March 15, 1932. F. A. FAHRENWALD 1,849,287

CONVEYING ELEMENTS FOR HEAT TREATING FURNACES

Filed June 13, 1928 2 Sheets-Sheet 1

Fig. 1

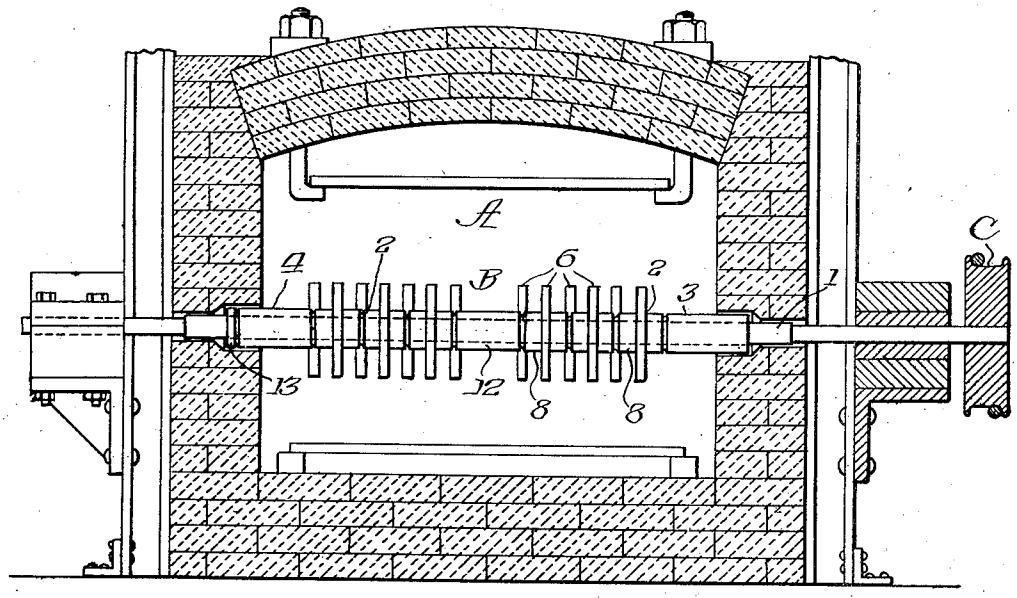
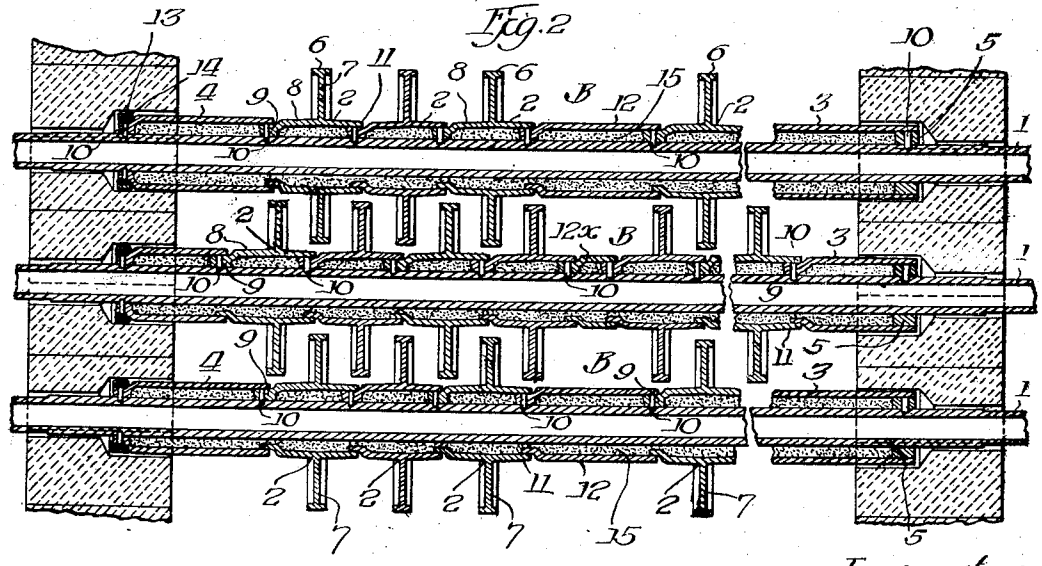


