

March 14, 1944.

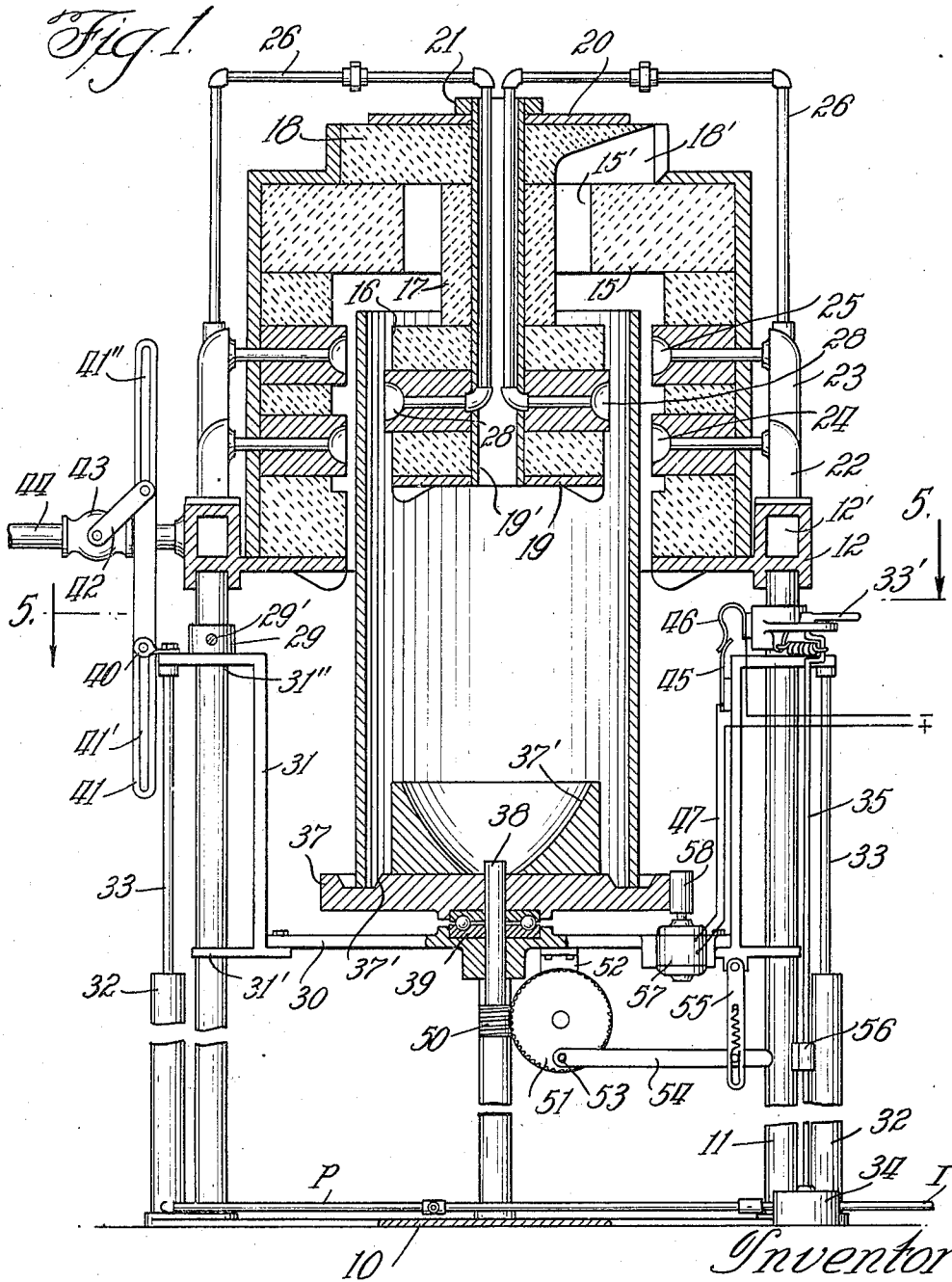
N. L. ETTEN

2,344,035

TUBE NOSE FORGING FURNACE

Filed Sept. 26, 1942

4 Sheets-Sheet 1



Inventor
Nicholas L. Etten
By: Jefft + Jefft. Attys.

March 14, 1944.

