Aug. 15, 1939. L. WILSON 2,169,314

METHOD AND APPARATUS FOR ANNEALING STRIP

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Fig. 1.

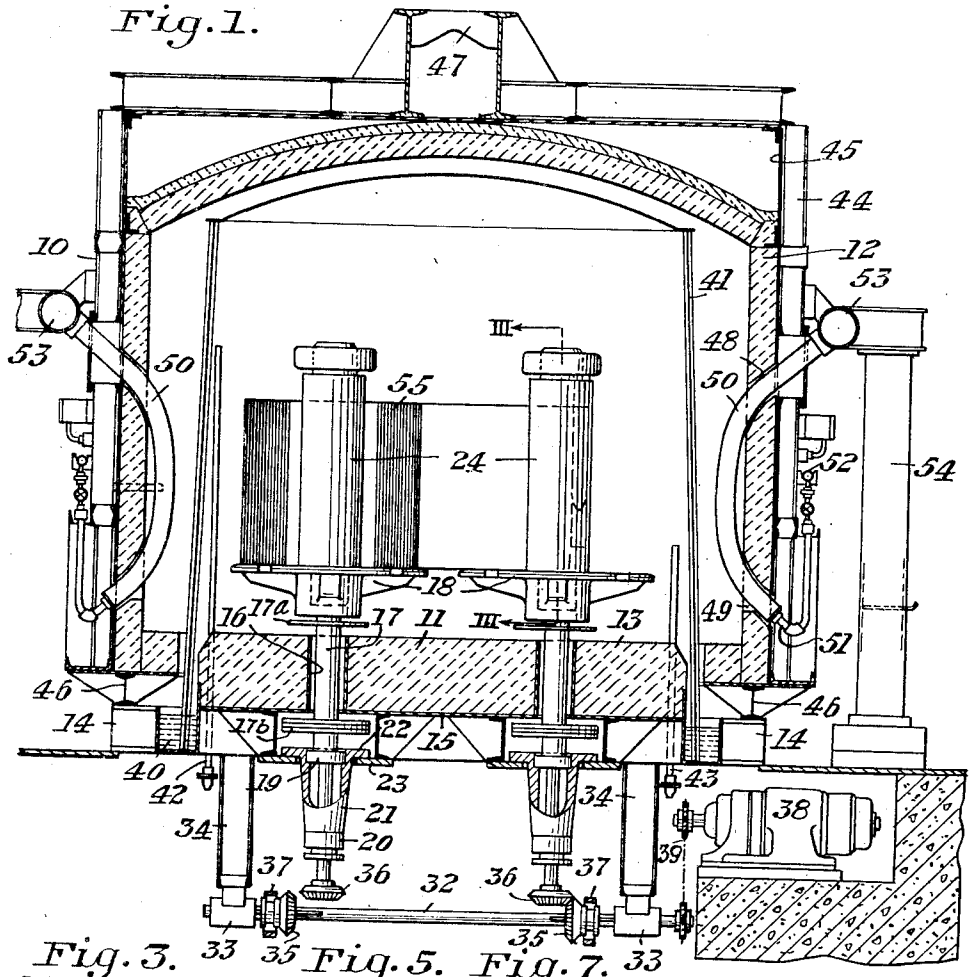


Fig. 3.

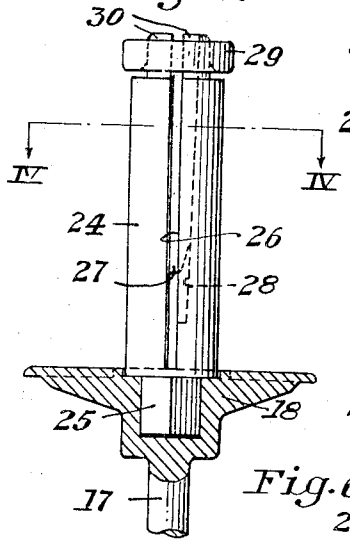


Fig. 5.

