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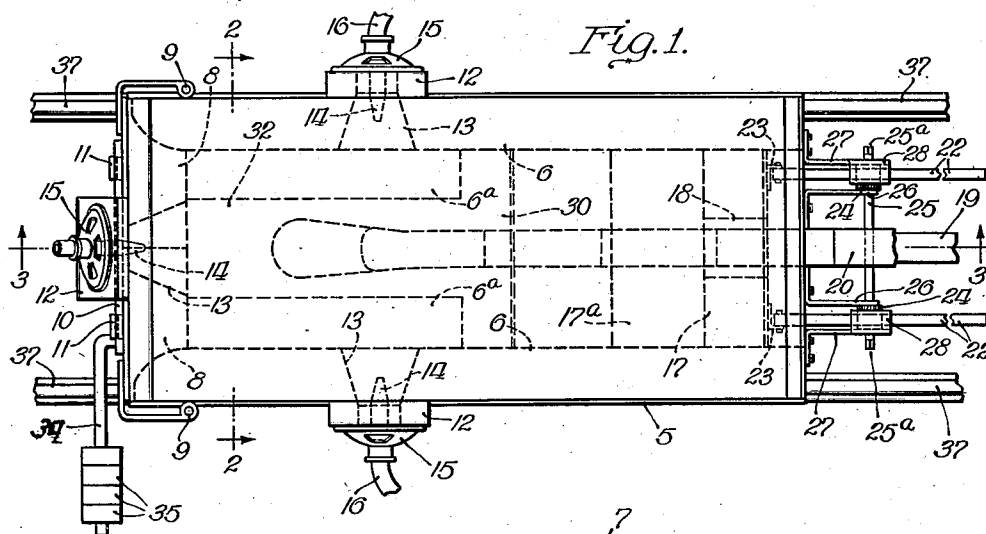
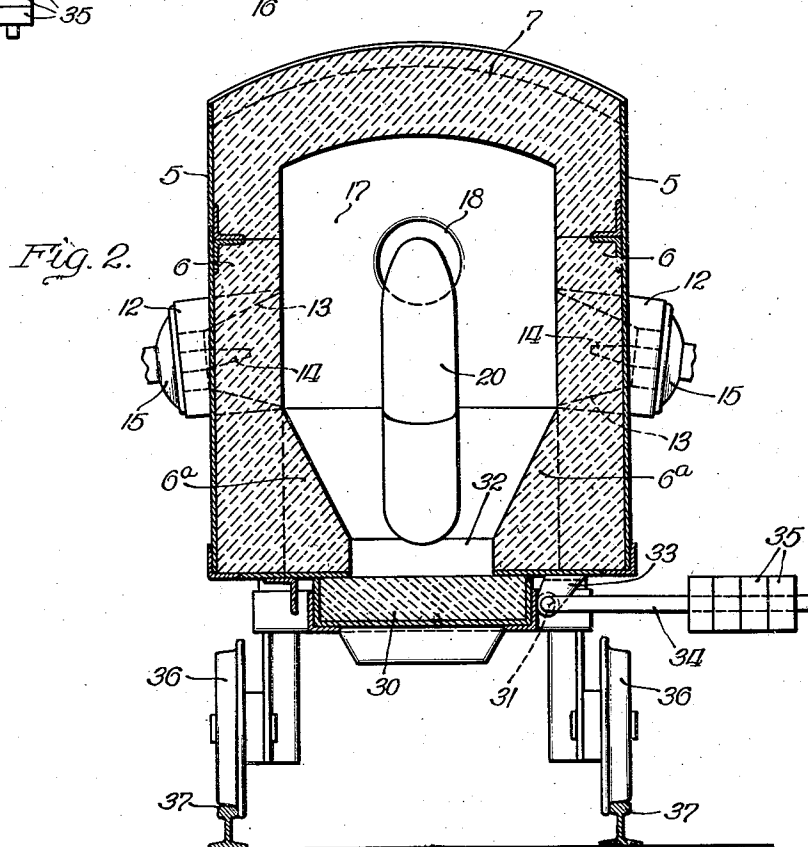
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PIPE BEND FURNACE

Filed Dec. 12, 1938

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 3.