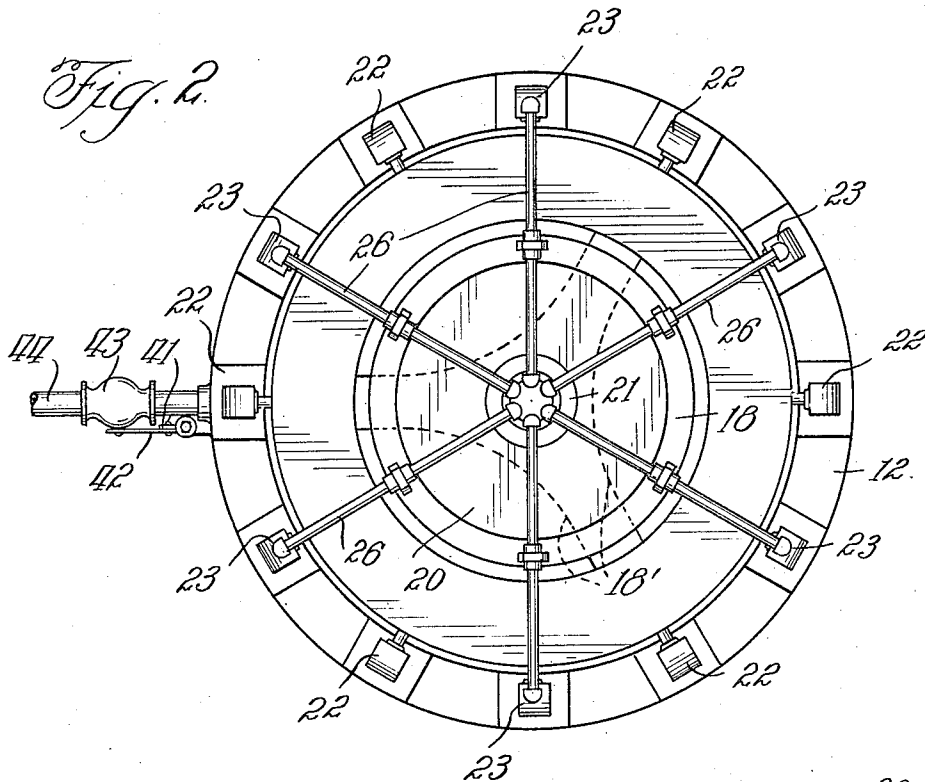
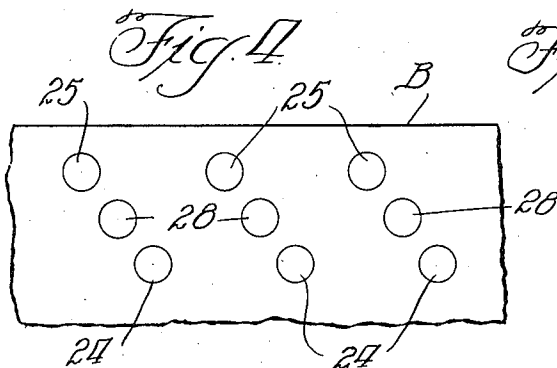
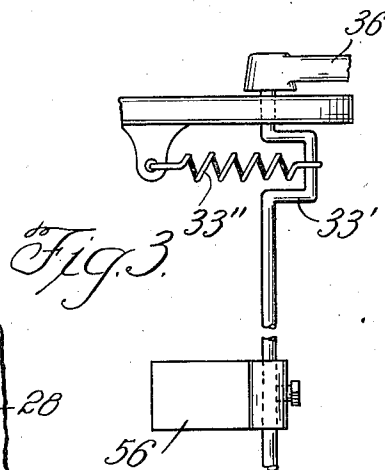
N. L. ETTEN

2,344,035

TUBE NOSE FORGING FURNACE

Filed Sept. 26, 1942

4 Sheets-Sheet 2



Inventor:
Nicholas L. Etten
By: Tefft + Tefft.
Att'ys.

March 14, 1944.

