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J. P. HAVEY

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HEATING FURNACE

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Fig-1

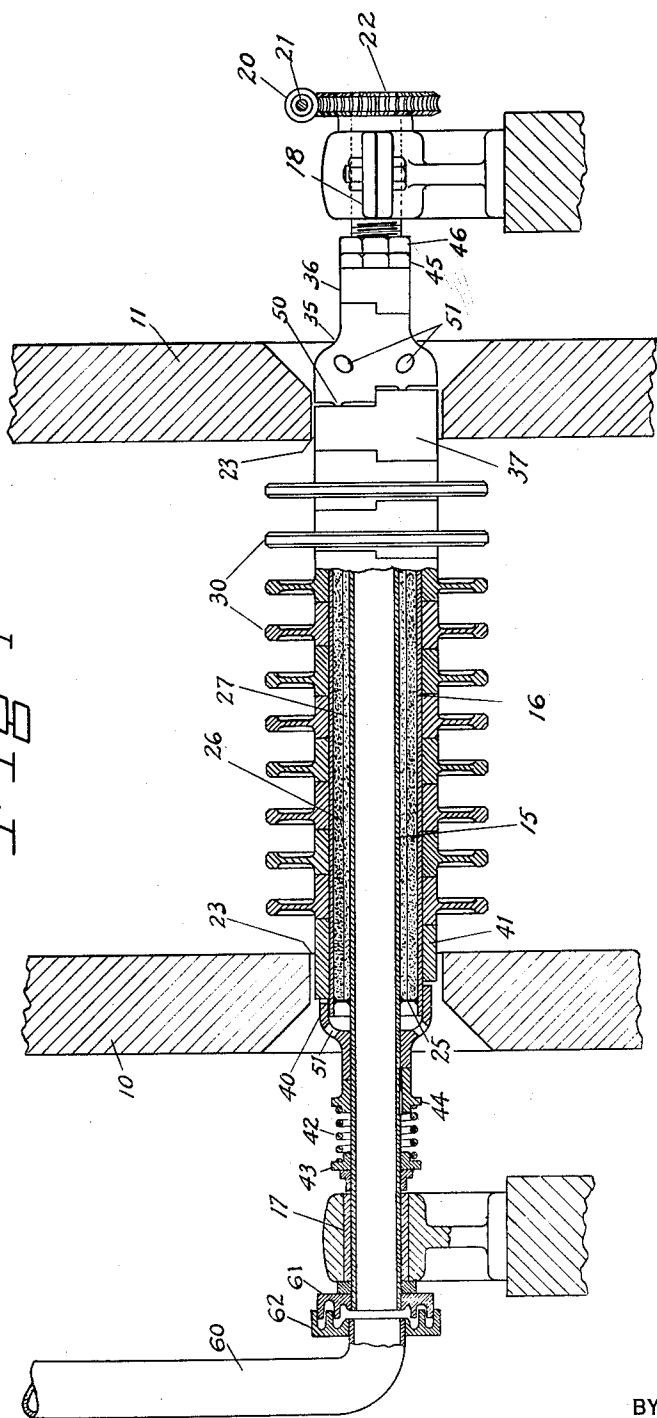
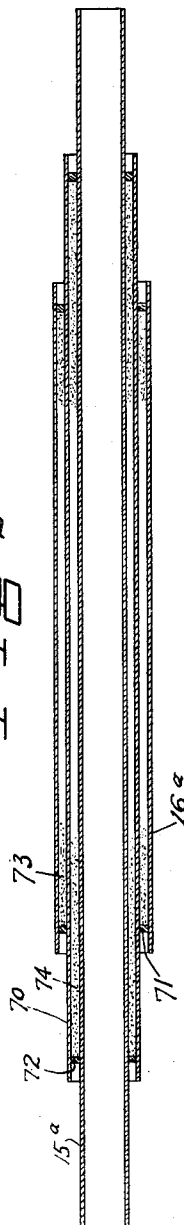


