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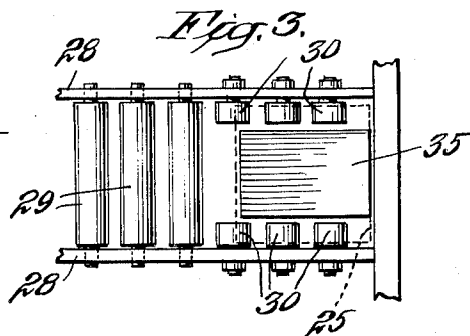
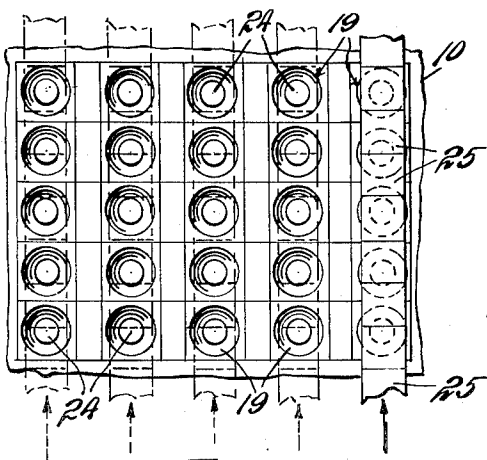
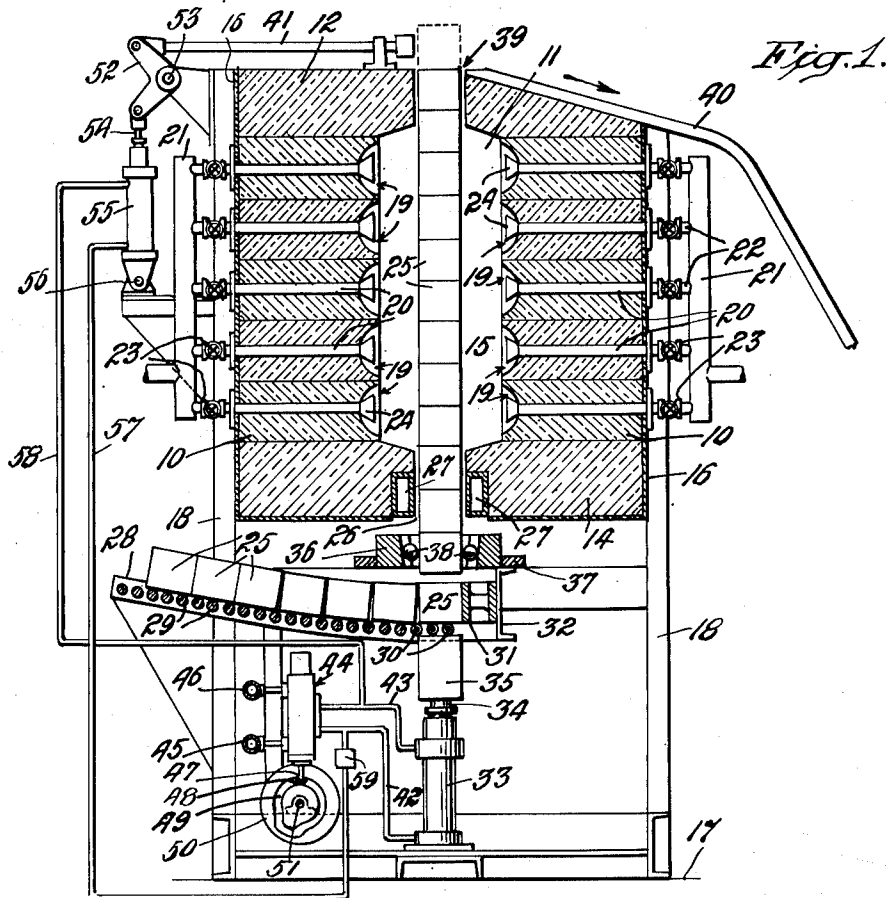
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2,591,259

