Feb. 19, 1957 Q. M. BLOOM 2,781,891

WORK CONVEYING MECHANISM

Original Filed July 15, 1950 3 Sheets-Sheet 1

FIG. 1

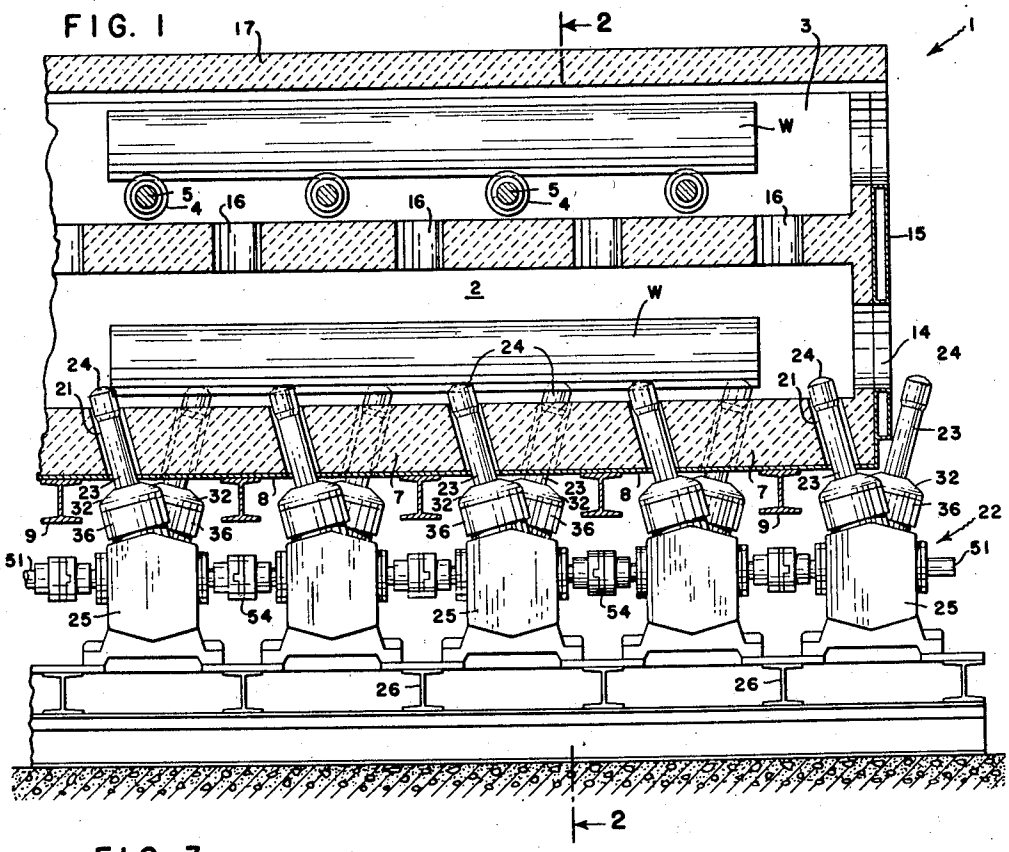
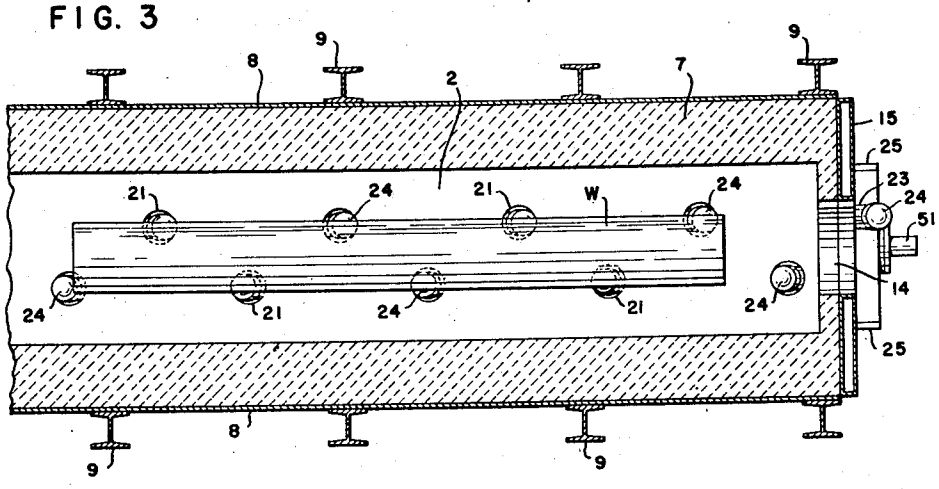