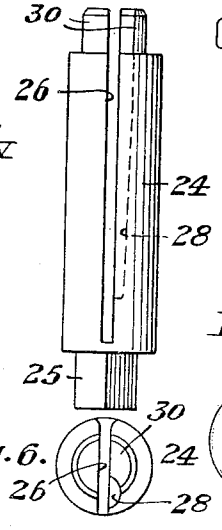


Fig. 7.

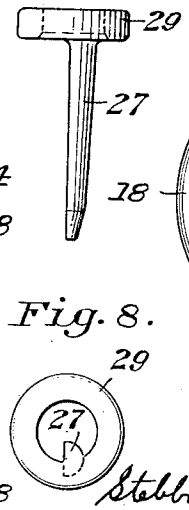


Fig. 4.

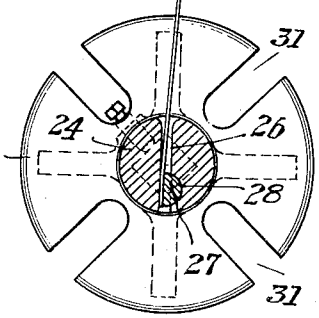


Fig. 8.

Fig. 6.

INVENTOR

Lee Wilson

by his attorneys

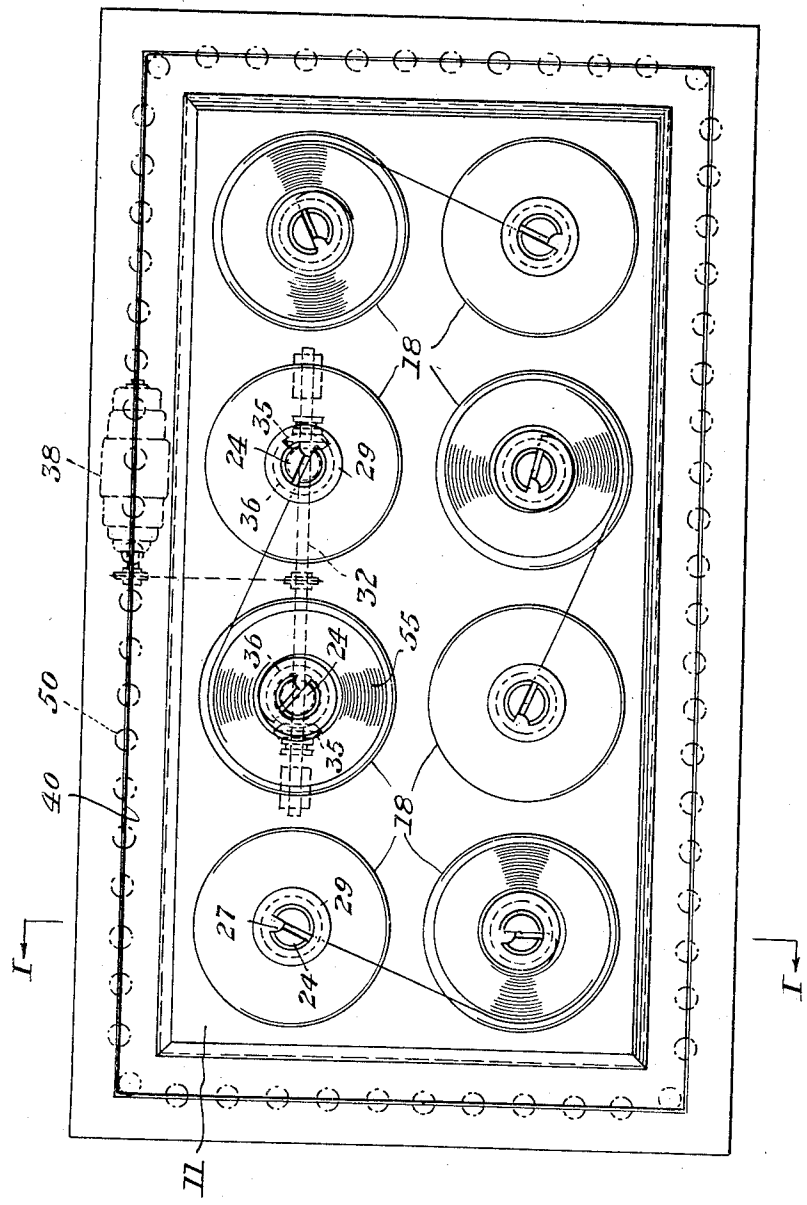
Stebbins, Blenko & Parmelee

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METHOD AND APPARATUS FOR ANNEALING STRIP

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Fig. 2.



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Patented Aug. 15, 1939

2,169,314

UNITED STATES PATENT OFFICE

2,169,314

METHOD AND APPARATUS FOR ANNEALING STRIP

Lee Wilson, Cleveland, Ohio, assignor to Lee Wilson Sales Corporation, a corporation of Ohio

Application January 3, 1938, Serial No. 182,949

6 Claims. (Cl. 266—3)

This invention relates to the heat treatment of metal in strip form and, more particularly, to a method and apparatus for annealing strip metal such as low carbon steel although it is also applicable to the treatment of other materials.

The annealing of strip in coils as heretofore carried on has not been satisfactory because of the long time required for bringing the entire mass of a coil up to the desired temperature and because the temperature of the coil in different parts thereof varies widely in spite of the greatest care which can be exercised to avoid such differences. These temperature differences cause the resulting material to exhibit different properties in different portions thereof.

I have invented a novel method and apparatus for annealing strip which greatly reduces the time required for heating and also insures that all portions of the coil are heated to substantially the same temperature. The advantages of the invention from the standpoint of increased output and improved quality of product require no enlargement.