BILLET HEATING FURNACE

Filed Sept. 26, 1946

4 Sheets-Sheet 1



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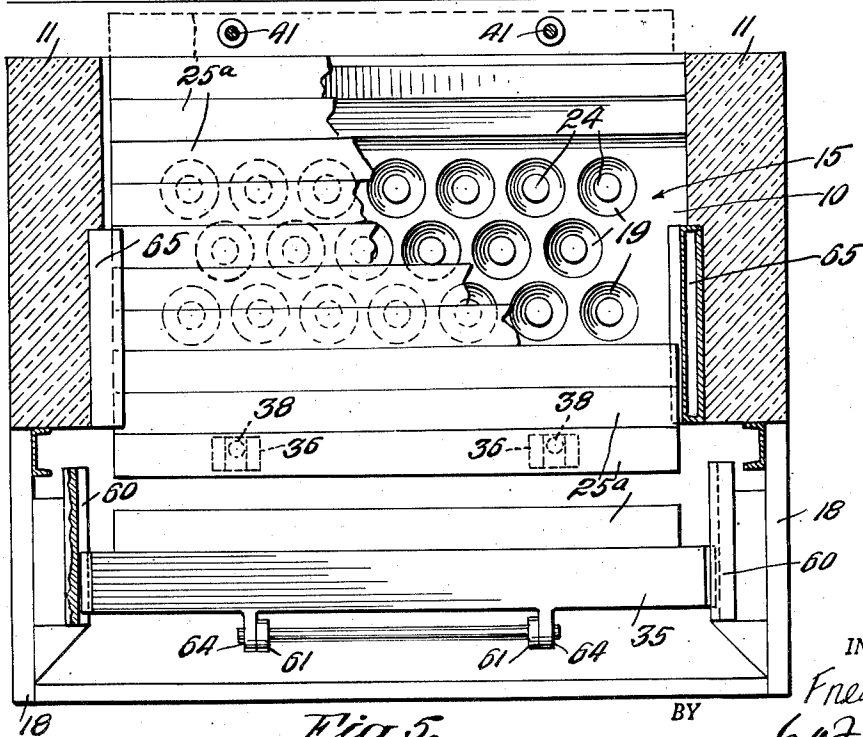
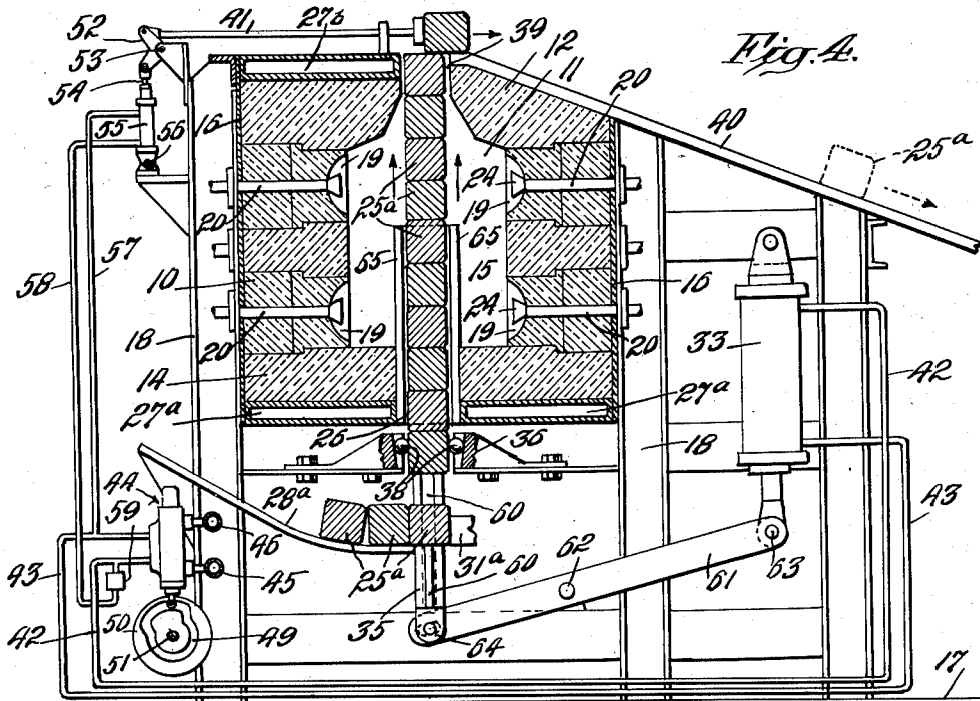
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BILLET HEATING FURNACE

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4 Sheets-Sheet 2



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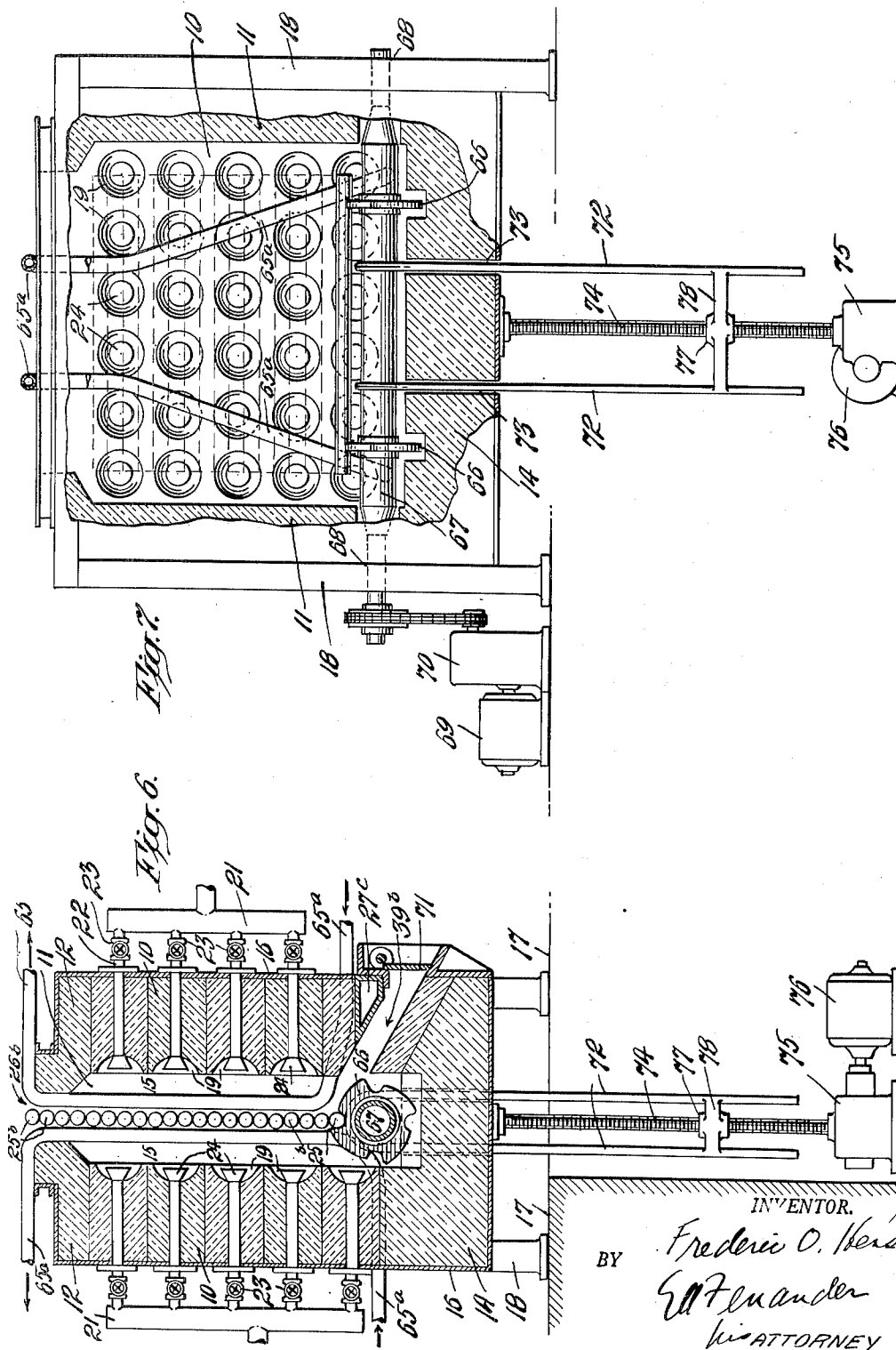
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BILLET HEATING FURNACE