FIG. 3



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WORK CONVEYING MECHANISM

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FIG. 2

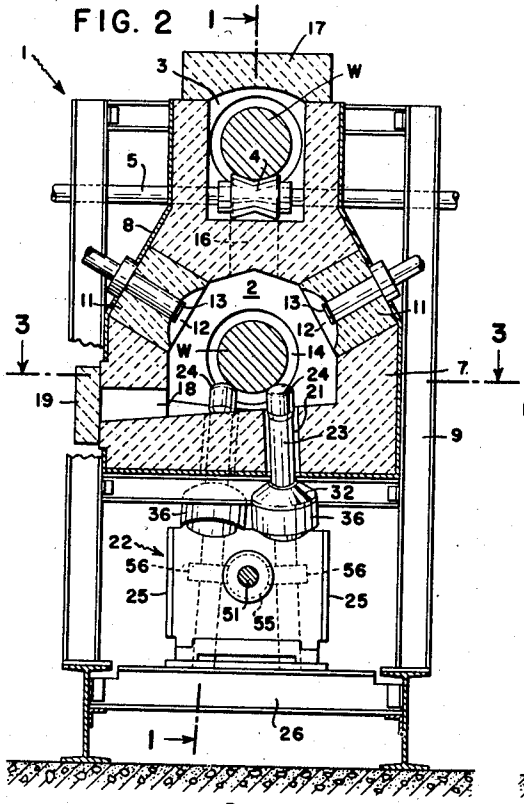
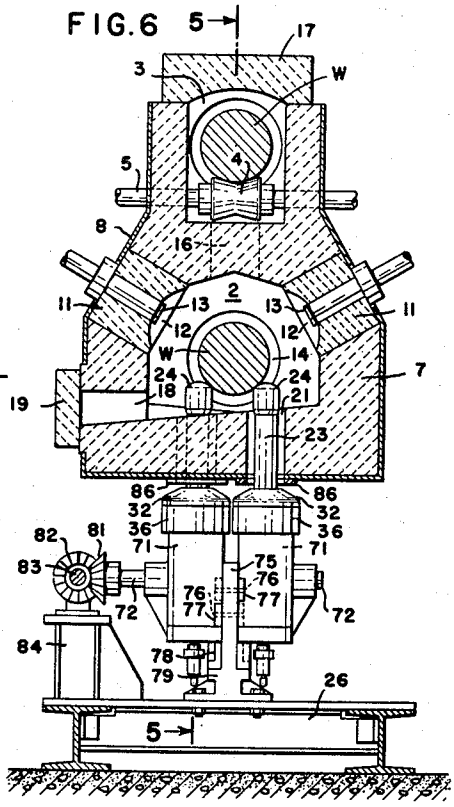


