Dec. 1, 1931. F. A. FAHRENWALD 1,834,207

CONTINUOUS SHEET STEEL NORMALIZING FURNACE

Filed Jan. 12, 1929

Fig 1

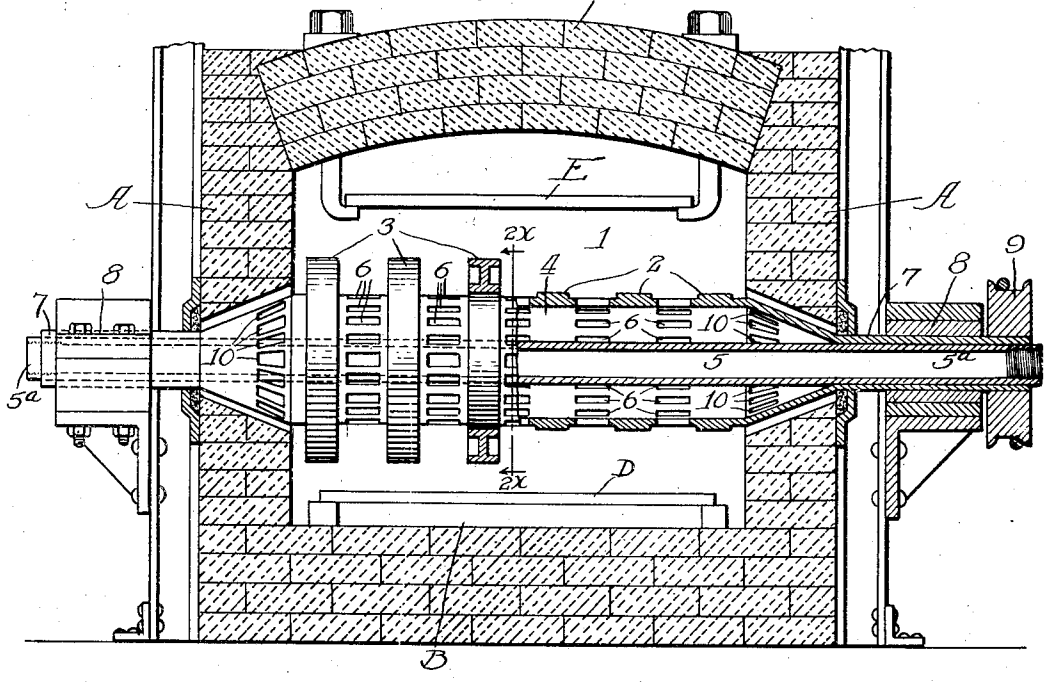
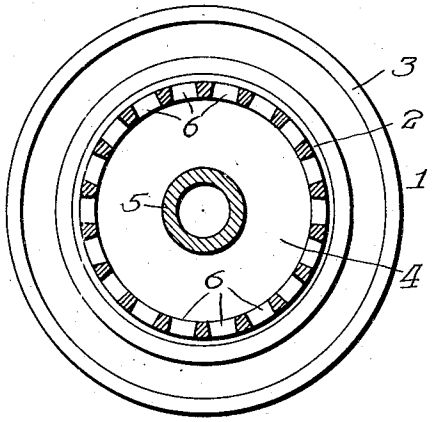


Fig 2



Witness

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UNITED STATES PATENT OFFICE

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CONTINUOUS SHEET STEEL NORMALIZING FURNACE

Application filed January 12, 1929. Serial No. 331,960.

This invention relates to steel treating furnaces, and particularly to heat treatment furnaces employing the roller type conveying system and used in the continuous heat treatment of sheets and plates for the purpose of annealing or normalizing the structure of the metal.