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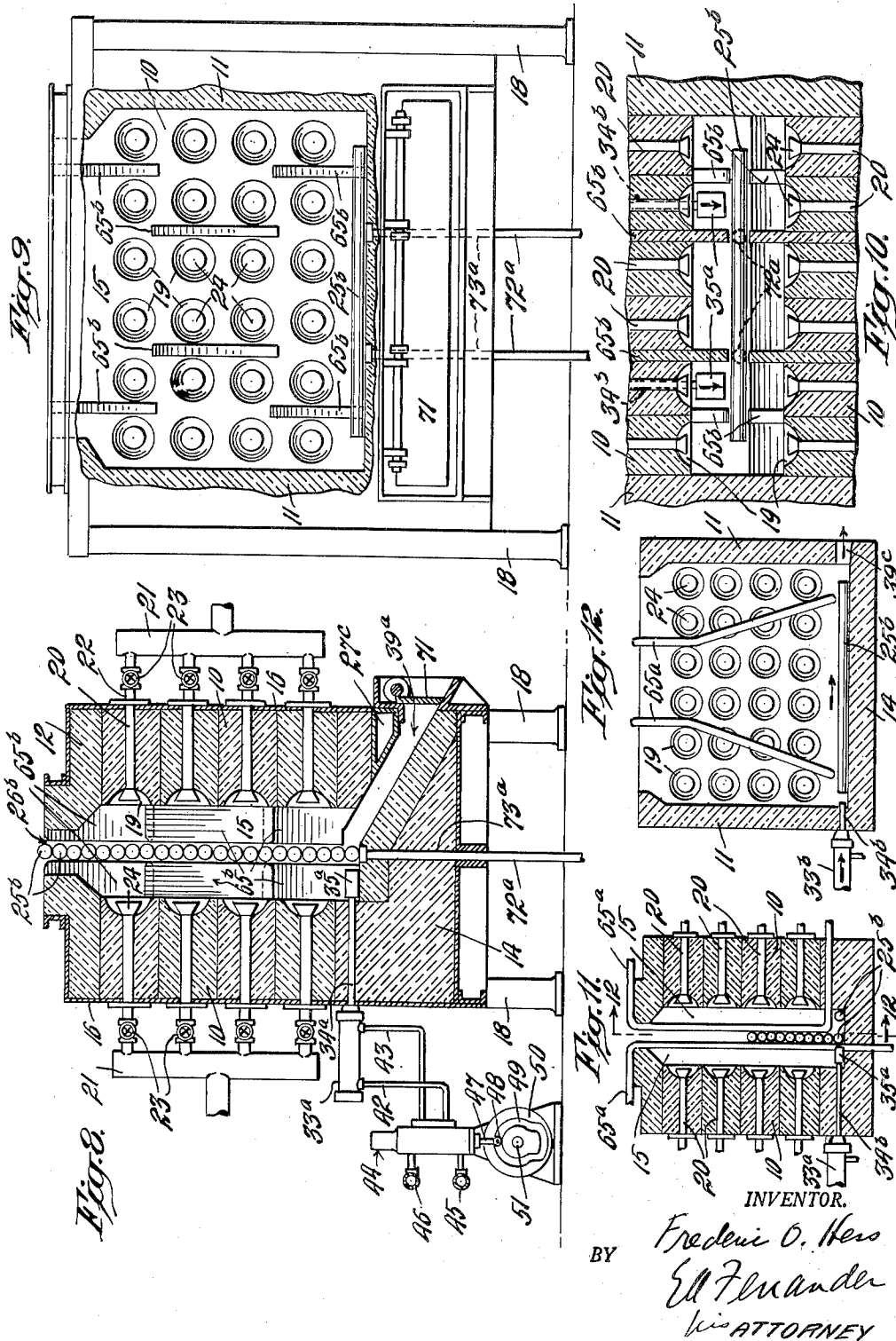
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BILLET HEATING FURNACE

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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,591,259

BILLET HEATING FURNACE

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2 Claims. (Cl. 263—6)

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This invention relates to billet heating furnaces.