FIG. 6



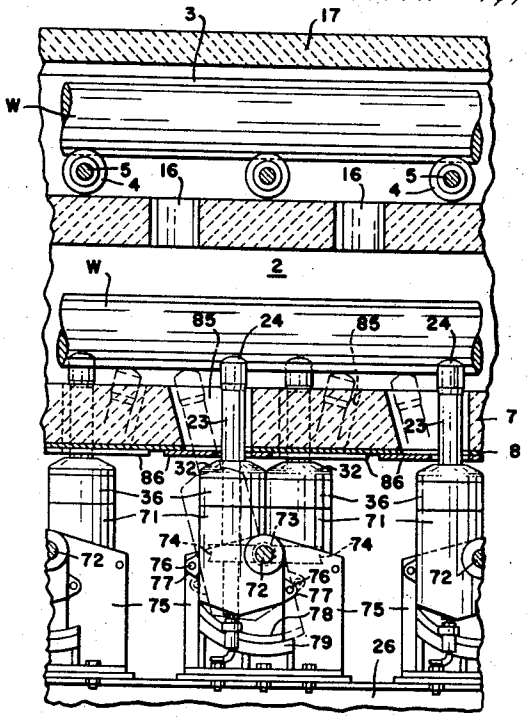


FIG. 5

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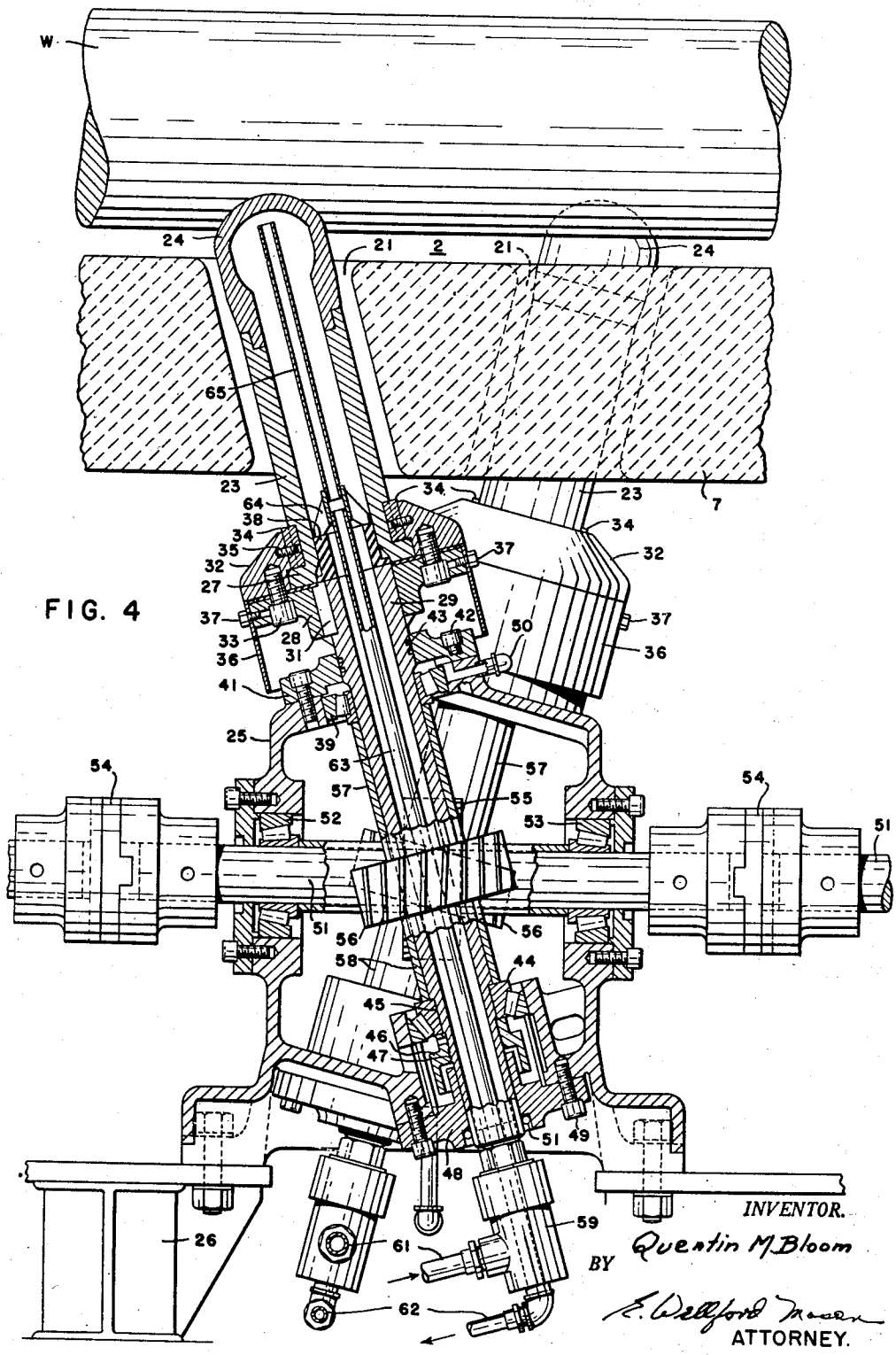
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WORK CONVEYING MECHANISM