Fig-2



INVENTOR
BY *Joseph P. Havey*
Efford & Scull
ATTORNEYS

UNITED STATES PATENT OFFICE

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HEATING FURNACE

Joseph P. Havey, New York, N. Y., assignor to
The Babcock & Wilcox Tube Company, West
Mayfield, Pa., a corporation of Pennsylvania

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17 Claims. (Cl. 263—6)

This invention relates to heating furnaces. More particularly, the invention relates to the construction and mounting of furnace rolls of annealing furnaces and other industrial heating furnaces, for supporting and feeding sheets, strips, tubes, bars, rods, and other articles of metal or other materials while being heated in the furnace. The object of the invention is, generally, to simplify and reduce the cost of the furnace equipment and to reduce the cost of operating the furnace, and to improve the heating.

Furnace rolls of industrial heating furnaces in which relatively high temperatures are maintained, such, for example, as furnaces for annealing metal sheets, are customarily cooled by means of water caused to flow through the rolls or roll shafts. This water cooling involves not only a considerable original equipment expense, but, also, a large operating expense including the cost of supplying the large amount of water required and the fuel cost of the heat taken from the furnace by the cooling water. There is, also, the further disadvantage that the work-supporting members of the rolls are usually maintained at a temperature considerably below the temperature to which the work is heated, and this results in an uneven heating of the work.

The present invention aims to provide furnace rolls which require only such cooling as may be secured by air-cooling, and most desirably with the air moving under natural draft, thus eliminating the use of water for cooling the rolls and greatly reducing the loss of heat from the furnace through the roll shafts; and to provide furnace rolls of which the work-supporting parts or members may while in operation be maintained at a temperature substantially equal to the furnace temperature and, therefore, equal to, or greater than, the temperature to which the work is heated.

Further objects of the invention are to provide a furnace roll which is of comparatively simple and inexpensive construction, and which will withstand operation at high temperatures for long periods.

Furnace rolls according to the invention comprise a shaft and one or more tubular sheaths or sleeves larger and shorter than the shaft, supported from the shaft, and arranged concentrically of the shaft, and of each other when there are more than one, each sleeve being supported adjacent to its ends by supporting means of relatively low heat conductivity and being insulated from the shaft, and from each other when there are more than one, by an insulating space which is most

desirably filled with suitable insulating material, the ends of the outer sleeve most desirably extending into and terminating within the roll openings in the furnace walls, and the ends of the shaft extending beyond the sleeve or sleeves to form journals which are mounted in suitable bearings outside the furnace walls.

The shaft is most desirably tubular to permit of its being air-cooled by the passage therethrough of sufficient air to prevent the building up of temperature by the relatively small amount of heat which reaches the shaft from the outer sleeve. The outer, or work-carrying, sleeve may be provided with removable work-supporting discs, or other suitable work-supporting members such as are commonly used on furnace rolls.

The work-carrying outer sleeve and the work-supporting discs or other work-supporting means will run at substantially furnace temperature, while the inner tube, or shaft, will receive so little heat as to require very little cooling to prevent any portion thereof from becoming heated to a temperature which would cause any serious loss of rigidity, and there will be a minimum loss of heat from the furnace. The outer cylinder, or sleeve, which is subjected to the furnace temperature is shortest and of greatest diameter and, therefore, most rigid, and the longer and smaller diameter and, therefore, weaker cylinder or cylinders are maintained at a relatively low temperature.

Furthermore, the weight of the work and of the work-supporting discs or other work-supporting members is borne directly by the outer tube or sleeve and is transferred to the shaft only at points near the shaft bearings and away from the central weaker and hotter portion of the shaft. The central portion of the shaft is thus under a uniform and relatively less stress, and may, therefore, be permitted to attain a higher temperature than would otherwise be safe, thus further reducing the degree of cooling required. And the outer tube, which directly supports the load, being of greater diameter and of less length between its points of support, may readily be made of such diameter and wall thickness as to have the required rigidity and relatively great load carrying capacity even when heated to a high furnace temperature.