It is an object of the invention to provide an improvement in billet heating furnaces for continuously heating billets to an elevated temperature suitable for forging and like forming operations. This is accomplished by continuously moving an upright stack of billets through a vertically disposed channel formed between spaced apart side walls of a refractory lined chamber, and simultaneously applying heat to opposite sides of the billets while passing through the channel to heat the billets rapidly to the desired elevated temperature.

More particularly, a substantially closed chamber is provided having inlet and outlet openings for the billets at opposite ends of the channel, and heating the billets directly by radiant burners which are incorporated and distributed in the spaced apart side walls and face the billets at opposite sides thereof. In this manner the billets passing through the channel in an upright stack are rapidly heated to the desired elevated temperature by the heating effects developed in the chamber including the highest temperature radiant heating component produced by the radiant burners.

Further, suitable mechanism is provided whereby billets may be successively fed at the inlet end of the chamber at one end of the upright stack and successively dislodged from the opposite end of the stack at the outlet end of the chamber for immediate removal to a forging machine.

The invention, together with the above and other objects and advantages thereof, will be more fully understood upon reference to the following description, taken in conjunction with the accompanying drawings forming a part of this specification, and of which:

Fig. 1 is a vertical view, partly in section, of a billet heating furnace embodying the invention;

Fig. 2 is a fragmentary view of one of the spaced apart side walls of the furnace shown in Fig. 1;

Fig. 3 is a fragmentary top plan view of the roller conveyor provided for the furnace of Fig. 1;

Fig. 4 is a vertical sectional view of a billet heating furnace illustrating a modification of the invention;

Fig. 5 is a view in elevation, taken at right angles to Fig. 4 and partly broken away and in section, to illustrate the invention more clearly;

Fig. 6 is a vertical sectional view of a billet

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heating furnace illustrating another modification of the invention;

Fig. 7 is a view in elevation, taken at right angles to Fig. 6 and partly broken away and in section, to illustrate details more clearly;

Fig. 8 is a vertical sectional view of a billet heating furnace illustrating a further modification of the invention;

Fig. 9 is a view in elevation, taken at right angles to Fig. 8 and partly broken away and in section, to illustrate details more clearly;

Fig. 10 is a horizontal sectional view of the billet heating furnace of Figs. 8 and 9;

Fig. 11 is a fragmentary vertical sectional view of a billet heating furnace illustrating a further modification of the invention; and

Fig. 12 is a vertical sectional view taken at line 12—12 of Fig. 11.

Referring to Figs. 1 to 3 inclusive, a billet heating furnace embodying the invention comprises refractory wall structure including spaced apart side walls 10, end walls 11, a roof 12 and floor 14 providing a substantially closed chamber 15. The side walls 10, end walls 11 and floor 14 are disposed within an outer metallic shell 16 which is supported in an elevated position above a foundation 17 by appropriate framework 18.

A number of vertical rows of radiant burners 19 are mounted and incorporated in the side walls 10 of the furnace. In the embodiment shown five vertical rows of radiant burners 19 are provided in the side walls 10, each row of burners in one of the side walls 10 being directly opposite a row of burners in the opposite side wall. The burners 19 preferably are of a direct fired type capable of producing high radiant heating temperatures in the chamber 15. Although not to be limited thereto, burners which have been found especially suitable are of the kind described and illustrated in Hess Patent No. 2,215,079, granted on September 17, 1940, and, if desired, reference may be had thereto for a detailed description of the burner structure.

Briefly, each burner 19 comprises a molded block of refractory material formed with a cup-shaped cavity facing the interior of the chamber 15 and having a central passage within which is disposed a tube or sleeve 20. Suitable connections are provided for individually supplying a combustible fuel mixture to each burner 19. As shown in Fig. 1, the combustible fuel mixture may be delivered from a source of supply to manifolds 21 to which are connected conduits 22 communicating with the sleeves 20. Suitable controls, including valves 23 connected in the

conduits 22, may be provided to control the pressure and rate at which the combustible fuel mixture is individually supplied to each burner 19.

The combustible fuel mixture, which may be a mixture of a suitable fuel gas and a combustion supporting gas, is supplied to the burners 19 and subdivided at each burner into a plurality of gas streams by distributors or tips 24 fixed to the inner ends of the sleeves 20 which terminate at the cup-shaped cavities. The cup-shaped cavities of the burners 19 serve as radiant heaters and are heated to high incandescent temperatures by reason of the combustion of the gas streams which takes place in the burner cavities.

In the billet heating furnace of Fig. 1, several upright stacks of billets 25 are intermittently moved upwardly through the chamber 15. Since the chamber 15 is considerably longer than it is wide, the chamber in effect forms a relatively narrow vertical channel or passage through which the billets pass. The floor 14 is formed with a number of spaced apart openings or inlets 26 through which the billets 25 enter the bottom part of the chamber 15. At each inlet 26 is provided an annular-shaped hollow collar 27 through which a cooling liquid is circulated in any suitable manner (not shown) to prevent overheating of the billet feeding mechanism by the heated furnace gases passing from the chamber 15 through the inlets.