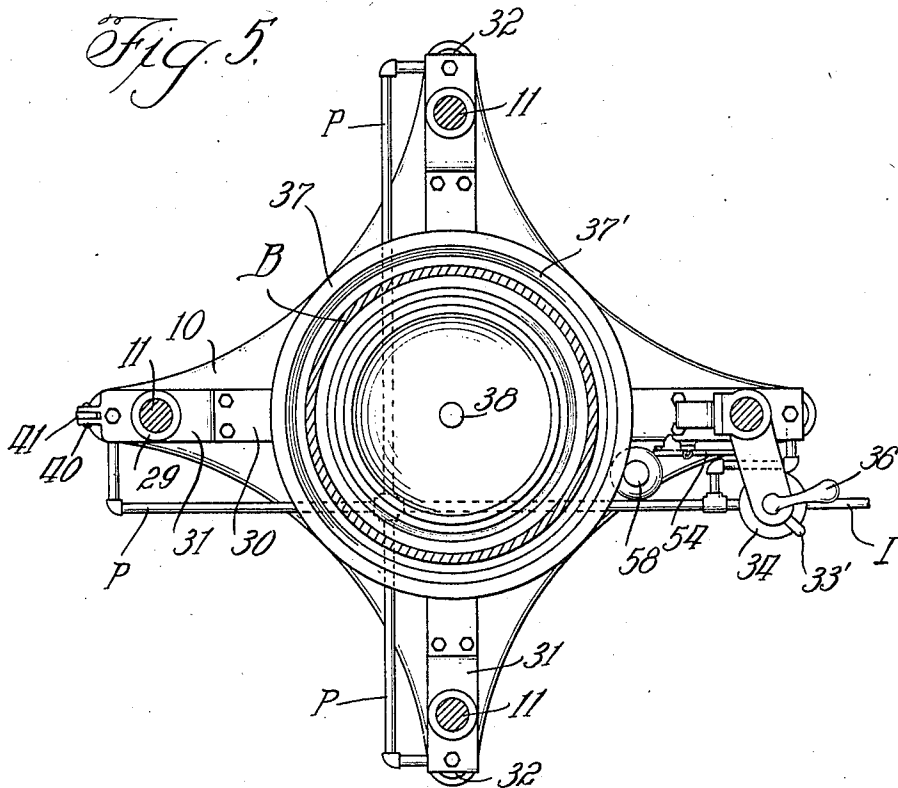
N. L. ETTEN

2,344,035

TUBE NOSE FORGING FURNACE

Filed Sept. 26, 1942

4 Sheets-Sheet 3



Inventor:
Nicholas L. Etten
By Tefft + Tefft. Att'y.

March 14, 1944.

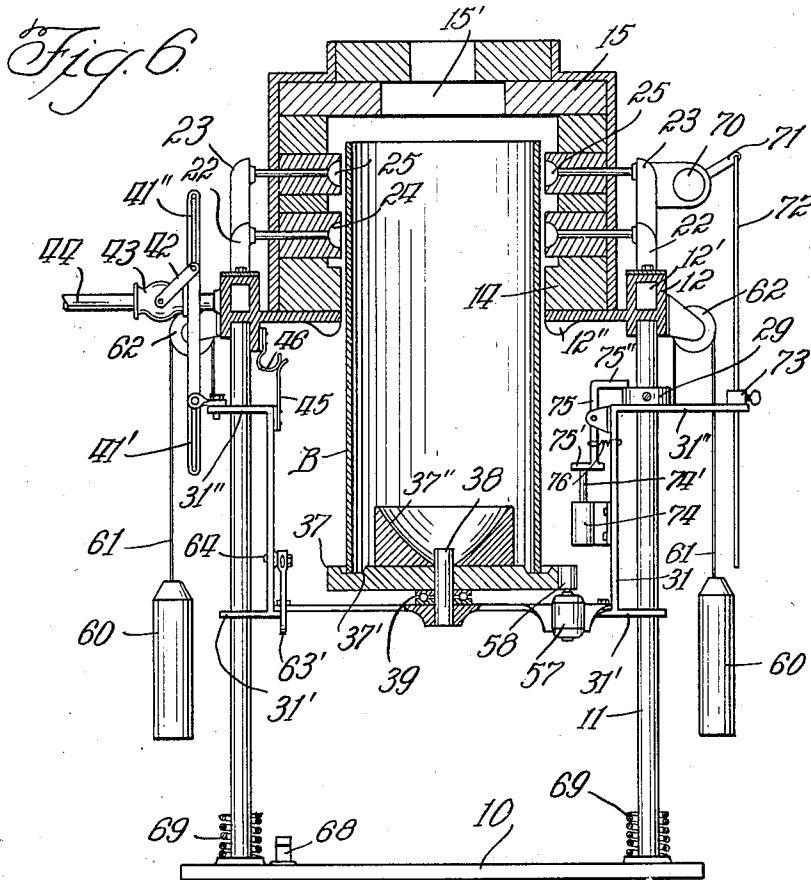
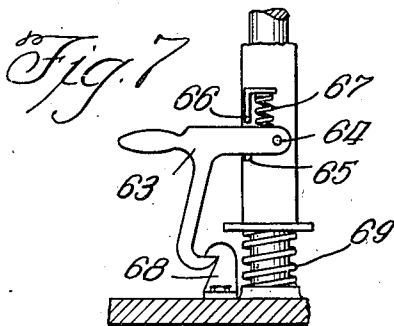
N. L. ETTEN

2,344,035

TUBE NOSE FORGING FURNACE

Filed Sept. 26, 1942

4 Sheets-Sheet 4



Inventor:
Nicholas I. Etten
By: Tefft & Tefft.
Att'ys.