In accordance with the invention I utilize a furnace of the cover type and provide the base thereof with a pair of turntables having coiling spindles upstanding therefrom. I provide driving means for the tables and spindles whereby a coil placed on one table can be unwound from the spindle thereof and rewound on the spindle of the other table while subject to the heat of the furnace cover. When the heating operation has been completed the furnace cover may be removed and the coil again unwound from one spindle and rewound on the other to facilitate cooling thereof, the strip being protected from contact with the atmosphere at all times by an inner heat conducting cover.

The following detailed description of a preferred embodiment and practice of the invention refers to the accompanying drawings illustrating such embodiment. In the drawings:

Figure 1 is a transverse section through a furnace of the cover type including the apparatus of the present invention and adapted to the practice of the method thereof;

Figure 2 is a plan view of the base of the furnace of Figure 1 with the cover removed; line I—I of Figure 2 indicates the plane on which the section of Figure 1 is taken;

Figure 3 is a partial sectional view along the line III—III of Figure 1 with parts in elevation;

Figure 4 is a partial plan view with a portion in section along the line IV—IV of Figure 3;

Figure 5 is an elevation of one of the coiling spindles;

Figure 6 is a plan view thereof;

Figure 7 is an elevation of means for anchoring the end of a coil to one of the spindles; and

Figure 8 is a plan view thereof.

The apparatus of my invention comprises a furnace 10 including a base 11 and a heating cover 12. The base includes a refractory hearth 13 carried on a structural framework including beams 14 and a floor plate 15. Openings 16 are formed in the hearth 14 and the floor plate for receiving vertical shafts 17 supporting turntables 18. Shield 17*a* and 17*b* are disposed on the shafts 17 to limit the loss of heat through the openings 16. The shafts 17 are journaled in bearings 19 and 20 disposed in housings 21. The housings 21 have out-turned flanges 22 adapted to rest on supporting plates 23 carried on the structural framework of the base.