The billet feeding mechanism comprises a number of inclined roller conveyors 28 upon which the billets 25 are placed and moved downwardly by gravity to regions immediately beneath the inlets 26. While only a single roller conveyor 28 is shown in Fig. 1, it is to be understood that similar conveyors are provided for feeding billets to each of the upright stacks maintained in the chamber 15, as indicated diagrammatically in Fig. 2.

The roller conveyors 28 include first sections at which the billets are supported by full length rollers 29 and second sections immediately beneath the inlets 26 at which the billets are supported at the side edges only by stub rollers 30. When each billet moves onto the second section of a roller conveyor 28, it comes to rest against a stop member 31 which is welded to a channel 32 forming part of the framework 18.

Beneath the stub roller sections of the conveyors and in alignment with the inlets 26 are mounted upright hydraulic cylinders 33. The cylinders 33 are of a conventional type within which are disposed movable pistons (not shown) connected to cylinder rods 34 which extend upwardly through the ends of the cylinders. To the upper ends of the cylinder rods 34 are fixed metal blocks or rams 35 which are of such size that they can move through the second stub roller sections of the roller conveyors, as best shown in Fig. 3.

When the rams 35 move upwardly they contact and engage the bottoms of the billets 25 bearing against the stop member 31. With continued upward movement of the rams 35 the billets 25 supported by the stub rollers 30 are lifted from the roller conveyors and raised against the bottom billets in the upright stacks.

Such bottom billets of the upright stacks are locked in position in annular-shaped members 36 which are fixed to rings 37 welded to parts of the framework 18. A number of balls 38 are held in races at the inner inclined faces of the members 36 and are instantaneously released and moved upwardly when the billets 25 being raised

from the roller conveyors 28 by the rams 35 engage the bottom billets of the upright stacks and move the latter upwardly.

The upward stroke of each cylinder rod 34 is of such length that the billets pass through the members 36 when lifted from the roller conveyors 28. When each cylinder rod 33 reverses its direction of movement and the ram 35 thereafter moves downwardly, the balls 38 move downwardly in their races and instantaneously lock the raised billet in the annular-shaped member 36. In this manner successive billets are moved from each roller conveyor 28 toward the inlet 26 immediately above it, and, after each billet is raised a sufficient distance, it becomes the bottom billet of a vertical stack of billets held in an upright position at the annular-shaped member 36.

After passing through the opening in the roller conveyor 28 adjacent to the stop member 31, each ram 35 acts to hold back the billets 25 on the roller conveyor. When the ram 35 subsequently moves downwardly and passes below the stub rollers 30, the billets are then free to move by gravity on the roller conveyor 28 until the end billet comes to rest against the stop member 31.

When a billet 25 is raised from one of the roller conveyors 28 and becomes the bottom billet in an upright stack, the top billet in the stack is raised through an outlet 39 at the upper part of the chamber 15 to a position adjacent to the upper end of a chute 40. A number of push rods 41 are provided at the top of the billet heating furnace and are intermittently actuated to push onto the chutes 40 the heated billets raised outside the furnace chamber 15. The chutes 40 leading from the several outlets 39 at the upper part of the chamber 15 may deliver the heated billets by gravity to the same forging machine or to different forging machines at which the desired forming operations are effected.

Each cylinder 33 is connected by conduits 42 and 43 to a valve control mechanism 44 to which oil or equivalent motive fluid is supplied under pressure through a conduit 45 from a source of supply and from which such fluid is returned through a conduit 46 to the source of supply. The valve control mechanisms, which may be disposed alongside one another, may be of any conventional type, such as that commonly referred to as a four-way valve mechanism.

Each valve control mechanism 44 is provided with a control member 47 which extends through an opening in an end wall thereof and is of such construction that, when the control member 47 is in its raised or upper position, oil under pressure is delivered from conduit 45 to say, the conduit 42, for example, at which time the other conduit 43 is in communication with the conduit 46 to return oil to the source of supply. Conversely, when the control member 47 is in its lower position, oil under pressure is delivered from conduit 45 to conduit 43, at which time conduit 42 is in communication with conduit 46 to return oil to the source of supply. Thus, oil under pressure may be supplied either through conduit 42 or conduit 43 to the bottom or top sides of the piston within the cylinder 33, respectively, depending upon the position of the control member 47.

In order to control and regulate the position of the valve control member 47, the lower end thereof is provided with a cam follower 48 which rides in a race 49 of a cam 50. The cams 50 pref-

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erably are connected to a common shaft 51 which is driven in any suitable manner, as through suitable speed reducing mechanism from an electric motor, for example. Each cam race 49 is of such shape that the control member 47 operatively associated therewith will be in its upper position for a part of the revolution of the cam, and the several cams 50 on the shaft 51 are staggered so that the control members 47 of the different valve mechanisms 44 will be moved in succession to their upper positions.

Since each cylinder rod 34 of a cylinder 33 will be moved upwardly during the interval of time the control member 47 associated with such cylinder 33 is in its upper position, as just explained, it will be apparent that the billets 25 will be raised in succession from the several roller conveyors 28 and that the stacks of billets will be raised in succession in the chamber 15. Hence, the billets 25 will be successively raised in the several stacks to positions adjacent the upper ends of the chutes 40.

Each push rod 41 is actuated to push a heated billet 25 onto the chute 40 immediately after it is lifted outside the heating chamber 15. This is accomplished by pivotally connecting each push rod 41 to one arm of a bell crank 52 which is pivotally mounted to the shell 16, as indicated at 53. The other arm of each bell crank 52 is pivotally connected to one end of a cylinder rod 54 whose opposite end is fixed to a piston (not shown) movable within a cylinder 55 supported at 56 to the metallic shell 16.