Fig. 2



Witness:

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Fig. 3

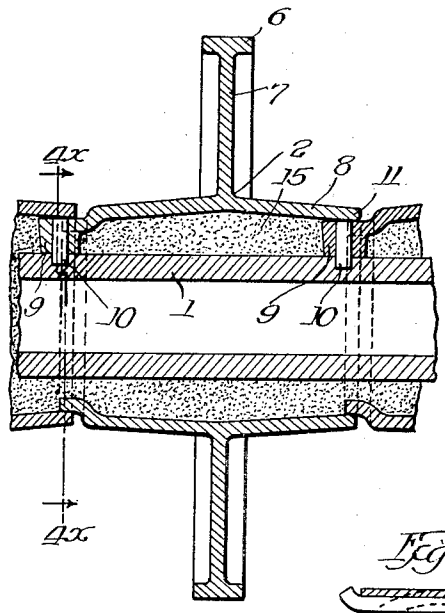


Fig. 4

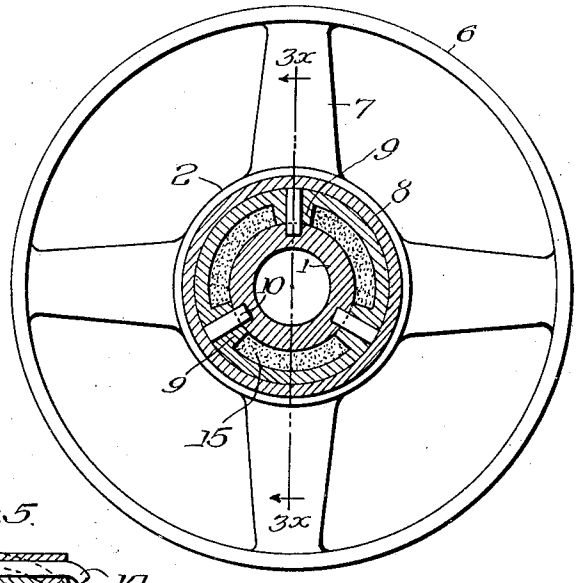


Fig. 5

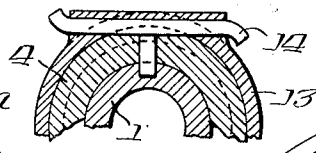


Fig. 6

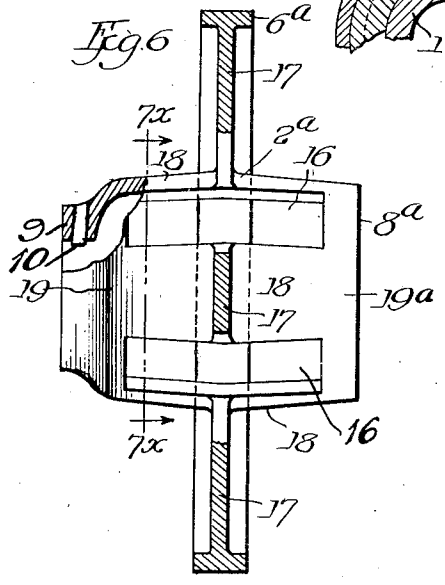
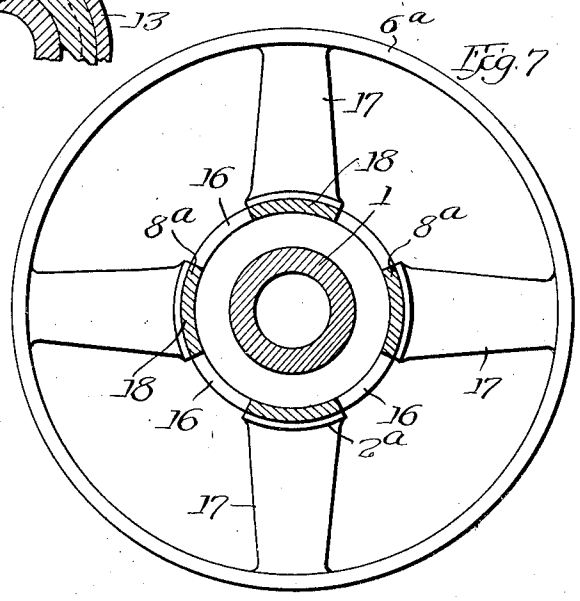