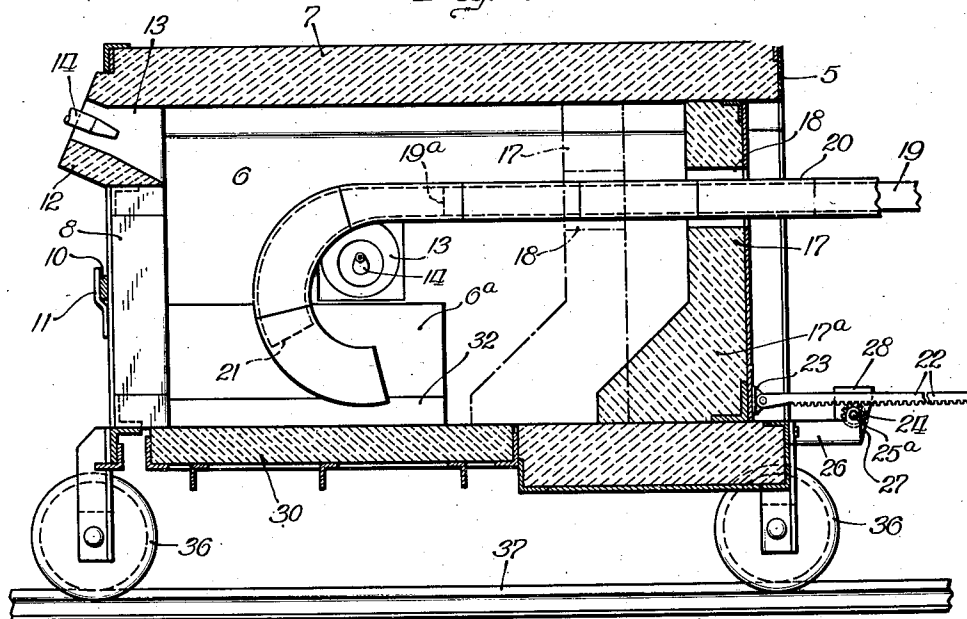
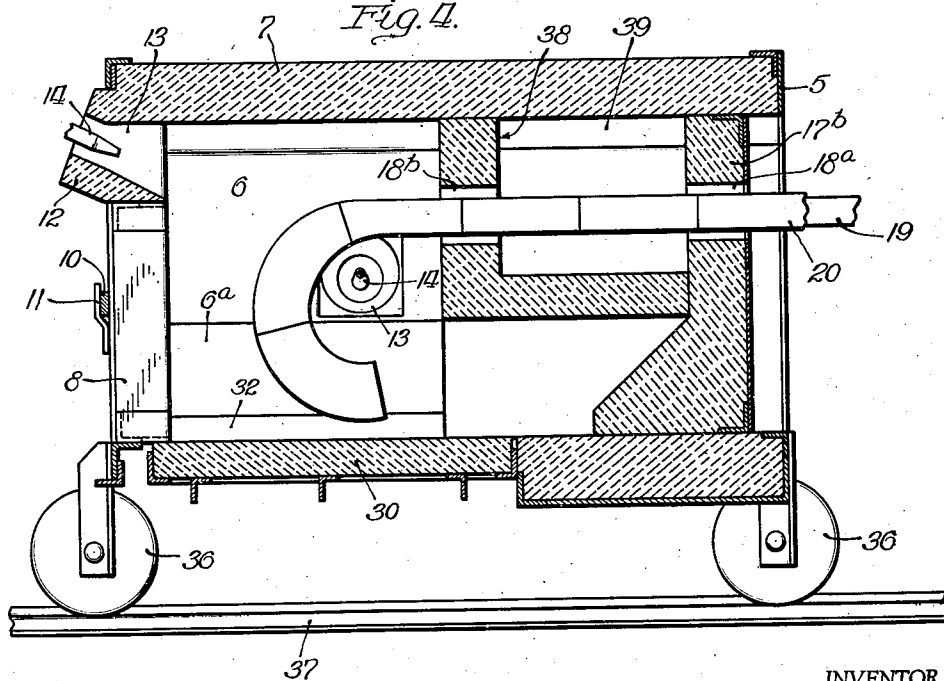


Fig. 4.