The opposite ends of the cylinder 55 are connected by conduits 57 and 58 to the conduits 42 and 43, respectively. In the conduit 57 is connected a valve 59 of known type, usually referred to as a sequence valve, which is adjusted so that oil under pressure will pass from conduit 42 into conduit 57 only after the cylinder rod 34 approaches and reaches the upper limit of its movement and the full line pressure builds up in the conduit 42. When this condition occurs, at which time the stack of billets has been raised so that a heated billet is outside the heating chamber 15 adjacent the chute 40, oil will then pass through conduit 57 to the bottom part of the cylinder 55 and below the piston therein to raise the cylinder rod 54 and actuate the push rod 41 to push the raised billet onto the chute 40.

When oil is supplied under pressure through conduit 43 to the upper part of each cylinder 33, the direction of movement of the cylinder rod 34 is reversed and the ram 35 fixed thereto moves downwardly. When this occurs oil under pressure will also be supplied to conduit 58 and cause the cylinder rod 54 to move downwardly and return the push rod 41 to the position shown in Fig. 1, so that the push rod will not interfere with the raising of the next heated billet at the top of the stack.

It will now be understood that an improvement has been provided in billet heating furnaces for continuously feeding billets in succession to one end of a vertical stack which is intermittently moved through a heating chamber and from the opposite end of which heated billets are immediately delivered to a forging machine. In the embodiment of the invention just described wherein the billets 25 are relatively short and of considerable cross-sectional area, it is possible to maintain upright stacks of such billets in which each billet rests directly upon the billet beneath it. By providing outlets 39 which are relatively small and in which clearance for the

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heated billets passing therethrough is at a minimum, each stack of billets will remain in an upright position even when the billets at the upper end of a stack should contact the side wall of an outlet 39 in the event the top billet being pushed toward the chute 40 tends to stick to the billet immediately beneath it.

As best shown in Fig. 2, the vertical rows of radiant burners 19 at the opposite side walls 11 are directly opposite the vertical stacks of billets 25 passing through the heating chamber 15. In this way the billets are effectively heated at opposite sides thereof to promote rapid heating of the billets to the desired elevated temperature. In effect, the spaced apart side walls 11 form a relatively narrow channel through which the billets pass, and the radiant burners 19 are at close range to the billets.

When the combustible gas mixture supplied to the radiant burners 19 consists of a mixture of ordinary city gas and air, for example, the cavities of the burners directly opposite the burners are heated to incandescent temperatures in a range of about 2700° F. to 3000° F. Hence, the billets 25 are heated by all of the heating effects developed in the chamber 15 including the highest temperature radiant heating component which is projected directly from the burner cavities to the billets. Moreover, the billets are completely enveloped in an atmosphere formed by the high temperature products of combustion produced in the burner cavities. Thus, the radiant heating of the billets is augmented by convection heating resulting from the high temperature furnace gases sweeping over the surfaces of the billets before passing through the restricted inlet and outlet openings 26 and 39, respectively.

Figs. 4 and 5 illustrate a modification of the invention which differs from the embodiment just described in that the billets 25a are in the form of long bars. The billet heating furnace in Fig. 4 is generally like that shown in Figs. 1 to 3 and similar parts are referred to by the same reference numerals. As shown in Figs. 4 and 5, the radiant burners 19 are arranged in the side walls 10 in three horizontal rows, the burners in adjacent rows being staggered with respect to each other.

Adjacent to the bottom of the floor 14 is provided a hollow wall member 27a through which a cooling liquid is circulated in any suitable manner. Likewise, a hollow jacket 27b is provided at the side of the roof 12 at which the push rod 41 is located. The cooling jacket 27b is also formed with inlet and outlet openings (not shown) through which a cooling liquid is circulated. The cooling jackets 27a and 27b serve as thermal shields to prevent overheating of parts of the billet feeding and discharge mechanisms positioned closely adjacent to the refractory wall parts of the chamber at the inlet 26 and outlet 39.

The bars 25a in Fig. 4 slide by gravity down an inclined ramp which extends lengthwise of the heating furnace between the end walls 11. When the ram 35 is in its lower position, as shown in Fig. 4, the lowermost bar 25a on the ramp moves sideways on top of the ram and comes to a stop against a stop member 31a. As shown in Fig. 5, the ram 35 at its opposite ends is vertically movable in guideways 60 fixed to parts of the framework 18 beneath the end walls 11.

The ram 35 is alternately raised and lowered by a hydraulically operated cylinder 33 through

a lever mechanism comprising a pair of spaced apart levers 61, each of which is pivoted at 62 at an intermediate region thereof. To the cylinder rod 34 is fixed a horizontal shaft 63 to which the outer ends of the levers 61 are pivotally connected. The inner ends of the levers 61 are pivotally connected to the underside of the ram 35, as indicated at 64 in Fig. 5.

Two spaced apart locking members 36 generally like that previously described are provided in the modification being described, as indicated in dotted lines in Fig. 5, the locking members in this instance being of a type which will permit the bars 25a to pass upwardly therethrough when raised by the ram 35; and, when the ram is subsequently lowered, to hold and support the stack of bars in which the bottom bar thereof is locked at spaced apart regions at the locking members 36.

