upon and cover the top end of a coil when said coil is supported by said bottom plate, a removable furnace bell adapted to be positioned on said furnace base over said coil covering plates and a coil disposed therebetween, and means for heating the interior of said furnace bell.

6. The method of protecting a coil of strip metal against contact with an undesirable atmosphere which includes the steps of substantially sealing the outer free end portion of the strip against the next below layer of the coil, covering the ends of said coil and leaving the side surface thereof exposed, maintaining a desired atmosphere within the hollow center of said coil under greater pressure than that which exists outside of said coil, and permitting said desired atmosphere to escape across the ends of said coil.

7. The method of heating a coil of strip metal which includes the steps of substantially sealing the outer free end portion of the strip against the next below layer of the coil, covering the ends

of the coil and leaving the side surface thereof exposed, directing protective gas into the hollow center of said coil at greater pressure than that which exists outside of said coil, and heating said coil in a furnace while maintaining said protective gas within said coil at greater pressure than that which exists outside of said coil.

8. The method of heating a coil of strip metal which includes the steps of substantially sealing the outer free end portion of the strip against the next below layer of the coil, supporting the coil on a base plate with the coil axis vertical, covering the upper end of the coil by a top plate in direct contact therewith, enclosing the coil and plates within a furnace, applying heat to said plates and to the side surface of said coil, and maintaining a gaseous atmosphere within the hollow center of the coil at greater pressure than that which exists within the furnace outside of the coil whereby said gaseous atmosphere is caused to escape into the furnace between said plates and the top and bottom ends of said coil.

9. In combination an apparatus for heating coils of strip metal, a bottom coil supporting and end covering plate adapted to support and cover the bottom end of a coil, a top end cover plate adapted to rest upon and cover the top end of a coil supported by said bottom plate, said bottom plate having a gas port extending therethrough, said plates having non-sealing engagement with said coil ends, and means for discharging protective gas through said port into the hollow center of the coil disposed on said bottom plate.

LEE WILSON.

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