In continuous sheet steel normalizing furnaces, it is customary to pass the steel sheet by substantially continuous movement through several succeeding furnace zones of different temperatures, namely, first, through a high temperature zone in which the sheet will be heated and held for a short time to a temperature of from 1700 to 2000° F., and then through zones gradually decreasing in temperature until near the discharge end, where the temperature may be as low as 1200° F. or even down to 400° F. in some instances. In bringing about these variations in temperature, it has ordinarily been the practice to use burners for about one third of the length of the furnace, measured from the charging end, and to maintain through means of such burners, and by radiation from the advancing sheets, such temperatures in the succeeding zones as will insure the desired heat in them, respectively. In many cases, however, and particularly where sheets of peculiar metallurgical characteristics are to be treated, it is desirable to drop the temperature of the sheet in certain zones more rapidly than will result naturally from merely feeding the sheet along over non-cooled shafts; and for this purpose, it has been proposed to equip certain zones of the furnace with artificially cooled conveying elements, such, for instance, as rollers mounted on water cooled shafts, a good example of which is to be found in U. S. Letters Patent No. 1,539,833, issued June 2, 1925, to the present inventor, and wherein is disclosed a water cooled shaft having mounted upon it a plurality of sheet supporting rollers each comprising a continuous circular ring supported by integral radial spokes through the medium of segmental blocks circumferentially spaced apart, but collectively defining a hub upon the water cooled shaft. But this method of producing a more rapid drop in temperature in a zone is not suitable for all kinds of sheets, because of the extreme difference in temperature between water cooled pipes or runners mounted thereon and the remainder of the enviroment of the particular zone, which sets up troublesome expansion and contraction differentials in the sheet and disadvantageously affects the structure of sheets of certain metallurgical constituency. Moreover, large quantities of water must be employed to keep the steel shafts at a sufficiently low temperature to prevent sagging.

An ideal conveyor element for furnaces used in treating sheets which would be injured by localized cooling influences, such as contact with rolls supported on water-cooled shafts, is that disclosed in Letters Patent No. 1,623,469, issued April 5, 1927, to the present inventor, which makes it wholly unnecessary to employ artificial cooling to render the conveyor roll self sustaining as a structure, even under the high temperatures encountered, and wholly avoids unequal cooling effects upon the sheet or, indeed, any cooling effect, since the feel roll is preferably maintained at or slightly above the temperature of the sheet; the particular construction of roll affording such effects being a one-piece hollow member of relatively large diameter, sufficiently apertured throughout its structure to provide for supporting its core at the time of casting the roll and to serve the purposes of the present invention by maintaining free conventional communication between the interior of the roll and the surrounding furnace space, and free from heat conducting contacts except with coaxially arranged short-end shafts or trunnions which extend through the furnace walls to supporting bearings; and having even the tapered portions through which it meets these short shafts largely reduced in heat conducting capacity by means of numerous apertures so that all the sheet bearing portions of the roll remain at substantially furnace temperature and are without temperature influence upon the sheet. But such a roll as heretofore constructed is not adapted for artificial cooling.

Now, the object of the present invention is

to provide a roll for use in continuous sheet steel normalizing furnaces, which, while free from heat conducting contacts substantially as set forth in the aforesaid Letters Patent No. 1,623,469 and sufficiently stable structurally to stand up under the high furnace temperatures encountered, will nevertheless be so constructed that it may be used to impose artificial cooling influence upon the furnace environment generally in the zone in which it is located, including the sheet bearing roll as a whole, and without localized temperature differences in the roll. To this end, the present invention consists essentially in arranging within a hollow roll of the kind described, without physical or heat conducting connection with any of the sheet supporting surfaces of the roll, a suitable conduit for an artificial heating medium, for instance, air or water, which because of its presence within the roll will exert its influence upon the zone environment generally as by absorbing heat radiated from the sheet and from the walls as well as heat from the contacting furnace gases and setting up convection which will render the temperature control substantially uniform throughout the zone.

More specifically, and particularly from the view-point of the preferred embodiment of the invention, the invention consists in arranging a cooling medium conduit of the kind described coaxial with the sheet supporting roll, and particularly a large diameter ventilated roll, and having this conduit enter and leave the furnace through the stub shafts or trunnions of the roll, with or without participation of the cooling conduit in the rotation of the roll.