In the modification of Figs. 4 and 5, vertical guides 65 are provided at the end walls 11 at opposite sides of the stack of bars 25a. The guides 65 extend upwardly from the hollow wall 27a at the inlet 26 and terminate about midway between the roof 12 and floor 14. From the upper ends of the guides 65 the bars 25a remain in a stable upright position without any guiding assistance. As shown in Fig. 5, the guides 65 may be formed of hollow metal members through which a cooling liquid can be circulated in any suitable manner.

Although a single push rod 41 is illustrated for pushing the raised heated bars 25a toward the chute 40, two or more such push rods 41 may be provided at spaced apart regions of the roof 12.

In Fig. 4 the cylinder 33 is positioned at one side of the billet heating furnace rather than beneath the furnace, as in the embodiment first described. However, the operation of the hydraulic cylinder 33 in Fig. 4 is like that of the corresponding hydraulic cylinder 33 of Fig. 1. In the modification being described, only a single valve control mechanism 44 and single cam 50 are required, and the operation of these parts is the same as explained above in connection with the embodiment of Fig. 1.

A further modification of the invention is illustrated in Figs. 6 and 7 which differs from the previous embodiments in that the billets 25b are in the form of round elongated bars and pass downwardly through the heating chamber 15. In Figs. 6 and 7 the bars 25b rest one upon the other and are guided through the chamber 15 by hollow guides 65a in the form of pipes.

As shown in Fig. 7, two guides 65a are provided at each side of the bars 25b, such guides including substantially straight vertical sections adjacent the inlet 26b and diverging sections extending downwardly from the vertical sections. With this arrangement different lengthwise portions of the bars 25b will only momentarily engage and contact the guides during downward movement of the stack of bars, so that the bars over their entire lengths will more or less be heated substantially uniformly by the time the bars reach the outlet 39b at the bottom of the chamber 15. The guides 65a at their lower ends pass through the side walls 10, and at the upper ends are bent and overlie the roof 12. A cooling liquid, such as water, for example, is circulated through the hollow guides 65b to prevent overheating of these parts.

The bars 25b are automatically discharged from the lower end of the chamber 15 by a num-

ber of cam members 66 fixed to a hollow shaft 67 journaled at its ends in parts of the framework 18, as indicated at 68 in Fig. 7. A cooling liquid, such as water, for example, is circulated through the shaft 67. The shaft 67 is driven from an electric motor 69 through suitable speed reducing mechanism 70.

When the cams 66 are driven by the shaft 67, the bottom bars 25b in the vertical stack are intermittently picked up by the notched regions of the cams and bodily moved sideways toward the downwardly extending outlet 39b into which the bars fall from the cams and roll by gravity through a spring-hinged flap door 71 which is normally biased to its closed position. Immediately above the outlet or chute 39b is provided a hollow jacket 27c through which a cooling liquid like water is circulated.

In order to initially load the billet heating furnace of Figs. 6 and 7, a pair of water cooled pipes 72, each of which is bent into the form of a U, is arranged for vertical movement in the heating chamber 15. During normal operation and when the heating furnace is loaded with billets, the bends of the U pipes 72 encircle the hollow shaft 67 and the spaced apart arms thereof extend downwardly through passages 73 in the floor 14. A vertically extending feed screw 74 depends downwardly from the heating furnace, the lower end of which is connected to a speed change mechanism 75 in turn driven by an electric motor 76. The feed screw 74 is provided with a threaded nut 77 having arms 78 extending outwardly therefrom to which the straight portions of the pipe 72 are fixed, as by welding, for example.

When the billet heating furnace of Figs. 6 and 7 is initially loaded the feed screw 74 is driven in such direction by the motor 76 that the nut 77 travels upwardly and raises the U-pipes 72 between the hollow guides 65a. When the bends of the pipes 72 are at the upper part of chamber 15 adjacent to the inlet 26b, the feed screw 74 is brought to a stop. Bars 25b are then positioned between the guides 65a at the inlet 26b, such bars being supported by the raised bends of the U-pipes 72. The feed screw 74 is then driven in such a direction that the nut 77 and pipes 72 fixed thereto move downward slowly, and, as the bends of the pipes are lowered, bars 25b are positioned between the guides 65a at the inlet 26b until a stack of bars is loaded in the heating chamber 15, as shown in Fig. 6. During operation of the billet heating furnace the bends of the pipes 72 encircle the hollow shaft 67 and cooling liquid is circulated therethrough to prevent undesirable overheating of these pipes.

A further modification of the invention is shown in Figs. 8 to 10 inclusive which is generally like the modification of Figs. 6 and 7 in that the billets are in the form of round elongated bars 25b and moved downwardly through the heating chamber 15. The guides 65b in the embodiment of Figs. 8 to 10 differ from the hollow guides shown in Figs. 6 and 7 in that they are formed of refractory material. The guides 65b are vertically disposed within the chamber 15 and project toward the interior of the chamber from the side walls 10 to which they are fixed. The guides 65b are in the form of short plates which are arranged at the side walls 10 in staggered relation, as shown in Fig. 9, so that each portion of the bars 25b will not be continuously contacting the guide plates during its

downward movement through the heating chamber.

In order to initially load the billet heating furnace of Figs. 8 to 10, elevator bars 72a are provided which extend downwardly from the bottom of the heating chamber 15 through passages 73a in the floor 14. Two or more bars 72a may be provided, as best shown in Fig. 9, and any suitable feed mechanism like that shown in Figs. 7 and 8 may be employed for simultaneously raising and lowering the bars 72a to initially load the furnace. The bars 72a may be formed of suitable high temperature alloy and formed with enlarged heads which are received in recesses in the floor 14 when normal operation of the billet heating furnace is underway.