The turntables are provided with spindles 24 removably disposed thereon. The spindles may conveniently have squared ends 25 adapted to fit in similarly shaped sockets in the tables. The spindles are split or slotted as at 26 to receive the end of a coil of strip to be wound thereon. An anchor pin 27 is adapted to be inserted in an internal groove 28 formed in the spindles. The groove and pin are tapered whereby the latter exerts a wedging action on the end of a strip passed through the slot 27 when pressed down into the groove 28, as shown in Figure 4. The pin 27 has a collar 29 adapted to embrace the reduced upper ends 30 of the spindles, which facilitates removal of the pin. The tables 18 are conveniently slotted as at 31 to facilitate removal of coils therefrom.

A transverse shaft 32 is suspended below the base 11, being journaled in bearings 33 carried on hangers 34 depending from the base. The shaft 32 has bevel gears 35 splined thereon adapted alternately to mesh with bevel gears 36 on the shafts 17. Gear shifting forks 37 associated with the gears 35 permit the latter to be moved into and out of mesh with the gears 36. The shaft 32 is driven by a motor 38 having a built-in speed reducer, through a chain and sprocket drive 39.

A sealing channel 40 extends around the hearth 13 and is positioned below the floor plate 15. An inner protective cover 41 of light metal plate is adapted to be disposed over the hearth, with its lower edges seated in said channel. Inlet and outlet connections 42 and 43 extend through the base of the hearth to permit the introduction

of any desired non-oxidizing gas within the cover 41.

The heating cover 12 is an open bottomed, refractory lined enclosure assembled within a structural framework 44 and sheathing plates 45. Beams 46 extend around the bottom edges of the cover and are adapted to rest on beams 14 of the base. A yoke 47 is provided for engagement by a crane hook when it is desired to raise the cover from the base. Ordinarily, one heating cover is employed in connection with several bases, being moved successively from one to another.

The side and end walls of the cover are provided with openings 48 and 49 suitable for receiving heat exchange tubes 50. The spacing of the heat exchange tubes 50 along the side and end walls of the furnace is indicated by dotted circles in Figure 2. A burner 51 extends into the lower end of each heat exchange tube 50, the several burners being supplied with fuel from mains 52. The upper ends of the tubes 50 are connected to headers 53 from which combustion gases are removed through a downtake 54. The latter communicates with an exhaust passage under the floor (not shown).

The invention may be practiced with a furnace having only a pair of turntables but, as indicated in Figure 2, it will generally be more efficient to install a plurality of turntables whereby several coils can be simultaneously treated in a single furnace. The number and arrangement of turntables may be varied within wide limits, as Figure 2 merely shows a typical arrangement which will be highly efficient. While a drive for only one pair of tables is shown, it will be understood that the other pairs of tables are similarly driven.

The method of my invention will be explained by outlining a normal cycle of operations which the apparatus shown in the drawings is adapted to perform. With the heating cover 12 and protective cover 41 removed from the base 11, a coil of strip is disposed on one of the turntables 18, for example the one shown on the left in Figure 1, as illustrated at 55. Additional coils may similarly be disposed on the other tables as shown in Figure 2. The inner end of each coil is anchored to the spindle of the table on which it is positioned by inserting the end through the slot 26 of the spindle and wedging it against one wall of the slot by inserting the pin 27 in its groove. The outer end of each coil is similarly anchored to an adjacent spindle. The protective cover 41 is then lowered over the base and the heating cover 12 likewise. Non-oxidizing gas is supplied through the inlet pipe 40 and the air trapped in the cover 41 is discharged through the outlet 43. The burners 51 being ignited, combustion gases flow through the tubes 50, heating them to radiant temperature. Heat is thus radiated to the walls of the cover 41 and to the coils therein by radiation and convection. After the furnace has been brought up to the proper temperature, the spindles to which the outer ends of the coils are secured are driven by the mechanism already described, to unwind the coils from the spindles to which their inner ends are anchored and rewind them on the first mentioned spindles. The entire length of each coil of strip is thus subjected progressively in strand form to the heating effect produced by the furnace. The portion of the coils progressively stretched between the spindles, being in single thickness, and subject to direct radiation from the protective cover as well as convection heating therefrom is rapidly brought up to the desired maximum temperature and the entire coil is rewound after successive portions thereof are raised to that temperature. As a result, the entire length of the coil is heated to the desired temperature for annealing within a much smaller time than would be required if the soaking of the heat through successive layers of the coil were relied upon to heat the inner portions thereof. A further result is that all portions of each coil are heated to substantially the same temperature.