If the roll is for use in a high temperature furnace, the outer, work-carrying sleeve should most desirably be made of a high heat-resisting alloy which will withstand the furnace temperature without scaling and without too great loss of rigidity. The shaft, and the intermediate sleeve or

sleeves, if there are any, may also be made of heat-resisting alloys, but usually it will not be necessary to make the shaft of such material, although it may be advantageous to do so because of its further reducing the necessary weight of the shaft.

A full understanding of the invention can best be given by a detailed description of constructions embodying the various features of the invention in approved forms, and such a description will now be given in connection with the accompanying drawing illustrating two approved embodiments of the invention, in which:

Fig. 1 is a cross-sectional view through a furnace chamber showing one of the furnace rolls partly in central longitudinal section; and

Fig. 2 is a central longitudinal sectional view of the main tubular members of another form of roll.

Referring to the drawing, and first to Fig. 1, this figure shows in transverse sectional view part of the side walls 10 and 11 of a sheet annealing or other article heating furnace of the kind having a series of parallel work supporting and feeding rolls extending transversely across the furnace chamber between the side walls of the furnace, the view showing one of the furnace rolls and supporting means therefor partly in section longitudinally of the roll.

The roll shown in Fig. 1 comprises a tubular shaft 15 and an outer work-supporting sleeve or sheath, 16 the internal diameter of which is substantially greater than the external diameter of the shaft. The shaft extends beyond the ends of the sleeve 16 and is mounted to turn in journal bearings 17 and 18 and is rotated by any suitable means, such as the means shown comprising a worm 20 on a driving shaft 21 which extends longitudinally of the furnace, the worm meshing with a gear 22 on the end of the roll shaft beyond the bearing 18. The outer cylinder, or sleeve, 16 is of a length to extend across the furnace chamber with its ends in the roll opening 23 in the furnace side walls 10 and 11, and it is mounted on the shaft by means of supporting collars, or rings, 25 located adjacent each end of the sleeve. The ring at one end of the sleeve is shown in Fig. 1, and a similar ring is positioned adjacent the other end of the sleeve.

The rings 25 are made to have low heat conductivity and may be thin rings of metal, most desirably a heat resisting alloy of low thermal conductivity. Also, the location of the rings adjacent the ends of the sleeve within the furnace walls results in much less heat being conducted from the sleeve through the rings to the shaft than would be the case if the rings were located to make engagement with a hotter part of the sleeve located within the furnace chamber. The space between the sleeve and shaft inside the rings 25 serves as a heat insulation space and is most desirably filled with suitable heat insulating material. Most desirably, this insulating material is of two kinds: an outer layer 26 of high refractory material selected primarily for its ability to withstand a high degree of heat, and an inner layer 27 which need not have such great heat resistance but is selected primarily for its heat insulating property.

The sleeve 16 carries a series of work-supporting discs 30 which may be formed in the usual manner with hub portions to seat on the sleeve which are of a length to suitably space the discs and have their meeting faces shouldered as shown so that the discs will be interconnected to rotate

together. The discs are positively driven from the shaft 15 by means of a driving sleeve 35 the outer end of which fits on the shaft 15 in shouldered, interlocking, engagement with the end of a collar 36 secured fast to the shaft. The inner end of the driving sleeve 35 is made larger to fit over the end of the sleeve 16 and has shouldered engagement with the hub of the end disc 30, or, as shown, with a collar 37 on the sleeve 16 between the hub of the end disc and the driving sleeve 35 and making shouldered engagement with each.

For holding the disc hubs pressed together, while at the same time allowing for difference in expansion between outer and inner members of the roll, a bearing sleeve 40 is provided at the other end of the sleeve 16, formed with a smaller outer end to fit on the shaft and a larger inner end to fit over the end of the sleeve 16 and bear against the hub of the end disc 30, or, as shown, against a collar 41 which bears against the hub of the end disc. The sleeve 40 is urged inward by a spring 42 compressed between a collar 43 fast on the shaft 15 and a collar 44 slidable on the shaft and bearing against the end of the sleeve 40.