In order that the invention may be fully understood, the preferred embodiment has been illustrated in the accompanying drawings, in which—

Figure 1 is a vertical transverse section of a typical continuous sheet steel normalizing furnace containing a roll constructed in accordance with the present invention; the roll being shown partly in axial section; the section of the furnace being coincident with the said roll; and electrical heat sources which occupy a zone in advance of the roll being shown in elevation; and

Figure 2 is a section on the line $2x$—$2x$ of Figure 1.

A—A represent the side walls, B the bottom, and C the arch of a conventional type of continuous sheet normalizing furnace; and D and E represent electrical resistance heating elements located in the initial zone of the furnace, which is a zone in advance of that through which the section of Figure 1 is taken, and toward which the view is given in said figure.

The reference 1 indicates generally the preferred embodiment of the combined zone-cooling and sheet advancing roll of the present invention. This roll 1 will ordinarily be located only in the zone or zones of the furnace following that in which the heating elements D and E are located. Or if, because of its superior structural features, it should be employed in the heating zone, its cooling element will not be brought into function or will be permitted to function only to a minimum extent sufficient to save the cooling conduit from the effects of extreme heat.

The more important structural and functional features of the roll are: First, sheet supporting surfaces of such conventional form as may be desired, for instance, annular ribs 2 or raised annular rims 3 carried by a shell 4 which is free from heat conducting contact or connection substantially throughout its length, excepting at its ends, so that all surfaces upon which the sheets rest may be brought into substantial temperature correspondence with the general environment of the zone, or at least to a temperature not less than that of the zone in which the roll is located and thereby avoid localizing cooling influences upon the sheets; the wall of the roll being preferably open at sufficiently numerous points to permit circulation or convection of furnace gases through it and thereby maintain this condition of roll temperature; and there being also, preferably, sufficient interruption in the roll structure at its ends where it meets its supporting elements, to materially choke heat conductivity between the supports and the body of the roll. Second, a cooling medium conduit 5 located within the roll 1, but substantially without cooling influence upon the roll other than that which results from absorption of radiant heat or the heat of convective gases and which, by reason of freedom of convection of gases through the roll, will exert its influence upon the zone environment in general rather than upon any localized portion of the roll.

6 represents openings or perforations through the wall 4 of the roll 1 which holes, or their equivalents, serve an important purpose in permitting proper coring of the roll when made by foundry methods, and in the present case serve the important additional purpose of ventilating the roll or opening it up to convection and circulation of furnace gases. 7 represents the stub shafts integral with the roll 1 but of very much smaller diameter and extending through the walls A of the furnace and into bearings 8 by which said shafts, and through them the roll 1, are supported with freedom to rotate under the drive of a pulley 9; and 10 represents openings made in the tapered portions of the roll for the purpose of reducing the sectional area of the metal between the main body of the roll and the supporting shafts 7, and thereby cutting down heat losses by conduction.

As thus far described, the roll 1, except for

its artificial cooling feature typified generally by the concentric air or water pipe 5, may follow the teachings of the specific embodiment used to illustrate U. S. Letters Patent No. 1,623,469, already referred to.

In applying the cooling pipe 5, it will preferably be supported by having its ends 5a fitting within the stub shafts 7 of the roll with sufficient snugness to prevent escape of furnace gases outward or flow of oxidizing atmosphere inward between the pipe and the shafts; and this pipe will be provided at its ends with suitable construction to adapt it for connection with the cooling medium supply from any suitable source. Pipe 5 may partake of the rotation of the roll 1, but it is not necessary that it do so. It may be made of appropriate heat resisting steel alloy or any material which will enable it to withstand sagging under such heat as will be encountered, modified by the cooling influence of the fluid medium passing through it. If air be used as the cooling medium, it can be connected with the air line through the burners, so that heat abstracted by the air from the cooling conduit can be returned to the furnace in the form of preheated air for supporting combustion. This, however, is not necessary. Water may also be used as a cooling medium, with or without any subsequent disposal of the water for a useful purpose that would help to make the process more economical.