UNITED STATES PATENT OFFICE

2,344,035

TUBE NOSE FORGING FURNACE

Nicholas L. Etten, Waterloo, Iowa

Application September 26, 1942, Serial No. 459,869

6 Claims. (Cl. 263—7)

This invention relates to furnaces for heating metals for forging, and particularly relates to furnaces for heating the ends of tubes for forging noses thereon. Although the invention has wider application, it will be disclosed and described as a furnace for heating tubes for the forging of bombs.

In forging noses on bomb tubes, it is desirable and under some conditions absolutely necessary to confine and control the heat in such a manner that the end portion to be forged is heated to forging heat (about 2200° F.), while the balance of the tube is held at low temperature (under 500° F.) with a sharp break-off (under two inches) between the heated and unheated portions.

In conventional forging furnaces using oil or gas fuel wherein the work is heated by the hot gases of combustion, water cooled rings have been utilized in attempts to control the heat and to prevent it from running down the tube. Similarly, air blasts have been directed on the tube to accomplish the same result. Such devices have proven troublesome, expensive and far from effective. Conventional methods of utilizing radiant heat for heating tubes have been tried, and although this is more effective than the other methods, the normal procedures have fallen short of success.

The particular object of this invention is to provide a tube heating furnace wherein the heat is applied rapidly and uniformly over the forging area by radiant heat to effect the heating of the forging area to high forging temperature before the balance of the tube can be heated by conduction.

Another object is to provide a tube heating furnace to accomplish the result above specified, and at the same time to prevent the formation of scale over the forging area by preventing oxidation.

And a further object is to provide furnace mechanism wherein tubes may be properly heated on the forging area under mechanically controlled conditions not subject to tinkering by the operator.

Other objects and benefits will be disclosed in the following descriptions and drawings in which

Fig. 1 is a cross sectional elevation view of the furnace for heating large tubes with inside and outside radiant burners;

Fig. 2 is a top plan view of the furnace shown in Fig. 1;

Fig. 3 is a broken elevational view of the hydraulic control valve as will later be explained;

Fig. 4 is a diagrammatic development of the

tube section showing the pattern of the radiant burner application to the tube;

Fig. 5 is a sectional top plan view of the furnace shown in Fig. 1 as it would appear on the section lines 5—5 of Fig. 1;

Fig. 6 is a cross sectional elevation view of an optional type of furnace to that shown in Fig. 1 as will later be explained; and

Fig. 7 is an enlarged broken side elevation view of the lock and lift mechanism of the furnace shown in Fig. 6.

Now referring to the drawings and at the outset to Fig. 1, a base 10 mounts four tubular support members 11, supporting a cast iron ring 12 having an integral gas manifold 12' therein. The ring 12 supports a fire brick inverted bell oven having side walls 14, a top 15 and an inner oven member consisting of three sections 16, 17 and 18 held together by a base member 19, a tube 19', a top cap 20 and a clamp nut 21 as shown.

On the top of the manifold 12' and mounted a series of six low manifold connectors 22 and six high manifold connectors 23 which distribute the gas in a conventional manner to a series of six lower radiant burners 24 and six top radiant burners 25 as shown. Six distributor pipes 26 deliver gas to a series of six inner radiant burners 28. By this arrangement it will be appreciated that provision is made for distributing gas to twelve outside burners 22 and 23 and six inside burners 28 in accordance with the pattern development of the application of these burners to the end of the tube as clearly shown in Fig. 4.

A slideable turn-table base 30 is mounted on the support tubes 11 by means of four guide brackets 31 having lower bearing members 31' and upper bearing members 31'' engaging the support tubes 11 to permit easy sliding movement of the support base 30 upwardly and downwardly on the support tubes 11. Such movement is actuated by two hydraulic cylinders 32 mounted on the base 10 and having piston rods 33 engaging the extensions 31' of the slide bracket 31. The upward movement of the base 30 is stopped by the adjustable rings 29 fixed on the tube 11 by the pin 29'. Fluid under pressure is delivered by an inlet pipe I to a hydraulic valve 34 and delivered to the hydraulic cylinder 32 by conventional piping P. The valve 34 is actuated by a hand lever 36 through a connecting rod 35 and the valve is held in open position when the handle 36 throws the crank 33' over center where it is held in that position by a spring 33'' as clearly shown in Figs. 2 and 3. It will be understood that by this arrangement when the rod 33 is moved in reverse

rotation to the point where the crank 33' is forced on the other side of the center, the spring 33'' will then automatically reverse the rotation of the rod 33, shut off the pressure fluid from the inlet pipe 37 and permit the fluid in the cylinders 32 to return to the hydraulic reservoir as will be understood as a conventional three-way valve control arrangement. This reverse movement is accomplished automatically by a special trip mechanism as will later be explained.