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FIG. 4



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United States Patent Office 2,781,891
Patented Feb. 19, 1957

2,781,891

WORK CONVEYING MECHANISM

Quentin M. Bloom, Huntingdon Valley, Pa., assignor to Selas Corporation of America, Philadelphia, Pa., a corporation of Pennsylvania

Original application July 15, 1950, Serial No. 174,009. Divided and this application September 26, 1951, Serial No. 248,399

5 Claims. (Cl. 198—127)

The present invention relates to apparatus for heating large billets, and more particularly to apparatus for conveying large, heavy billets through a furnace or other device while the billets are being heated or being moved from one point to another.

The heating of large billets for piercing or other purposes has heretofore usually been done in rotary hearth or roller hearth furnaces. Even with furnaces of this type the handling of the heavy billets, which may weigh as much as three and one half to four tons, is a problem that has occasioned much difficulty.

In accordance with the present invention large billets that may be as much as thirteen inches in diameter and sixteen feet long are heated individually in substantially cylindrical furnaces. The billets are moved one after the other in end to end relation. The furnace may be continuous or made in sections as desired, and depending upon the length thereof that is required to bring the billets up to the desired temperature. In some cases it may be desirable to provide a preheating chamber above the heating chamber and connected therewith by passages through which products of combustion may pass. In such a case the billets are moved in one direction through the preheating chamber, and in an opposite direction through the heating chamber.

The mechanism for moving the billets through the preheating chamber may comprise conventional conveyor rollers of heat resistant material. The mechanism for moving the billets through the heating chamber, however, comprises a number of rotating shafts with their upper ends extending through the floor of the furnace. These shafts are spaced at intervals throughout the length of the furnace and are provided with caps upon which the billets rest. As the shafts are rotated the billets are moved axially through the furnace. By mounting the shafts at an angle to the vertical in the direction of billet movement the billets will be rotated around their axes as well as being moved axially. This construction is such that a minimum number of openings is made through the furnace wall for the conveying mechanism. Equally as important is that the billets are being supported only at a plurality of points so that they may be evenly heated. There is an absolute minimum contact between the billets and their supporting and conveying mechanism.

The present application is a division of my copending application Serial No. 174,009 filed July 15, 1950, now Patent No. 2,592,236. The said application is directed to the combination of a furnace and conveying means to move elongated work to be heated through the furnace. The present application is directed to the conveying mechanism per se.

An object of the invention is to provide means to convey an elongated object through a path by mechanism including parts that engage the work at a plurality of spaced points. A further object of the invention is to provide mechanism to rotate elongated objects around their axes as they are being moved through an axially disposed path.

The various features of novelty which characterize my

invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a section through the furnace taken on line 1—1 of Figure 2;

Figure 2 is a section through the furnace taken on line 2—2 of Figure 1;

Figure 3 is a section of the furnace taken on line 3—3 of Figure 2;

Figure 4 is a view in section showing the details of the conveying mechanism;

Figure 5 is a section of the furnace corresponding to Figure 1, and taken on line 5—5 of Figure 6, but having a modified form of conveying mechanism; and

Figure 6 is a view from the right of Figure 5.

Referring to the drawing, there is shown a furnace 1 having an elongated heating chamber 2 through which the work W, shown herein as cylindrical billets, is passed. The furnace may be provided with a second chamber 3 in which work is preheated, and is shown herein with such a chamber located directly above the chamber 2. The furnace may be either a single elongated chamber or may consist of a number of units placed end to end. Work is moved through the preheating chamber by means of conveyor rolls 4 mounted on shafts 5 that extend through the sidewalls of the chamber and which are supported in suitable bearings. These shafts may be either perpendicular to the line of travel of the billets or at a slight angle to the perpendicular. In the latter case, the skewed rollers will cause the work to be rotated around its axis as it is being advanced through the preheating chamber. In some cases this is desirable since the work can often be more evenly heated around its periphery if it is rotated as it is passing through the furnace.