The lowermost guide plates 65b are formed and arranged so that the bottom bars in the vertical stack can be intermittently pushed sideways into the chute or outlet 39a. This is accomplished by providing a pair of hydraulically operated cylinders 33a at one side of the furnace whose cylinder rods 34a pass through a side wall 10 and are connected to rams 35a, as indicated in Figs. 8 and 10.

The cylinders 33a are connected by conduits 42 and 43 to a common valve control mechanism 44, like that shown in Fig. 1 and previously described, for alternately moving the cylinder rods 34a back and forth. The valve control mechanism 44 is provided with a control member 47 to which is fixed a cam follower 48 which rides in a race 49 of a cam 50 like that previously described and shown in Fig. 1. The shaft 51 to which the cam 50 is fixed may be driven in any suitable manner, as by suitable speed reducing mechanism in turn driven by an electric motor, for example.

A still further modification of the invention is illustrated in Figs. 11 and 12 which is generally like that shown in Figs. 6 and 7 in that the hollow guides 65b are in the form of pipes for guiding a stack of round elongated bars downwardly through the heating chamber 15. In Figs. 11 and 12 hydraulically operated cylinders 33a like those described and shown in Figs. 8 and 10 are provided for intermittently pushing the bottom billets sideways.

In addition, a hydraulically operated cylinder 33b is provided at one end of the billet heating furnace whose cylinder rod 34b passes through an opening in an end wall 11 and acts to push the displaced bottom billets lengthwise through an outlet 39c formed in the opposite end wall 11 of the billet heating furnace.

The cylinder 33b may be connected by conduits to the conduits adapted to supply motive fluid alternately to the opposite ends of the cylinder 33a, in the same manner as the cylinder 55 in Fig. 1 is connected by conduits 57 and 58 to the conduits 42 and 43 for the cylinder 33. Further, a sequence valve like the valve 59 in Fig. 1 may be connected in one of the conduits connected to an end of the cylinder 33b, whereby the cylinder rod 34b will be actuated immediately after each bottom billet in the stack is moved sideways and displaced and when the full line pressure builds up in the conduit connected to move and actuate the rams 35a toward the stack of billets.

It is to be understood that suitable vertical bars like the bars 72a in Figs. 8 and 9 may be employed in the billet heating furnace of Figs. 11 and 12, whereby the furnace may be initially loaded with round elongated bars.

In view of the foregoing, it will now be under-

stood that an improved billet heating furnace has been provided for continuously heating billets by bodily moving an upright stack of such billets vertically through a heating chamber having inlet and outlet openings for the billets at opposite vertical ends of the chamber. In each of the embodiments shown and just described, structure is provided whereby an upright stack of billets may be maintained in a stable position in a heating chamber. Also, in the several embodiments each stack of billets is transported vertically through a heating chamber by mechanism having parts thereof at the vicinity of one of the chamber openings, such mechanism being intermittently operable to alter the size of the stack of billets by a single billet.

More specifically, each embodiment of the improved billet heating furnace embodies holding means for supporting an upright stack of billets in the heating chamber. Each stack of billets in the several embodiments is transported vertically through a heating chamber by mechanism which is associated with the stack holding means and intermittently operable to modify the size of the stack of billets by a single billet. Stated another way, the mechanism associated with the holding means for supporting each stack of billets is intermittently operable to replace the bottom billet of the stack of billets with another billet.

In the embodiments shown and described above, the holding means for supporting the stacks of billets act against the bottom billets of the stacks. In the embodiments of Figs. 1 and 4, the stacks of billets are transported vertically upward by intermittently feeding a billet to the bottom of the stacks, while in the embodiments of Figs. 6, 8 and 11 the stacks of billets are transported vertically downward by intermittently removing and discharging the bottom billets from the stacks.

While several embodiments of the improved billet heating furnace have been shown and described, I do not wish to be limited to the particular arrangements set forth, and I intend in the following claims to cover all modifications and changes which do not depart from the spirit and scope of the invention.

What is claimed is:

1. A billet heating furnace comprising means providing a refractory lined chamber having spaced apart side walls forming a vertically extending channel therebetween, holding means including notched rotatable cam means operable to act against the bottom billet of an upright stack of billets adapted to be maintained in the channel, said chamber having inlet and outlet openings for the billets at the upper and lower ends, respectively, of the channel, means to transport the stack of billets vertically downward through the channel including mechanism operable to rotate the notched cam means to intermittently remove the bottom billet from the stack, and means for firing said chamber to heat the billets to an elevated temperature during transport through the channel.

2. A billet heating furnace comprising means providing a refractory lined chamber having spaced apart side walls forming a vertically extending channel therebetween, holding means embodied in the furnace operable to act against the bottom billet of an upright stack of billets adapted to be maintained in the channel, said chamber having inlet and outlet openings for the billets at the upper and lower ends, respectively,

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of the channel, means to transport the stack of billets vertically downward including mechanism associated with the holding means which is intermittently operable to remove the bottom billet from the stack, means vertically movable within the channel for its full length to facilitate initially loading the furnace with billets to provide a stock of billets therein, and means for firing said chamber to heat the billets to an elevated temperature during transport through the channel.

FREDERIC O. HESS.

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