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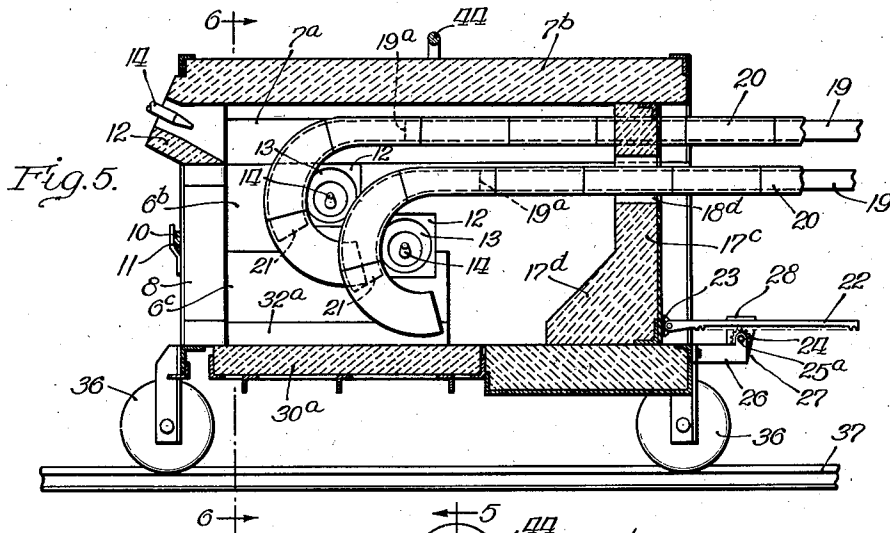
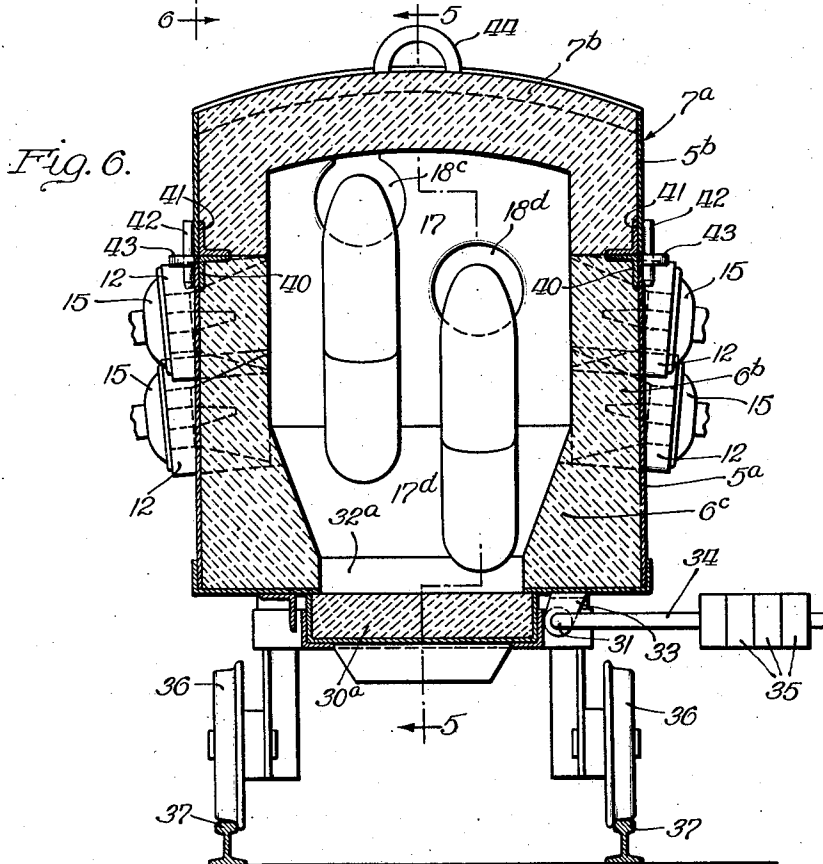
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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,206,519

## PIPE BEND FURNACE

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Application December 12, 1938, Serial No. 245,093

9 Claims. (Cl. 266-5)

This invention relates to furnace structures and has to do with a furnace for use in forming articles, such as pipe bends and analogous articles, from tubular blanks.