The furnace is constructed of refractory material 7 in accordance with usual furnace practice, which refractory is backed up by sheet metal work 8. The entire furnace is rigidly held in position and supported by structural steel members 9. It will be seen that the heating chamber 2 is shaped so that it closely surrounds the work being heated and is provided on each side with a row of burner blocks 11 that are directed toward the work. Each of these burner blocks forms a part of a burner of the type disclosed in the patent of A. A. Furczyk, No. 2,561,793 issued on July 24, 1951. These burners are of the radiant type and are provided with cup-shaped depressions 12 into which the end of a distributor 13 extends. A suitable mixture of gas and a combustion supporting gas are supplied through the distributor and from which they are discharged in a substantially radial direction into the cup. The fuel mixture is ignited as it leaves the distributor and burns within the cup to heat the same to incandescence. The burners are so designed that complete combustion takes place within the cup so that flame will not impinge upon the work. Radiant heat is directed from the incandescent cups 12 toward the work, and this heat is augmented by convection heat produced by the hot products of combustion which circulate around the work in a highly turbulent condition. Some of the hot products of combustion are discharged through entrance and exit openings 14 at the ends of the furnace chamber 2. Most of the hot products of combustion, however, are discharged through the openings 16 into the preheat chamber 3 in order to preheat the work moving through that chamber.

The openings 14 at the end of the furnace are of a diameter smaller than the diameter of the furnace cham-

ber and slightly larger than the maximum diameter of the billets that are to be heated. These openings may be faced with a water-cooled jacket **15** that will serve to protect the ends of the furnace from the action of the hot products of combustion which are blasted through this opening. It is noted that the roof of the preheating chamber **3** is formed of slabs **17** which can be removed to give access to this chamber and, through the openings **16**, to the chamber **2**. It is also noted that the floor of the chamber **2** is provided with a plurality of openings **21** through which the work forwarding or conveyor mechanism shown generally at **22** may extend into the furnace chamber. This conveyor mechanism is used to move the work axially through the heating chamber **2** and is of a novel construction. The conveyor mechanism will now be described.

The mechanism for moving the work through the heating chamber of the furnace includes a plurality of upstanding members **23** made of heat resisting alloy and each of which has a cap **24** on the upper end thereof upon which work is supported. It will be seen that these members extend from below the furnace and into chamber **2** through the opening **21** in the bottom of the chamber. The openings **21** need be only large enough to receive the members, which are set at an angle of approximately 15° to the vertical as shown in Figures 1 and 4. The members, however, are substantially vertical in a direction at right angles to the length of the furnace chamber as shown in Figure 2. From an inspection of Figure 3 it will be seen that the members **23** are placed in two parallel rows through the furnace chamber and that the members of each row are staggered with respect to the members in the other row. The members **23** can be spaced at any necessary interval. On a furnace designed to handle billets of a minimum of six feet in length the members will be spaced on two foot, ten inch centers so that each billet will at all times be supported on at least four of the members, two in each row.

Each of the members **23** projects from and is mounted for rotation in a gear box **25** taking the form of a housing that is in turn supported on structural members **26** below the furnace. Referring to Figure 4 it will be seen that the lower end of member **23** is provided with a flange **27** that rests against a flange **28** attached to a hollow shaft **29** and is axially aligned with the shaft. The flange **28** is preferably welded to the shaft **29** but may also be maintained against rotation with respect thereto by a suitable key such as that shown at **31** in the drawing. The member **23** is held in position on the shaft by means of a split collar **32**, each half of which surrounds the member and is attached by bolts **33** to flange **28**. In order to prevent relative rotation between the member and its driving shaft, keys **34** are fastened by set screws **35** to the halves of the collar. These keys are received in suitable keyways that are formed in lower end of member **23** just above the flange **27**. A skirt **36** is attached to the periphery of the flange **28** by means of suitable screws **37**. This skirt acts to protect the supporting parts for member **23** and to prevent any possibility of scale or dirt which may fall through the opening **21** of the furnace from getting into the driving mechanism for the supporting member. The upper end of shaft **29** is reduced as shown at **38** in the drawing to receive the lower end of member **23** and to guide the same into place as it is being lowered into position through the openings **16** and **21** of the furnace.