Fig. 7



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UNITED STATES PATENT OFFICE

FRANK A. FAHRENWALD, OF CHICAGO, ILLINOIS

CONVEYING ELEMENTS FOR HEAT TREATING FURNACES

Application filed June 13, 1928. Serial No. 285,049.

This invention relates to improvements in steel treating furnaces, and specifically pertains to the roller type conveyor system for use in such furnaces in the continuous heat treatment of sheet and plate steel.

In the earlier types of so-called roller bottom furnaces, it was customary to employ a series of transverse driven shafts made up of hollow seamless tubing and water cooled, and to mount upon these shafts, disks of steel or alloy upon which the material to be treated was carried through the furnace; but roller type conveyors as heretofore constructed, while successful to a measurably important degree, have not attained the high degree of success which is afforded by the present invention, first, because of relatively low efficiency as to heat losses manifested both in expense of maintaining furnace temperature and in cooling influences encountered by the work while being treated; and, secondly, because of low durability of the sheet conveying rollers and their supporting parts manifested mainly in the destructive influence of excessive expansion of the conveying elements under the influence of heat without proper provision for the same. Moreover, some of the heretofore known roller types of conveyors, while successful with certain classes of work, are not adapted for other classes of work. A roller type of furnace conveyor heretofore widely used in furnaces of the kind referred to, and particularly in furnaces where heat losses due to the cooling water in the shafts was not objectionable or where the cooling influence of the cold shafts upon the sheets themselves was not harmful, is that described in my Letters Patent No. 1,539,833 issued June 2, 1925, wherein the conveying roll, comprising a continuous circular rim supported by integral spokes, had its spokes supported upon the shaft by segmental blocks separated one from another and collectively defining a hub-like structure; and one which provided a very superior although more expensive conveying means in which it was possible to operate the furnace without the use of cooling water, is that described in my Letters Patent No. 1,623,469, issued April 5, 1927. But each of these types of conveying means for furnaces is uneconomical in some classes of work, that disclosed in the patent first mentioned because of the cost of compensating heat losses through the exposed water cooled shafts and the harmful cooling effects of such shafts on the steel being treated, and the form of conveyor shown in the second named patent because, while exceedingly economical in conservation of heat and avoidance of harmful cooling influence upon the work that is being heat treated, it is, because of great weight of expensive metal required, prohibitive in the first cost of the roller equipment.

The object of the present invention is to provide a construction of roller conveyor for furnaces of the kind referred to, which will be very economical in its construction, its maintenance, and its performance, and this object is realized by providing a construction which will so far reduce the transfer of heat, from the sheet bearing roller surfaces to the shafts upon which they are mounted, that water cooled shafting can be economically used; the roller assembly can be made up of relatively inexpensive steel tubing for the shafting and readily produced wheels or disks mounted thereon; while not affording the degree of heat conservation that is permitted by the construction shown in Patent No. 1,623,469, it will nevertheless be much more efficient in heat conservation than roller conveyors for furnaces of the water cooled shaft type heretofore made; and it will attain a sufficiently high degree of efficiency with low first cost of the equipment to substantially offset the cast of heat losses.

Obviously, the main desideratum in accomplishing the desired result is the mounting of the wheel disks or other roll elements upon their shafts with an efficient barrier against heat transfer between said elements and their shafts, without sacrifice of driving connection or complications arising from heat-expansion of the apparatus. Numerous attempts have been made heretofore to solve the problem of producing this condition in the mounting of such roll elements upon their shafts, but without success, failure being due mainly to the fact that where good results

have been attained in the interception of heat transfer, poor results have followed in establishing the necessary physical or mechanical connection through which the roll elements may be driven by their shafts; and where proper supporting and driving connection between the roll elements and the shaft has been attained, it has been at the expense of proper allowance for expansion and contraction incident to high and fluctuating temperatures encountered.