I claim:

1. In a metallurgical furnace having walls defining a heating chamber, a combined work supporting and furnace cooling roll having coaxial shafts at its opposite ends projecting through furnace walls, the roll being of materially greater diameter than the diameter of its shafts, and having free convectional communication between its interior and the surrounding space of the heating chamber and being free from heat conducting physical connections otherwise than at its said shafts, and an imperforate cooling element of materially less diameter than said roll located within but supported independently of said roll and without direct heat conducting connection therewith.

2. In a metallurgical furnace having walls defining a heating chamber, a combined work supporting and furnace cooling roll having coaxial shafts at its opposite ends projecting through the furnace walls, the roll being of materially greater diameter than the diameter of the shafts and having free convectional communication between its interior and the surrounding space of the heating chamber but free from heat conducting physical connections otherwise than at said shafts, and an imperforate cooling element located within said roll but of materially less diameter than said roll, supported by said shafts but otherwise free from heat conducting connection with said roll.

3. A sheet supporting and furnace cooling roll for metallurgical furnaces, comprising a relatively large substantially cylindrical apertured wall providing free convectional communication between the interior of the roll and the surrounding furnace space, shafts projecting from the ends of said roll and adapted to rotatably support the same, said roll being free from physical heat conducting connection except through said shafts, and a cooling member supported by said shafts within said roll.

4. A sheet supporting and furnace cooling roll for metallurgical furnaces, comprising a relatively large substantially cylindrical apertured wall providing free convectional communication between the interior of the roll and the surrounding furnace space, shafts projecting from the ends of said roll and adapted to rotatably support the same, said roll being free from physical heat conducting connection except through said shafts, and a cooling member supported by said shafts within said roll, comprising a conduit adapted to receive a fluid cooling medium.

5. A furnace cooling and sheet supporting and advancing roll for metallurgical furnaces, comprising a cylindrical body portion of relatively large diameter having a wall perforated to permit circulation of furnace gases through the roll, shafts extending from the ends of said roll and adapted to rotatably support the same, and a fluid cooling medium conduit concentric with said roll, supported by said shafts therein and free from conductive convection with the roll except through its shafts.

6. A furnace cooling and sheet supporting and advancing roll for metallurgical furnaces, comprising a cylindrical body portion of relatively large diameter having a wall perforated to permit circulation of furnace gases through the roll, shafts extending from the ends of said roll and adapted to rotatably support the same, and a fluid cooling medium conduit concentric with said roll and supported by said shafts therein; said conduit fitting said shafts and closing them against the escape of furnace gases or the inflow of atmospheric air.

7. In a metallurgical furnace, a hollow sheet supporting and conveying roll comprising a relatively large substantially cylindrical body wall, and shaft supporting said body wall, and a relatively smaller imperforate cooling fluid conduit located within said body wall but free from direct heat conducting connection therewith and exercising its cooling influence upon the roll by conducting away heat traveling across the space between said body wall and said conduit and said space being unobstructed and permit-

ting free convectional transfer of heat between said body wall and conduit.

8. In a metallurgical furnace having walls defining a heating chamber, a work supporting roll comprising a substantially cylindrical body portion of relatively large diameter, having means for supporting it at its ends, and an imperforate cooling fluid conduit of relatively small diameter supported within said body portion and wholly free from heat conducting physical connection with said body portion otherwise than at its ends; the space between said body portion and conduit being unobstructed and free for convectional transfer of heat between them; and the furnace being closed against convectional transfer of heat at the ends of the roll.

Signed at Chicago, Illinois, this 31st day of Dec., 1928.

FRANK A. FAHRENWALD.

CERTIFICATE OF CORRECTION.

Patent No. 1,834,207. December 1, 1931.

FRANK A. FAHRENWALD.

It is hereby certified that the above numbered patent was erroneously issued to "American Manganese Steel Company, of Chicago Heights, Illinois, a corporation of Maine", as assignee of the entire interest in said invention, whereas said patent should have been issued to the inventor said Frank A. Fahrenwald, as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of July, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)