Shaft **29** is guided at its upper end in the housing **25** of the gear box by means of a bearing **39** that is protected from above by a cap **41**. This cap is attached to the housing by bolts **42**. It is noted that the shaft **29** has oil seal rings **43** between it and the cap. These rings protect the shaft from dust that may otherwise get into the housing, and also act to retain oil that is sprayed into the housing and over the bearing **39**. The lower end of the shaft **29** is guided by and the end thrust of the shaft is taken up by a bearing **44** that is placed on a reduced portion **45** of the shaft. This bearing is held in place on the shaft by a sleeve **46** that is threaded on the lower reduced end of the shaft, with the upper end of the sleeve engaging the inner-race of the bearing to hold the same against the shoulder formed on the shaft where the reduced portion **45** terminates. The lower end of the housing through which the shaft extends is closed by an annular plate **48** which is held in position by bolts **49**. During the operation of the device oil for lubricating the bearings and the driving gears to be described is forced into the upper part of the housing at **50** with the lower portion of the housing including the cap **48**, forming a sump into which the oil can be collected for recirculation. To this end the sleeve **46** has a downwardly extending portion which serves somewhat to prevent oil from flowing between the plate **48** and the shaft. In addition, there is provided an oil seal **51** in the lowerface of the plate **48** to prevent any loss of oil.

The drive for each of the member **23** in each of the units is obtained from a driving shaft **51** that extends through the housing in the direction of the furnace chamber. This shaft is journalled in bearings **52** and **53** on each side of the housing and is provided on each end with a coupling **54** that can be connected to similar shafts in the adjacent units. A suitable motor is provided to drive the shafts so that all of the members **23** throughout the length of the furnace are driven at the same speed. The arrangement is such that shaft **51** has a helical gear **55** on it which meshes with and drives two gears **56**, one of which is on each of the shafts **29**. The gear **56** is keyed to shaft **29**, and is held in position axially of the shaft **29** by a sleeve **57** which extends between the gear and the upper bearing **39** and a sleeve **58** which extends between the gear and the lower bearing **44**. These sleeves not only serve to locate the gear **56** on the shaft **29**, but also to absorb the thrust of the gear and transfer it to the bearing. It will be seen that the two gears **56** and shafts **29** in each unit will be driven in opposite directions. This means that the members **23** in one row, in Figure 3 for example, will be rotated clockwise while the members **23** in the other row will be rotated counterclockwise. Therefore, a billet resting as shown in Figure 2 partially on members in both rows will be moved axially through the furnace.

Since the cap **24** and the upper end of the member **23** extend into the furnace and are subjected to the heat thereof, it is advisable to water-cool these parts. For this purpose the lower end of shaft **29** has a rotary union **59** fastened to it. The union is provided with an inlet pipe **61** through which a suitable coolant may be supplied thereto and an outlet pipe **62**. This outlet pipe is connected in the union with a pipe **63** that extends axially of the shaft **29** to the upper end thereof where it is held in concentric relation with shaft **29** by a spider **64**. Threaded into the upper end of the spider is a pipe **65** forming a continuation of pipe **63** that extends to the upper end of the member **23** as is shown in the drawing. Therefore, as the coolant, which is usually water, is introduced through the inlet **61**, it will flow upwardly in shaft **29** and member **23** into the cap **24**. From here the water will flow back through pipes **65** and **63** to the outlet pipe **62**. The amount of cooling that is obtained will depend both upon the volume of water supplied through the member as well as the height of the pipe **65**. The nearer this pipe is to the inside surface of the cap **24** the more the latter will be cooled.

Referring to Figure 1 of the drawing it will be seen that each opening **16** between chambers **2** and **3** is so spaced that it is in axial alignment with a member **23** of adjacent conveyor units. In assembling or dis-assembling these members with respect to the rest of the apparatus, the top **17** of the chamber **3** will be removed. Thereafter

the skirt 36 and the split ring 32 will be removed from the shaft 29. A suitable tool can then be inserted through an opening 16 to withdraw one of the members 23 from the furnace. This procedure can be followed with comparative ease when it is necessary to repair the conveying mechanism for any reason. After the members 23 have been removed it is, of course, easy enough to disconnect the couplings 54 and withdraw the housing 25 for repair or replacement. The construction described herein is such that repair and replacement of the various supporting means can be rapidly accomplished with a minimum of disruption of the entire system.