It is known to form articles, such as pipe bends, by passing tubular blanks over a suitable mandrel, the blanks being mounted upon a rod to which the mandrel is secured and being forced over the mandrel by relative movement between the latter and the blanks lengthwise of the blanks. That may be accomplished by either moving the mandrel rod and the mandrel lengthwise of the blanks, while restraining the latter against lengthwise movement, or by imparting lengthwise movement to the blanks while the mandrel and the rod remain stationary. Both methods are known in the art and need not be described in detail. In order that the blanks may pass over the mandrel and be properly formed thereby, they are heated to a proper working temperature, the temperature depending upon the material of the blank, its wall thickness, and other related factors. Under present practice, the blanks are commonly heated by disposing the mandrel and adjacent portion of the mandrel rod within a hood-like structure, the interior of which is heated by suitable burners. That is objectionable in that the hood-like structure referred to is open to the atmosphere for a considerable portion of its area, so that an objectionable amount of heat escapes to the atmosphere and is wasted, and in many instances the extent of heating of the blanks cannot be controlled with sufficient accuracy.

My invention is directed to a furnace which is substantially closed to the atmosphere, preventing objectionable loss of heat, in which the extent of heating of the blanks may be accurately controlled to suit various conditions, and in which the articles produced from the blank may be discharged from the furnace with expedition and facility and without risk of damage thereto. Further objects and advantages will appear from the detail description.

In the drawings:

Figure 1 is a plan view of a furnace embodying my invention;

Figure 2 is a sectional view taken substantially on line 2-2 of Figure 1, on an enlarged scale;

Figure 3 is a sectional view taken substantially on line 3-3 of Figure 1, certain parts being omitted and certain other parts being shown in elevation;

Figure 4 is a view similar to Figure 3 but showing a modified form of furnace embodying my invention;

Figure 5 is a sectional view similar to Figure 3, taken substantially on line 5-5 of Figure 6, on a reduced scale, but showing a second modified form of furnace embodying my invention; and

Figure 6 is a sectional view taken substantially on line 6-6 of Figure 5, on an enlarged scale.

The furnace body is of box-like formation and of elongated rectangular shape in plane, as shown in Figure 1. It comprises a suitably reenforced plate metal casing 5 within which are disposed two thick refractory side walls 6, which support a thick refractory top wall 7. The front of the furnace is closed by two doors 8 hinged to the furnace body at each side thereof, at 9, and normally held closed by a bar 10 engaged in suitable cleats 11 appropriately secured on the outer faces of the doors 8. At its front upper portion the furnace is provided with burner block 12, defining an inwardly flaring burner opening 13, which receives nozzle 14 of a gas burner 15 of known type, suitably mounted on block 12. Each of the side walls 6 is also provided with a burner block 12 and an associated burner 15 mounted thereon. Gas may be supplied to the burners through flexible hose 16 suitably attached thereto, or in any other suitable manner. It will also be understood that any other suitable type of burners may be provided, using either gaseous fuel or liquid fuel. The body of the furnace thus defines interiorly a heating chamber, and the burners, disposed at the forward position of the furnace, provide means for heating that chamber.

A thick wall structure 17, of considerably increased thickness at its lower portion 17a, fits closely within the rearward portion of the furnace and extends throughout the cross-sectional area thereof, providing a closure therefor. This wall structure is provided with a restricted opening 18 therethrough, which opening accommodates a mandrel rod 19 and tubular blanks 20 mounted thereon, there being a curved mandrel 21 secured to the forward end of rod 19, at 19a, within the heating chamber of the furnace. The doors 8 provide ready access to the interior of the furnace, for removal of mandrel 21 or for attachment thereof to the mandrel rod 19, which may be accomplished by screw means of known character, or in any other suitable known manner.