The present invention meets the three requirements of intercepting heat transfer, establishment of proper supporting and driving connections, and free allowance of expansion and contraction of the roll units relatively to either solid or water cooled shafts, and at the same time affords great economy in production, assembly, and replacement of the roll elements, by subdividing the roll elements upon each shaft into a plurality of units, which are in heat-conducting relation to the shaft only through relatively small cross-sectional areas of the means which position them upon, space them from and place them in driven connection with their shaft; the distance of their spacing being such as will afford substantial heat insulation, either through space alone or through space assisted by a barrier against convection or radiation such as a refractory, non-conducting substance confined by the sleeve; also by having each supporting sleeve not only connected with its supporting shaft through the means having reduced conductive capacity and interengaged with the shaft in a manner to definitely anchor the roll element as a whole against relative movement on the shaft both circumferentially and axially, but by having the sleeve of each roll element, at its end remote from its spacing and driving connection, supported from the shaft by means which leaves it free from abutment or thrust against an adjacent unit when it expands under heat, for example, by telescoping it upon the supporting and anchoring end of the next ensuing roll sleeve, or if at the end of the series of roll members, similarly supporting it upon the spacing and driving end of a dummy-sleeve or upon additional inwardly projecting spacing means. The spaces between the shaft and the sleeves may or may not be filled with an insulator to reduce transfer of heat by radiation or by convection.

In the accompanying drawings in which the preferred manner of employing my invention is illustrated,

Figure 1 is a vertical transverse section through a typical furnace to which the subject-matter of the present invention is intended to be applied, and in the application of which a solid or non-cooled shaft is used.

Figure 2 is a fragmentary detail view in horizontal section showing three related roll elements supported in walls of such a furnace, and showing a hollow, cooled shaft.

Figure 3 is an axial section of a roll unit together with fragmentary portions of the sleeve of a roll unit (either a roller carrying sleeve, or a dummy-sleeve) at either end of it.

Figure 4 is a section on the line $4x$—$4x$ of Figure 3.

Figure 5 is a detail view indicating a method of securing the anchoring pins of the last of the series of elements which go to make up a complete roll unit.

Figure 6 is a view of a modified construction of a roll unit appropriate for use with or without insulating material between the sleeve and the shaft, the rim and spokes being shown in section, and the sleeve being shown in plan; and

Figure 7 is a section on the line $7x$—$7x$ of Figure 6.

A represents the heat treating furnace, B rolls mounted therein to provide means for supporting and advancing sheet or plate material through the furnace, and C is typical of any approved means of imparting rotation to a roll.

Each roll B comprises a shaft 1 which may be solid as shown in Fig. 1, but is preferably hollow and water cooled as shown in the remaining figures; roll units 2, 3 and 4, separately formed and individually mounted upon the shaft 1 and including roller-carrying units 2 in such numbers and at such positions as will afford proper support for the sheet or plate material that is to be heat treated; dummy units or end sleeves 3 and 4 surrounding and insulating those portions of the shaft 1 which lie beyond the field of sheet support; and a separately formed ring 5 anchored to the shaft 1 as a means of supporting the free outer end of the dummy unit or end sleeve 3. Each roll unit 2 comprises a rim 6 supported by spokes 7 upon a sleeve 8. Each sleeve 8, as well as the end sleeves 3 and 4 has, at one end, a spacing, positioning and driving connection, here shown as consisting of lugs 9, extending radially inward and interengaged with the shaft 1, and these lugs, as shown more clearly in Figs. 3 and 4, are of restricted cross-sectional area so that they afford very restricted paths of heat conductively between the shaft 1 and the sleeve 8. In order that lugs 9, in addition to spacing the roll-units 2, 3 and 4, from the shaft 1, may serve as means for anchoring the units in fixed positions longitudinally of the shaft and establishing driving connection between the shaft 1 and said units, circumferentially of the shaft, at least one lug 9 of each roll unit carries a pin 10 which dips into the shaft 1 sufficiently for the purpose stated. That is to say, there may be one of these pins in each lug 9, or but one pin to each roll unit. The end 11 of each sleeve 3, 4 or 8 which is remote from its supporting and anchoring lugs 9,