In an installation using furnaces of the type disclosed herein, the furnace can be made as a single elongated structure, but it is usually made in sections or units that are axially aligned with each other. Individual sections are desirable since one furnace section and a conveying mechanism associated therewith may be replaced when the furnace section needs repair or relining, as it will from time to time, without the necessity of shutting down the entire line.

In the operation of a furnace system of the type described herein it is necessary that the billets being heated be at least as long as the distance between three adjacent supporting members 23 that are in the same side of the furnace chamber. The minimum length of the billets handled will be dependent upon design problems, and will generally be in the neighborhood of six feet. The maximum length of billets handled, however, would depend entirely upon mill practice. The billets to be heated are placed by some suitable lifting machanism in axial alignment with the preheating chamber 3 and are moved through that chamber by the rollers 4. During this process they are heated by the products of combustion coming through the openings 16 from chamber 2. Thereafter the billets are moved to a lower level until they are aligned with the supporting members 23 in the furnace chamber 2. The billets are moved by these supporting members through the furnace chamber 2 where they are brought to the desired temperature. It will be seen that each billet is supported by at least two of the caps 24 on each side of a vertical line through the center thereof as indicated in Figure 2. As the caps are rotated in opposite directions they will act upon the billet and move it axially through the furnace chamber.

In view of the fact that the members 23 are set at an angle to the vertical in the direction of movement of the billet, the billet will also be given a rotating movement around its axis. This can be readily understood because of the vectors involved in the support of the billet at its point of contact with the caps 24. The construction shown herein permits the handling of an extremely heavy billet with a minimum of apparatus in the furnace itself. Furthermore, since the billet is being moved axially and is being rotated while it is moved, and since the billet is only supported at any one time at a plurality of points on its surface, the billet will be evently heated throughout its length without the possibility of cold spots or streaks being formed thereon. The present construction reduces engagement of the handling mechanism against the billet to an absolute minimum. In the embodiment of the invention described above the supporting members 23 are fixed at an angle of about 15° to the vertical. This will produce a revolution of a 13" diameter billet around its axis in 12.7 feet of linear travel.

In some cases it may be desirable to have the members 23 set at a different angle so that a billet, perhaps of a smaller diameter, will be rotated in a greater or shorter distance of linear travel. A construction by means of which the supporting members 23 can be adjusted angularly is disclosed in Figures 5 and 6 of the drawing. In this case the supporting members are mounted in bearings in a manner similar to that described above. Here, however, each of the supporting members and its bearing structure is placed in an individual housing 71 which is

rotatable around an axis formed by a driving shaft for each pair of supporting members. This drive shaft is indicated at 72 and has a worm 73 on it meshing with worm gears 74 that are keyed to the hollow shafts 29 upon which members 23 are mounted. Each of the housings is fastened in its adjusted angular position to a center plate 75 that is mounted on the supporting structure 26. The housings are fastened to this plate by means of bolts 76 which extend through ears 77 on the housing. The plate 75 can be provided with holes, or it can be provided with slots through which the bolts extend so that the housing can be adjusted to any angular position within its limits of travel. Each housing is also provided with a downwardly extending arcuate flange 78 that rests upon a track or shoulder 79 forming a part of the center plate 75. The center of the radius of curvature of the tracks are at the shaft 72 so that the housings will be supported on the tracks in any of their adjusted positions.

Referring to Figure 6, it will be seen that the shaft 72 extends from one side of the housing and has a bevel gear 81 on its end which meshes with a bevel gear 82 on a drive shaft 83. This drive shaft extends parallel to the furnace and is supported for rotation in bearings that are mounted on structure 84 which is attached to the furnace supporting foundations. The shaft 83 will be driven by a motor at any suitable speed so that all of the supporting members 23 will be driven at the same speed to forward the work through the furnace at the desired rate.