Referring to Figure 3, it will be noted that the side burners 15 are disposed below opening 18, at the lower or inner curved side of the mandrel 21, whereas the front burner 15 is disposed above opening 18 and above the upper or outer curved side of mandrel 21, being inclined downward and inward toward the mandrel, the side burners being inclined inward and upward of the heating chamber transversely thereof. The burners thus act to best advantage for heating to desired extent the blanks upon the mandrel and upon the portion of the mandrel rod 19 disposed within the furnace forward of the wall structure 17. Since the opening 18 is restricted, with but sufficient clearance between

this opening and the blanks on the mandrel rod 19 to permit escape from the furnace of the products of combustion or waste gases, the furnace is substantially closed to the atmosphere and but little loss of heat occurs, rendering it possible to heat the blanks to the desired temperature and to maintain them at that temperature. Having the waste gases escape through opening 18 only is advantageous as being conductive to rapid heating of the blanks. In special cases, where less rapid heating of the blanks is desirable, the rate of heating may be controlled by opening one or both of the doors 8, or a bottom door, to be described presently, to an appropriate extent.

It is desirable, in the interests of quickly and accurately shaping the blanks to desired form, that the blanks be heated in advance, within the furnace, to approximately the maximum temperature which they can sustain without buckling when subjected to lengthwise pressure for starting the blanks on the mandrel and then moving them along the mandrel rod and over the mandrel. Blanks of various diameters and wall thicknesses are used, the size of the blank and its wall thickness, as well as the material of the blank, depending upon the articles to be formed. Accordingly, it is necessary, in order to attain the best results, that means be provided whereby the extent of heating of the blanks may be varied to suit conditions. That may be accomplished by changing the position of the wall structure 17, thereby changing the length of time during which the blanks are exposed to the heat within the furnace. With that object in view, two rack bars 22 are suitably attached, as by means of brackets 23, to wall structure 17 adjacent the bottom and each side thereof. Rack bars 22 mesh with pinions 24 secured upon a shaft 25 rotatably mounted in two pairs of brackets 26 and 27 secured to and projecting rearward from the furnace body. Each of the brackets 27 is provided with a flange 28 extending over the adjacent rack bar 22 and restraining it against upward movement out of mesh with its associated pinion 24. Shaft 25 is squared at each end, at 28a, for reception of a suitable crank handle, by means of which the shaft may be rotated for adjusting the wall structure 17 in either direction. It will be apparent that when the wall structure 17 is moved forward into its position indicated by dot and dash lines in Figure 3, the length of mandrel rod 19 extending into the heating chamber of the furnace, forwardly of wall structure 17, is considerably less than it is when the wall structure 17 is in its full line position shown in Figure 3. Accordingly, with wall structure 17 in its forward position, the blanks upon the mandrel rod 19 are exposed to the heat within the heating chamber for a less length of time than is the case when wall structure 17 is disposed nearer to the back of the furnace body. As a result, the blanks are heated to a lower temperature, when the wall structure 17 is in its forward position, than when it is moved rearward. This adjustability of the wall structure 17 provides means whereby the temperature to which the blanks are heated preliminary to endwise passage thereof over the mandrel may be accurately controlled, and objectionable loss of heat is avoided.

The furnace body is provided with a discharge opening 32 through its bottom, disposed beneath the mandrel 21. This opening normally

is closed by a door 30 suitably secured, at one side, to a pintle rod 31 pivotally mounted, along one side of opening 32, in brackets 33 suitably secured to the bottom of the furnace body. Rod 31 is provided with a handle 34 projecting to one side of the furnace body and disposed in substantially horizontal position, when door 30 is in its normal raised position closing opening 32. Conveniently, weights 35 are suitably mounted on handle 34, providing a counterweight effective for moving door 30 upward into closed position and maintaining it in the latter position. Each side wall 6 of the furnace body is provided with a lower downwardly and inwardly inclined element 6a extending from the adjacent side opening 32, these elements 6a converging downward and inward to the sides of the opening. After a blank has completed its passage over the mandrel 21, and has been formed into a pipe bend, the resulting pipe bend drops onto the upper face of door 30, through opening 32. The bend thus formed is discharged by swinging door 30 downward about the axis of pintle rod 31, into such position that the formed bend slides off of the door, the latter being then returned to normal closed position by the counterweight means. Since the door 30 is opened but momentarily for discharge of a bend, objectionable loss of heat due to opening of the door is avoided.