The sleeve 40 may also serve as a driving sleeve. For this purpose, its inner edge is formed to make shouldered engagement with the collar 41, and the collar 41 makes shouldered engagement with the hub of the end disc; and, in the construction shown, instead of having the sleeve 40 keyed to the shaft 15, its outer end is shouldered to fit the correspondingly shouldered inner end of the collar 44, and the collar 44 is keyed to the shaft so that while free to slide longitudinally of the shaft it is held to turn therewith to rotate the sleeve 40.

One at least of the rings 25 should have a sliding fit with either the shaft or the sleeve 16 so as to permit relative movement of different parts under unequal expansion and contraction, but both of the rings should be secured to one of these members so that they will be held against movement out of position.

In order to provide for adjustment of the supporting discs 30 longitudinally of the roll, the driving collar 36 is adjustably secured to the shaft 15, as by means of a nut 45 and jam nut 46 screwed on a threaded portion of the shaft. The collar 43 which takes the thrust of the spring 42 is also screwed on a threaded portion of the shaft so as to be adjustable correspondingly with the collar 36. This adjustability of the collar 43 also serves for adjusting the strength of the spring pressure on the bearing sleeve 40.

In order to reduce, as far as possible, the passage of heat from the sleeve 16 and the collars 37 and 41 to the sleeves 35 and 40, and thence to the shaft, the internal diameter of the inner ends of the sleeves 35 and 40 is made slightly greater than the external diameter of the sleeve 16 so as to avoid contact with the sleeve 16, and the inner edges of the sleeves 35 and 40 are formed with projecting lugs 50, shown on the sleeve 35, so that there shall be minimum contact between the sleeves 35 and 40, and the collars 37 and 41, respectively. The sleeves 35 and 40 are also formed with holes 51 to prevent heat from building up within the sleeves and around the supporting rings 25.

The ends of the shaft are left open to permit movement of air therethrough, but, as stated, only a slight movement of cooling air through the shaft 15 will usually be required. I have found that a sufficient flow of air through the shaft

may be secured by connecting to one end of the shaft an upwardly extending pipe, or stack, 60, the connection being made in any convenient manner to reduce air leakage, as by means of collars 61 and 62 on the meeting ends of the shaft and stack, respectively, as shown, these collars being formed with concentric overlapping flanges which serve to sufficiently reduce the air leakage without being in wearing contact.

For certain conditions of load and temperature, the rolls in order to have the required strength should most desirably be made with more than one cylinder, or sleeve, outside the shaft. The higher the furnace temperature and the longer the roll and the greater the load, the more need of greater strength and a plurality of outer sleeves. Fig. 2 shows the tubular members of a three tube roll having a tubular shaft 15a, an outer sleeve 16a, and an intermediate sleeve 70. The outer sleeve is supported on the intermediate sleeve by supporting rings 71 of compressed asbestos or other suitable material, and the intermediate sleeve is supported on the shaft by similar rings 72, the rings for supporting each sleeve being positioned adjacent the ends of the sleeve, and the insulation space between the outer and intermediate sleeves and between the intermediate sleeve and the shaft being packed with insulating material. The insulating material 73 between the outer and intermediate sleeves is selected primarily for its heat resistance, and that 74 between the intermediate sleeve and the shaft for its insulating property.

What is claimed is:

1. In a heating furnace having spaced side walls, a work supporting and feeding roll extending across the furnace chamber between the side walls of the chamber, said roll comprising a hollow shaft, work-carrying means adapted to operate at substantially furnace temperature comprising a sleeve the internal diameter of which is substantially greater than the external diameter of the shaft and a plurality of work supporting discs mounted on said sleeve, and collars adjacent the ends of said sleeve for supporting the sleeve on the shaft in coaxial relation thereto, the end portions of said sleeve extending into and terminating within roll openings in the side walls, and the end portions of the shaft extending beyond the ends of the sleeve and beyond the side walls to serve as journals for the roll.