is left free from thrust abutment and for movement endwise, relatively to the adjacent unit as well as to the shaft 1, but is accurately centered around the shaft; for instance, by telescoping it with or otherwise lapping it upon the supported and anchored end of the next adjacent roll unit, and has sufficient freedom of such endwise movement (in the direction of the axis of the roll) to permit the sleeve to expand and contract under changes of temperature without transmitting thrust to any other part. In assuming this position of axially slidable support upon the supported and anchored driving end of the next adjacent roll unit, each open end 11 overlies the anchoring pin or pins 10 of the unit upon which it rides and thus becomes the means of holding said pins in place.

Dummy-sleeves 3 and 4 are mounted upon the shaft 1 precisely like the sleeves of the roll units, in that each has supporting and anchoring lugs at one end and a freely movable support at its other end. If desired, an additional dummy-sleeves or sleeves such as 12 may be introduced between two roll units along an intermediate longitudinal line of the furnace, when a furnace is built wide enough for two sheets to travel abreast, in separated lanes. These intermediate dummy-sleeves may be of different lengths, for instance, of greater length as shown at 12 in the two outer rolls of the group of Figure 2, or of shorter length as shown at 12*x* in the intermediate roll of Figure 2.

An important feature of the present invention resides in the condition that a roll is divided up into such number of roll units or other elements that with each element positively spaced longitudinally of the shaft by anchoring it at one end to the shaft and having its other end free to move relatively thereto, without endwise impingement or thrust, each unit will expand and contract independently of the others, and but a relatively short distance, thus eliminating the overall cumulative expansion of previous types, which had to be accommodated between the walls of the furnace, and without objectionably changing the position of the rims of the rolls. In other words, the present invention totally eliminates the problem of excessive expansion and contraction for each unit and for the complete roll assembly.

An important advantage growing out of such a roll construction is that the elements of the roll may be cheaply constructed by ordinary foundry practice, and readily assembled upon a shaft. In such assembly, the ring 5 is first placed in position and secured by its pin 10; and dummy-sleeve 3 is then slipped on with its free open end surrounding the ring 5, thereby confining the pin 10 of ring 5 against displacement; pin 10 of dummy-sleeve 3 is then inserted to fix said sleeve 3 against displacement; the first roll unit 2 is then placed in position with its free end overlapping the anchoring pin 10 of the dummy-sleeve 3 and in turn receives its own anchoring pin; and the series of elements is thus built up upon the shaft until a predetermined grouping of such elements is attained; the last element 4 having its anchoring pin 10 secured by some suitable means such as separately formed ring 13, which in turn may be prevented from slipping off the reduced end of said element 4 by any suitable means, such, for instance, as the lynch pin 14 shown in Figure 5.

15, in Figures 2, 3, and 4, represents refractory heat insulating substance, which may be of any approved character, and which may be applied between the shaft 1 and the roll elements which surround it when it is desired to add to the space insulating effect by interrupting convection and radiation of heat toward the water cooled shaft. This insulation may be applied in bulk, by ramming it into the spaces as the elements are applied just before they are brought into telescopic seating one upon another; but it is preferably molded in the elements before they are put upon the shaft. It may also take the form of ordinary pipe insulation, premolded into split cylinders of suitable dimensions for the purpose. But the invention is by no means limited to the use of this insulating material; on the contrary, the units may serve quite efficiently by mere space insulation.

As shown in the modified form of roll element 2*a* in Figures 6 and 7, the sleeve 8*a* may, if desired be constructed with slots 16 running longitudinally of the sleeve but terminating short of its ends, leaving the spokes 17 supported by straps of metal 18 extending the greater portion of the length of the sleeve, but fixed at their ends by bands 19, 19*a*, one of which, 19, will carry the spacing and driving connections 9 as in Figures 2 to 4 for the unit, while the other band 19*a* will provide the open, freely sliding telescoping and pin-carrying end of the unit described in connection with the previous figures. With such a construction, roll element 2*a* is very much more resilient under stresses set up by the unequal expansion of the rim 6*a* and the sleeve 8*a*. The form of roll element shown in Figures 6 and 7 may be used with space insulation only, as shown, or it could obviously confine premolded insulation members in its cage-like structure.