The furnace body preferably is suitably mounted upon flanged wheels 36, which travel upon rails 37, in order that the furnace may be moved along the rails, at the same rate as the rate of movement of the mandrel rod 19, in cases where the mandrel rod is moved lengthwise through the blanks and the latter are restrained against lengthwise movement. Such movement of the furnace maintains the mandrel 21 in the position within the furnace shown in Figures 1 and 3. In cases where the mandrel rod is held against lengthwise movement and the blanks are forced along this rod lengthwise thereof, and over the mandrel 21, the furnace also remains stationary. Both methods are known in the art, as above noted, and need not be described in greater detail.

In the modified form of furnace shown in Figure 4, a stationary wall structure 17b extends throughout the entire interior cross-sectional area of the furnace, adjacent the back thereof, and is provided with an opening 18a for accommodation of the mandrel rod 19 and blanks 20 thereon. A second wall structure 38, of L shape in section lengthwise of the furnace, extends forward and upward from wall structure 17b and defines therewith, and with the top wall 7 and upper portions of side walls 6 of the furnace, a dead air space 39. Wall structure 38 is provided, through its inner vertical arm, with an opening 18b corresponding to and aligned with opening 18a, for accommodation of the mandrel rod and the blanks mounted thereon. The blanks disposed within the dead air space 39 are effectively shielded from the intense heat within the heating chamber of the furnace, though they may be preliminarily heated to a certain extent within space 39. That may be advantageous, in certain cases, as providing means whereby the blanks are more gradually raised to the desired temperature, while preventing heating of the blanks to an objectionably high temperature, it being noted that the vertical arm of wall structure 38 is disposed a considerable distance from the back of the furnace body. The furnace of Figure 4 is particularly suitable where it is desired to heat

the blanks to a certain predetermined temperature, particularly if the heating of the blanks should be less abrupt than would be the case when using the furnace of Figures 1 to 3, inclusive.

The modified form of furnace shown in Figures 5 and 6 is provided with a removable upper portion 7a, including a refractory top wall 7b, which seats upon the lower main body portion of the furnace. The latter is provided with a plate metal case 5a, thick refractory lining walls 6b, reinforced at their upper outer edges by angle strips 40 and thickened at their lower portions 6c and there converging downward to discharge opening 32a, and a counter-weighted door 30a controlling opening 32a. Upper portion 7a is provided with a thick refractory lining forming continuations of walls 6b, and reinforcing angle strips 40 seating upon strips 41. Pins 42, welded or otherwise suitably secured to upper portion 7a, extend through plates 43 secured to the lower main body portion of the furnace, for accurately positioning thereon upper portion 7a. The latter may also be provided with a steel ring or loop 44 suitably anchored therein, for convenience in removal and replacement thereof. Removal of upper portion 7a of the furnace gives ready access to the interior thereof for relining, repairs or other purposes.

Back wall structure 17c, thickened at its lower portion at 17d, is provided with two openings 18c and 18d, the latter being disposed lower than the former. Each of these openings accommodates a mandrel rod 19 and blanks 20 thereon, there being a curved mandrel 21 secured to the inner end of each rod, within the furnace, as before. The mandrel rod 19 which extends through opening 18d projects into the furnace a less distance than the rod extending through opening 18c, so that the longer or outer side of the lower mandrel is spaced below and in rear of the shorter or inner side of the upper mandrel, as shown in Figure 5. Two burner blocks 12 are mounted at each side of the furnace, one below the other, each carrying a burner 15, the vertical distance between the two burners 15 being the same as the vertical distance between openings 18c and 18d. Nozzles 14 of the two upper side burners are disposed on a line, transversely of the furnace body, a short distance below the inner or shorter side of the upper mandrel 21, and nozzles 14 of the lower side burners are disposed similarly relative to the lower mandrel, the upper burners at opposite sides of the body being thus disposed in a common vertical plane extending transversely of the body and the heating chamber, and the opposite lower burners being similarly disposed in a common vertical transverse plane. Upper portion 7a of the furnace carries, at its forward end, a burner block 12 on which is mounted a burner the nozzle of which is disposed at the transverse center of the furnace and inclined downward and rearward thereof, as before, it being noted that openings 18c and 18d, and consequently mandrels 21, are disposed at opposite sides of and equidistant from the central vertical lengthwise plane of the furnace body and the heating chamber thereof. It will be seen that the lower side burners are effective for heating the inner sides of blanks on the lower mandrel 21, and the upper side burners are effective for heating the inner sides of blanks upon the upper mandrel 21. The upper side burners are also effective, to a considerable extent, for heating the outer sides of blanks upon