2. In a heating furnace having spaced side walls, a work supporting and feeding roll extending across the furnace chamber between the side walls of the chamber, said roll comprising an air-cooled hollow shaft, work-carrying means adapted to operate at substantially furnace temperature comprising a sleeve the internal diameter of which is substantially greater than the external diameter of the shaft and a plurality of work supporting discs mounted on said sleeve, and means adjacent the ends of said sleeve for supporting the sleeve on the shaft in coaxial relation thereto and for preventing relative rotation of the shaft and said work-carrying means and adapted to permit limited relative longitudinal movement between the shaft and said sleeve, the space between the shaft and said sleeve containing insulating material, the end portions of said sleeve extending into and terminating within roll openings in the side walls, and the end portions of the shaft extending beyond the ends of the sleeve and beyond the side walls to serve as journals for the roll.

3. A furnace roll for supporting and feeding articles being heated, comprising an outer work-carrying sleeve of a length to extend across the furnace chamber and adapted to operate at substantially furnace temperature, and a hollow shaft which extends through the sleeve and beyond each end thereof and the diameter of which is substantially less than the internal diameter of the sleeve to provide an insulation space between them, and means adjacent the ends of the sleeve for supporting the sleeve on the shaft in coaxial relation thereto and for preventing relative rotation of the shaft and the sleeve and adapted to permit limited relative longitudinal movement between the sleeve and the shaft, whereby load on the sleeve is transmitted away from the middle portion of the shaft and to points on the shaft adjacent the ends of the sleeve.

4. A furnace roll, comprising an outer work-carrying sleeve of a length to extend across the furnace chamber, work supporting discs mounted on the sleeve adapted to operate at substantially furnace temperature, and an air-cooled hollow shaft of substantially smaller diameter than the internal diameter of the sleeve and the ends of which extend beyond the ends of the sleeve to serve as journals, the sleeve being mounted on the shaft by collars adjacent the ends of the sleeve, and the space between the shaft and the sleeve and between said collars being filled with insulating material, one of said collars permitting relative longitudinal movement between the sleeve and the shaft.

5. A furnace roll for supporting and feeding articles being heated, comprising a plurality of tubular members of different diameters arranged concentrically one within another, the ends of the inner tubular member extending to serve as journals, the outer tubular member being of a length to extend across the furnace chamber and being supported by collars of low heat conductivity located adjacent the ends thereof and being insulated to minimize the heat loss inward therefrom, and the inner tubular member being open for access of cooling air to the interior thereof.

6. A furnace roll for supporting and feeding articles being heated, comprising three tubular members of different diameters arranged concentrically one within another, the ends of the inner tubular member extending beyond the ends of the intermediate tubular member to serve as journals and the ends of the intermediate tubular member extending beyond the ends of the outer tubular member, the outer and intermediate tubular members each being supported by collars of low heat conductivity located adjacent the ends thereof and being insulated to minimize the heat loss inward therefrom, the inner tubular member being open for access of cooling air to the interior thereof.

7. A furnace roll for supporting and feeding articles being heated, comprising three tubular members of different diameters arranged concentrically one within another, the ends of the inner tubular member extending to serve as journals, the outer and intermediate tubular member each being supported by collars of low heat conductivity located adjacent the ends thereof, a filling of insulating material in the spaces between said collars, the inner tubular member being open for access of cooling air to the interior thereof.

8. A furnace roll for supporting and feeding ar-

titles being heated, comprising an outer sleeve, a shaft which extends through the sleeve and beyond the ends thereof and the diameter of which is substantially less than the internal diameter of the sleeve to provide an insulation space between them, the sleeve being supported on the shaft by collars of low heat conductivity adjacent the ends of the sleeve, work-supporting means mounted on said outer sleeve, and means for driving said work-supporting means comprising a driving sleeve mounted on the shaft and having an enlarged end which extends over the end of said outer sleeve but spaced away therefrom and engages said work-supporting means at spaced points.