From the foregoing description of the embodiment herein selected for the purpose of illustration, it will be seen that the invention exemplifies a heat treating furnace, as well as a unit to be used in building up a roll for a heat treating furnace, in which the roll unit which enters into the construction of the roll is mounted upon its shaft through the medium of a means that serves the three-fold purpose of spacing the unit from the shaft, po-

sitioning the unit longitudinally of the shaft, and establishing driving connection between the shaft and the unit, all without restricting the axial expansion of the unit under the influence of temperatures encountered in the operation of a furnace, so that when these units are assembled upon the shaft each has its own individual spacing, positioning and driving connection restricted to one part of the unit and leaving the remainder of the unit free to expand under the influence of heat, and this expansion can take place without longitudinal thrust between the units or abutment of one unit against another, even though the free ends of the units may rest upon and be spaced from the shaft by a sliding bearing upon an adjacent unit.

I claim:

1. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having a longitudinally restricted driving connection between it and the shaft located near one end of the unit through which it is driven independently of the other units and being otherwise free from driving connection with the shaft; the driving connection of each unit serving to space it from the shaft; each unit having a circumferential load-bearing portion of restricted axial dimension intermediate of its ends, and having its end remote from said driving connection supported upon an adjacent unit with sufficient clearance from the adjacent unit to permit axial abutment of one unit against another under heat expansion.

2. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having near one end thereof a longitudinally restricted driving connection between it and the shaft through which it is driven independently of the other units and being otherwise free from driving connection with the shaft; the driving connection of each unit serving to space it from the shaft and to fix the position of said unit lengthwise of the shaft; and said unit having a circumferentially related load-bearing portion of restricted axial dimension, remote from said driving connection in the direction of the axis of the unit, and being free from shaft contacting portions radially within or adjacent to said load-bearing portion.

3. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having near one end thereof a longitudinally restricted driving connection between it and the shaft through which it is driven independently of the other units and being otherwise free from driving connection with the shaft; the driving connection of each unit serving to space it from the shaft and to fix the position of said unit lengthwise of the shaft; each unit having a circumferentially related load-bearing portion remote from its said driving connection, and being free from shaft contacting portions radially within or adjacent to said load-bearing portion and having its end remote from said driving connection supported by an adjacent unit; the lengths of the units when so fixed being such that they are free from thrust under heat expansion.

4. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having a driving connection between it and the shaft through which it is driven independently of the other units; the driving connections being restricted in cross-section area and heat conducting capacity, and leaving the units free to expand radially and axially; and each unit having an expansible free portion which is supported radially of the shaft, independently of its said driving connection.

5. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with heat insulating spacing between the units and the shaft; each unit having near one end thereof, spacing lugs of low heat conducting capacity through which it is supported upon the shaft, and having its opposite end open and free of such supporting means, and means inter-engaging a lug or lugs of each unit with the shaft and thereby driving the unit from the shaft independently of the other units.

6. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having a driving connection between it and the shaft through which it is driven independently of the other units; the driving connection of each unit serving to space it from the shaft; the end of each unit remote from its spacing and driving means being supported upon the adjacent unit with freedom to move axially of the shaft.

7. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft, with spacing between the units and the shaft; each unit having a driving connection between it and the shaft through which it is driven independently of the other units; the driving connection of each unit serving to space it from the shaft, the spacing and driving connection of each unit being located near one end thereof and the other end of the unit being in axially sliding bearing upon the sleeve of the adjacent unit.

8. A roll for a heat treating furnace, comprising a shaft and a plurality of independent roll units surrounding said shaft; each unit comprising an axially elongated sleeve spaced from the shaft; and each sleeve having at one end spacing and driving connection with the shaft, and having its other end axially slidable upon an adjacent unit; and refractory heat insulating material in the spaces between the sleeves and the shaft.