Since the supporting members 23 are adjustable through an angle it is necessary to have openings 85 in the bottom of the furnace that are long enough to permit the full adjustment of the supporting members. These openings will permit an undesirably large volume of air to be drawn in through the bottom of the furnace. Therefore, plates 86 having an opening in them through which the supporting members extend are provided at the bottom of the furnace to cover the openings 85. The plates 86 can be mounted in any suitable fashion so that they are slidable along the bottom of the furnace to cover the openings 85 in any adjusted position of the members 23. The top of the caps 24 on the members 23 will vary in height somewhat with respect to the bottom of the furnace as they are adjusted to various angular positions. This variation, however, is not sufficient to change the height of the billet with respect to the burners enough to have any effect on the heating of the billet.

This embodiment of the invention operates in exactly the same manner as the above-described embodiment with the addition that the rotation of the billets during the time that they are being heated can be adjusted from zero when members 23 are vertical to a maximum when members 23 are at their greatest angular position with respect to the vertical. In most cases the angle of the members 23 with respect to the vertical will only be adjusted once for a given size and composition of billets that are being heated. This adjustment will not be changed unless the size of the billet being heated is changed or unless its analysis requires that it be rotated at a different speed. The proper speed of rotation or angle of adjustment of the members 23 can best be determined empirically.

From the above description it will be seen that I have provided a conveying mechanism to move a billet through a furnace while it is being heated, which mechanism contacts the billet at a minimum area of its surface so that substantially the entire billet is at all times exposed to the heat of the furnace. In addition to the above, the construction of the mechanism is such that extremely heavy billets can be handled rapidly and with ease to forward the work continuously through the furnace while it is being heated, and from the furnace to a point of use such as, for example, a piercing mill.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in

the form of the apparatus disclosed without departing from the spirit and scope of the invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. A conveying mechanism for elongated cylindrical articles comprising a plurality of pairs of conveying members, means to mount said pairs of members in a line with the members forming side by side rows on opposite sides of a vertical plane extending along the path through which the articles are to be moved, means to mount the members of each pair in an upwardly extending direction and at an angle to the vertical in the direction of said path with the members of one row tilted in one direction and the members of the other row tilted in an opposite direction along said path, drive means extending along said path, gearing between said drive means and said members to rotate said members of each pair in opposite directions, and a cap on the top of each member upon which an article to be conveyed is supported, whereby an article supported jointly by members of each pair will be moved along said path as said members are rotated.

2. Apparatus for moving elongated work through a furnace including a conveying unit comprising a housing, a pair of members projecting upwardly from said housing on opposite sides of a vertical plane, means to mount said members substantially parallel to each other and substantially vertical in one plane and at opposite angles from the vertical in a plane at right angles to said last mentioned plane, a drive shaft extending through said housing between said members, a drive gear on said shaft, a gear on each member meshing with the gear on said drive shaft, and a work supporting portion axially disposed on the top of each member.

3. Conveying mechanism for elongated cylindrical articles comprising in combination a plurality of pairs of article supporting members extending in a row along the path through which the articles are to be moved, each pair of members extending at opposite angles to the vertical in the direction of said path and on opposite sides of a plane extending vertically through said path, each member having an article supporting portion located axially at its upper end, means to support each member adjacent to its lower end, and means to rotate the members of each pair in opposite directions with the portions of the members in each pair that are nearest to each other moving in the direction of said path whereby articles supported jointly by said pairs of members will be moved helically through said path.

4. Conveying mechanisms for heavy elongated work comprising a plurality of pairs of upwardly extending members, each member having a cap axially disposed on the upper end thereof upon which the work to be conveyed is supported, means to support said members at their lower ends on opposite sides of vertical plane with the members of each pair extending at opposite angles to the vertical in the direction of the path of movement of the work, and with the members of each pair in alignment with the members of each other pair, and means to rotate the members of each pair in opposite directions with the aligned members of each pair rotating in the same direction whereby work supported by the caps of each pair will be conveyed in an axial direction and rotated around its axis as it is being conveyed.

5. The combination of claim 4 including means to adjust the supporting means for each member to vary its angle to the vertical and thereby vary the speed with which work will be rotated around its axis.

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