9. A furnace roll for supporting and feeding articles being heated, comprising an outer sleeve, a shaft which extends through the sleeve and beyond the ends thereof and the diameter of which is substantially less than the internal diameter of the sleeve to provide an insulation space between them, the sleeve being supported on the shaft by collars of low heat conductivity adjacent the ends of the sleeve, work-supporting means mounted on said outer sleeve, and means for driving said work-supporting means comprising a driving sleeve mounted on the shaft and having an enlarged end which extends over the end of said outer sleeve but spaced away therefrom and engages said work-supporting means, said driving sleeve having air openings therein.

10. A furnace roll for supporting and feeding articles being heated, comprising an outer sleeve, a shaft which extends through the sleeve and beyond the ends thereof and the diameter of which is substantially less than the internal diameter of the sleeve to provide an insulation space between them, the sleeve being supported on the shaft by collars of low heat conductivity adjacent the ends of the sleeve, work-supporting discs having their hubs seated on said outer sleeve and in interlocking engagement with each other, a driving sleeve at one end of said outer sleeve mounted on the shaft and having an enlarged end for driving said discs, and a spring-pressed bearing sleeve at the other end of said outer sleeve mounted on the shaft and having an enlarged end for pressing said discs together.

11. A furnace roll for supporting and feeding articles being heated, comprising an outer sleeve, a shaft which extends through the sleeve and beyond the ends thereof and the diameter of which is substantially less than the internal diameter of the sleeve to provide an insulation space between them, the sleeve being supported on the shaft by collars of low heat conductivity adjacent the ends of the sleeve, work-supporting discs having their hubs seated on said outer sleeve and in interlocking engagement with each other, a driving sleeve at one end of said outer sleeve mounted on the shaft and adjustable longitudinally on the shaft and having an enlarged

end for driving said discs, a spring-pressed bearing sleeve at the other end of said outer sleeve mounted on the shaft and having an enlarged end for pressing said discs together, and means for adjusting the spring pressure on said bearing sleeve.

12. A furnace roll, comprising a metal tube for conducting cooling fluid, a sleeve surrounding said tube, insulating material confined between the tube and the sleeve, said sleeve being integral and free from fissures which would permit the insulating material to sift out, a plurality of work-supporting discs carried by the sleeve, and closure members adapted to retain the insulating material in the space between the tube and the sleeve, one of said closure members permitting relative longitudinal movement between the tube and the sleeve.

13. A furnace roll, comprising a hollow metallic one-piece sleeve, said sleeve being free of fissures which would permit leakage of insulating material, a shaft formed by a cooling fluid tube extending through said sleeve, insulating material confined between the tube and the sleeve, and closure members adapted to retain the insulating material between the tube and sleeve, one of said closure members permitting relative longitudinal movement between the tube and the sleeve.

14. A furnace conveyor assembly, including in combination a shaft, a sheath encircling the shaft, conveyor wheels or discs removably mounted on the sheath, means for rotating said wheels or discs with the sheath, and means extending between and engaging the sheath and shaft for maintaining the predetermined spacing of the shaft from the sheath.

15. A furnace conveyor assembly, including in combination a shaft, a sheath encircling the shaft, conveyor wheels or discs mounted on the sheath, means for rotating said wheels or discs with the sheath, and means extending between and engaging the sheath and shaft for maintaining the predetermined spacing of the shaft from the sheath and for retaining heat insulating material within the sheath and about the shaft.

16. A furnace conveyor assembly including in combination a shaft, a sheath encircling the shaft, conveyor wheels or discs removably mounted on the sheath for rotation therewith, and means extending between and engaging the sheath and shaft for maintaining the predetermined spacing of the shaft from the sheath.

17. A furnace conveyor assembly including in combination a shaft, a sheath encircling the shaft, conveyor wheels or discs mounted on the sheath for rotation therewith, and means extending between and engaging the sheath and shaft for maintaining the predetermined spacing of the shaft from the sheath and for retaining heat insulating material within the sheath and about the shaft.

JOSEPH P. HAVEY.