the lower mandrel. In that manner the lessened heating effect of the front burner, with respect to the outer sides of blanks upon the lower mandrel relative to the outer sides of blanks upon the upper mandrel, due to the latter being nearer the front of the furnace, is compensated for. That assures that both the inner and the outer sides of blanks upon both mandrels are heated to substantially the same extent, which is conducive to uniformity of product and increased production. The burners also, of course, contribute to heating of the interior of the furnace.

While I preferably arrange the burners as shown, in the several forms of furnaces illustrated, they may be arranged in other suitable ways. Also, if desired, the furnaces of Figures 1 to 4, inclusive, may be of multiple type and of proper width to receive any desired number, within limits, of mandrel rods and associated mandrels, with blanks thereon, the back wall structure of the furnace, in each case, being appropriately formed to that end.

As has been above indicated, changes in construction and arrangement of parts of my invention may be resorted to without departing from the field and scope thereof, and I intend to include all such variations, as fall within the scope of the appended claims, in this application, in which the preferred forms only of my invention have been disclosed.

I claim:

1. In a furnace for heating tubular blanks to be formed by endwise movement over mandrels, a furnace body defining a heating chamber for reception of mandrels and blanks to be formed, a wall structure closing the back of said chamber provided with two openings spaced apart transversely thereof and disposed one lower than the other for accommodation of mandrel rods and blanks thereon, and two burners at each side of the furnace body opening into said chamber one disposed lower and further from the front of said heating chamber than the other.

2. In a furnace for heating tubular blanks to be formed by endwise movement over mandrels, a furnace body defining a heating chamber for reception of mandrels and blanks to be formed, a wall structure closing the back of said chamber provided with two openings spaced apart transversely thereof and disposed one lower than the other for accommodation of mandrel rods and blanks thereon, and two burners at each side of the furnace body opening into said chamber one disposed lower and further from the front of said heating chamber than the other, the vertical distance between said two burners at each side of said body being the same as the vertical distance between said two openings.

3. In a furnace for heating tubular blanks to be formed by endwise movement over mandrels, a furnace body defining a heating chamber for reception of mandrels and blanks to be formed, a wall structure closing the back of said chamber provided with two openings spaced apart transversely thereof and disposed one lower than the other for accommodation of mandrel rods and blanks thereon, said openings being disposed at opposite sides of and equidistant from the central vertical lengthwise plane of said heating chamber, two burners at each side of the furnace body opening into said chamber one disposed lower and further from the front of said heating chamber than the other, and a burner opening into said heating chamber at the front thereof on said central plane.

4. In a furnace for heating tubular blanks to be formed by endwise movement over mandrels, a furnace body defining a heating chamber for reception of mandrels and blanks to be formed, a wall structure closing the back of said chamber provided with two openings spaced apart transversely thereof and disposed one lower than the other for accommodation of mandrel rods and blanks thereon, said openings being disposed at opposite sides of and equidistant from the central vertical lengthwise plane of said heating chamber, two burners at each side of the furnace body opening into said chamber one disposed lower and further from the front of said heating chamber than the other, the vertical distance between said two burners at each side of said body being the same as the vertical distance between said two openings and the upper and lower burners at opposite sides of said body being respectively disposed in a common plane extending transversely of said body, and a burner opening into said chamber adjacent the front and the top thereof on said vertical plane and inclined downward and inward of said chamber.