9. A roll for a heat treating furnace, comprising a shaft, a plurality of roll units surrounding said shaft, with spacing between the units and the shaft, independent driving connections between the respective units and the shaft, comprising spacing lugs and driving pins connecting one or more of the lugs with the shaft; each unit having a position that confines the driving pin of an adjacent unit.

10. A roll for a heat treating furnace, comprising a shaft and a series of roll units surrounding said shaft, with spacing between the units and the shaft; each unit having an axially and circumferentially restricted driving connection with the shaft, through which it is driven independently of the other units, and having its end remote from its driving connection free and in axially movable relationship to a next adjacent unit; and an axially sliding support for the free end of the first unit in the series.

11. A roll for a heat treating furnace, comprising a shaft and a series of roll units surrounding said shaft, with spacing between the units and the shaft; each unit having a driving connection with the shaft, through which it is driven independently of the other units, including a pin extending into the shaft, and having its end remote from its driving connection in slidably free relationship to the next adjacent unit, and an axially sliding support for the free end of the first unit in the series; the pin of one unit being confined by the free end of an adjacent unit, and the last unit of the series having means for confining its pin.

12. As a new article of manufacture a roll unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, and spacing means of restricted cross-sectional area extending inwardly from said sleeve and constructed to interlock with a shaft, and thereby fix the position of the unit upon the shaft both axially and rotatably.

13. As a new article of manufacture, a roll-unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, and spacing means of restricted thermal conductive capacity and restricted longitudinal dimension restricted in location to one end only of, and extending inwardly from said sleeve and adapted to enter into bearing upon the shaft; said sleeve being provided with a load bearing portion having axially restricted connection with the sleeve in a plane axially remote from said spacing means, and said spacing means being provided with means for establishing driving connection with the shaft.

14. As a new article of manufacture, a roll-unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, and spacing means of restricted thermal conductive capacity extending inwardly from said sleeve and adapted to enter into bearing upon a shaft; said means being provided with means for establishing driving connection with the shaft; the first-named means being located near one end of the unit, and the other end of the unit being adapted for sliding support during thermal expansion of the unit.

15. As a new article of manufacture, a roll unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, spacing means of restricted cross-sectional area extending inwardly from said sleeve and having their ends adapted to enter into bearing upon the shaft, means for establishing driving connection between said spacing means and the shaft; the last-named means comprising pins adapted to enter the shaft radially of the sleeve.

16. As a new article of manufacture, a roll unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, and spacing and driving means of restricted thermal conductive capacity extending inwardly from said sleeve and adapted to enter into engagement with the shaft; said sleeve being constructed with longitudinal slots terminating short of its ends.

17. As a new article of manufacture, a roll unit adapted to enter into assembly with other roll units in building a roll for a heat treating furnace, said unit including in its construction a hub-like sleeve adapted to surround a shaft, and spacing and driving means of restricted thermal conductive capacity extending inwardly from said sleeve and adapted to enter into engagement with the shaft; said sleeve carrying a rim, and spokes connecting it with said rim and being constructed with slots in the spaces between its spokes.

18. As a new article of manufacture, a roll unit as described in claim 17, in which

the hub-like sleeve has circumferentially continuous portions at the ends of its slots, one of which said portions carries the spacing and driving means, while the other is adapted for free thermal expansion movement.

19. A conveyor element comprising a hub having an internal diameter materially exceeding the diameter of the shaft by which it is carried, supporting means carried by and extending radially inward from said hub near one end thereof and having inner ends engaging the shaft whereby the hub is supported in concentrically spaced relation to the shaft the remainder of said hub being free from shaft contacting means, a peripheral carrying surface formed on said hub and of greater diameter than said hub having a connection with said hub of axially small dimension, low heat conducting capacity, and in a plane axially remote from said supporting means, and a heat-resisting shaft-protecting packing introduced intermediate said hub and said shaft.

Signed at Chicago, Illinois, this 12th day of June, 1928.

FRANK A. FAHRENWALD.