After all the coils have been unwound and rewound and thereby heated to the desired temperature for annealing, the cover 12 may be removed for cooperation with another base. The completion of the unwinding and rewinding operation may be determined by observation through suitable sight holes (not shown) and the drive for the winding spindles stopped in time to prevent the ends of the coils attached to the unwinding spindles from being detached therefrom. The heated coils are now subjected to slow cooling in the non-oxidizing atmosphere maintained within the protective cover 41. This cooling may be facilitated by driving the spindles over which the coils were originally disposed (e. g. the left-hand spindle in Figure 1) to unwind the heated coil from the spindle on which it was rewound during heating, thereby subjecting the entire length of the strip progressively to the cooling effect exerted by the atmosphere on the cover 41. As the cover cools, obviously, the heat of the coils is radiated thereto and the temperature of the coils thereby reduced. The cooling, like the heating, is expedited by the unwinding and rewinding of the coils to expose all portions of the strip in strand form for radiation to the cover 41.

After the heated coils have been unwound and rewound, they are permitted to cool slowly to a temperature below that at which atmospheric oxidation proceeds rapidly. The cover 41 is then removed and the coils are ready for further processing. It is to be understood, of course, that a plurality of unwinding and rewinding operations may be performed on the coils during either the heating or the cooling stage of the cycle or both.

It will be apparent from the foregoing description that the invention is characterized by outstanding advantages, particularly the rapidity which heating and cooling can be effected and the uniformity of the temperatures to which various portions of the coils are heated. A further advantage results from final cooling of the material in coil form. By this step, a product is obtained having physical properties superior to those of strip which is cooled in strand form before coiling.

Although I have illustrated and described herein but a preferred embodiment and practice of the invention, it will be understood that changes in the method and apparatus disclosed may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Apparatus for annealing strip comprising a pair of turntables rotatably disposed above a refractory hearth, a refractory lined heating cover disposable over said turntables, means for securing to one turntable the end of a coil of strip disposed on the other turntable, and means for driving said one turntable to unwind said coil and rewind it thereon.

2. Apparatus for heating strip comprising a base, a pair of turntables rotatably mounted on said base having spindles upstanding therefrom, a heating cover disposable on said base and adapted to enclose said turntables and means for driving one of said turntables to unwind a coil of strip on the other and progressively subject it in strand form to the action of the heating cover.

3. In a method of annealing strip, the steps including disposing a coil of strip in an enclosure, applying heat to the coil, and unwinding the coil and re-winding it in said enclosure whereby to expose the strip progressively in strand form to said heat.

4. In a method of annealing strip, the steps including disposing a coil of strip in an enclosure, applying heat to the coil, unwinding the coil and re-winding it in said enclosure whereby to expose the strip progressively in strand form to said heat, discontinuing the application of heat to the coil, and again unwinding said coil and re-winding it while in said enclosure to cool it progressively in strand form.

5. In a method of annealing strip, the steps including placing a coil of strip on a support, enclosing it in a protective enclosure, supplying heat to the enclosure, unwinding and re-winding the coil, discontinuing the supply of heat, and cooling the strip by again unwinding and re-winding the coil while in said enclosure.

6. In a method of annealing strip, the steps including placing a coil of strip in a protective enclosure, enclosing the coil and protective enclosure in a heating enclosure, unwinding and re-winding the coil in said enclosures to facilitate absorption of heat by the strip, removing the heating enclosure from the coil and protective enclosure, and again unwinding and re-winding the coil while in said protective enclosure to facilitate cooling of the strip.

LEE WILSON.