5. In means for forming articles from tubular blanks, a furnace comprising a body defining a heating chamber, substantially closed except for an opening in a vertical wall of said chamber, a mandrel rod of substantially uniform diameter extending through said opening into said chamber to a length to accommodate a plurality of tubular blanks mounted end to end on said rod, a curved mandrel of gradually increasing diameter attached to the inner end of said rod, the latter and said mandrel being maintained in substantially fixed relation to said furnace, said opening being of a size to provide clearance about said rod and a blank thereon providing an outlet for combustion products effective for inducing flow of hot combustion gases about and along the mandrel rod and the blanks thereon, and burner means opening into said chamber for heating it, said burner means being directed for the application of maximum heat at said mandrel with resultant flow of hot combustion products about and along the blanks on the mandrel and rod within said chamber, whereby such blanks moved lengthwise on said rod through said opening into said chamber are gradually heated while traveling from said opening to said mandrel where they are formed into pipe bends of enlarged diameter and then dropped within said chamber.

6. In means for forming pipe bends from tubular blanks, a furnace comprising a body defining a heating chamber, substantially closed except for an opening in a vertical wall of said chamber, a mandrel rod of substantially uniform diameter extending through said opening into said chamber, said opening being of a size to accommodate said rod and a tubular blank thereon, a curved mandrel of gradually increasing diameter attached to the inner end of said rod and distanced from said opening, and means for heating tubular blanks on said rod and mandrel, said heating means being directed for the application of maximum heat at said mandrel and products of combustion leaving said chamber through the clearance in said opening around said mandrel rod and blank thereon, whereby such blanks moved lengthwise on said rod through said opening into said chamber are gradually heated while traveling from said opening to said mandrel where they are formed into pipe bends of enlarged

diameter and then dropped within said chamber.

7. In means for forming pipe bends from tubular blanks, a furnace comprising a body defining a heating chamber, substantially closed except for an opening in a vertical wall of said chamber, a mandrel rod of substantially uniform diameter extending through said opening into said chamber, said opening being of a size to accommodate said rod and a tubular blank thereon, a curved mandrel of gradually increasing diameter attached to the inner end of said rod and distanced from said opening, means for heating tubular blanks on said rod and mandrel, said heating means being directed for the application of maximum heat at said mandrel and products of combustion leaving said chamber through the clearance in said opening around said mandrel rod and blank thereon, whereby such blanks moved lengthwise on said rod through said opening into said chamber are gradually heated while traveling from said opening to said mandrel where they are formed into pipe bends of enlarged diameter and then dropped upon a portion of the floor of said chamber, and means for mounting said portion of said floor for opening movement by the weight of the pipe bends dropped thereon.

8. In means for forming pipe bends from tubular blanks, a furnace comprising a body defining a heating chamber, one wall of said chamber being adjustable to vary the length thereof, said chamber being substantially closed except for an opening in said adjustable wall, a mandrel rod of substantially uniform diameter extending through said opening into said chamber, said opening being of a size to accommodate said rod and a tubular blank thereon, a curved mandrel of gradually increasing diameter attached to the inner end of said rod and distanced from said opening, and means for heating tubular blanks on said rod and mandrel, said heating means being directed for the application of maximum heat at said mandrel and products of combustion leaving said chamber through the clearance in said opening around said mandrel rod and blank thereon, whereby such blanks moved lengthwise on said rod through said opening into said chamber are gradually heated while traveling from said opening to said mandrel where they are formed into pipe bends of enlarged diameter and then dropped within said chamber.

9. In means for forming pipe bends from tubular blanks, a furnace comprising a body defining a heating chamber, substantially closed at the sides and top except for an opening in a side wall of said chamber, a mandrel rod of substantially uniform diameter extending through said opening into said chamber, said opening being of a size to accommodate said rod and a tubular blank thereon, a curved mandrel of gradually increasing diameter attached to the inner end of said rod and distanced from said opening, and means for heating tubular blanks on said rod and mandrel, said heating means being directed for the application of maximum heat at said mandrel and products of combustion leaving said chamber through the clearance in said opening around said mandrel rod and blank thereon, whereby such blanks moved lengthwise on said rod through said opening into said chamber are gradually heated while traveling from said opening to said mandrel where they are formed into pipe bends of enlarged diameter and then dropped from said mandrel.