Mounted on the slideable base 30 is a turn-table 37 arranged to support the bomb tube B by the groove 37' for the nose heating operation and by the support bosses 37'' for the tail forming operations after the nose has already been formed. The turn-table 37 is supported by a shaft 38 and a conventional thrust bearing 39 as shown. The shaft 38 extends somewhat above the turn-table 37 in order to extend into the hole of the nose of the bomb B and thus assist the support bosses 37' in supporting the bomb for the tail heating operation.

When the bomb B is lifted into heating position within the bell oven as shown in Fig. 1 by the hydraulic cylinders 32 and the piston rods 33, a forked bracket 40 attached to the end of the bracket member 31' lifts a link 41 attached to an arm 42 of a conventional butterfly valve 43 to open the butterfly valve 43 and permit the full flow of gas from the inlet pipe 44 through the manifold 12' and the connector members 22, 23, 26 and 27 to apply full heat to the bomb tube B through the radiant burners 24, 25 and 28. Upon reverse movement of the base 30 the link 41 through the slots 41' and 41'' reverses the movement of the butterfly valve handle 42 so that the gas is turned low and thus conserved when the bomb B is not in heating position within the bell oven. It will be understood by this arrangement there is provided means whereby the radiant burners are only operating at full force when the bomb tube B is in heating position. At all other times, the burners are turned low to conserve the gas. It will be appreciated that under this system of heating tubes only radiant heat is utilized and in as much as the burners immediately become radiant when the gas is turned on, the furnace is at full effectiveness almost instantaneously. In order to enhance this effect only the highest quality of insulating fire brick are used in the bell oven. These high quality insulating fire brick hold the heat very effectively and in fact only become red hot for a fraction of an inch from their outside surface.

It will be appreciated by a study of Fig. 1 that the radiant burners are held very close to the surface of the tube. In fact, the burners are preferably placed at a fraction of an inch away from the tube surface. The full purpose of this arrangement will later be explained in more detail.

When the bomb tube B is raised into heating position, an electrical contact switch 45 and 46 is engaged and thereupon an electric circuit 47 is closed which actuates a motor 57 to which is attached a small friction pulley 58 engaging the outside periphery of the turn-table 37 and thus rotates the bomb tube B. By this arrangement, it will be obvious that the greatest uniformity of heat application is obtained over the entire heating area because the radiant burners 22, 23 and 28 are spaced accurately to cover the entire heated area and with the bomb tube B rotating,

the maximum uniformity of heat application is obtained.

The foregoing numerals and explanation, with the exception of those describing the hydraulic mechanism, apply equally well to Fig. 1 and the optional type of furnace shown in Fig. 6.

Now in Fig. 1 the automatic control of the furnace is accomplished mechanically. When the turn-table 37 is revolved by the friction pulley 58 and the motor 57, a worm 50 attached to the shaft 38 actuates a worm gear 51 mounted on a bracket 52 and carrying a push rod 54 supported by a bracket 55 while pivotally attached to the worm gear 51 by a pin 53. It will be appreciated that with a single thread worm 50 and a worm gear 51 having about two hundred teeth, the worm gear 51 will revolve very slowly. By adjusting the size of the friction pulley 58 the rotation of the worm gear 51 is adjusted to make one revolution in some three to four minutes depending upon how long it is necessary to heat the bomb tube B to proper forging temperature (about 2200° F.). Therefore, on each revolution of the worm gear 51 the push bar 54 contacts the trip lever 56 on the valve rod 33 and pushes the crank 33' over center where it is moved to full off position by the spring 33'' as heretofore explained.

Now explaining the operation of the mechanism for Fig. 1, the operator places the bomb tube B on the turn-table 37 and actuates the hydraulic lever 36 to "on" position. The base 30 is then raised to "up" position as shown in Fig. 1 where it is stopped by the stop collar 29. At this point the electric circuit is closed by the switch 45 and 46 and the turn-table 37 is revolved by the motor 57. At the same time, the butterfly valve 43 is opened by the mechanism 40, 41 and 42 and the full pressure of gas is permitted to flow to the radiant burners and thus the full radiant power of the burners is applied to the forging area of bomb tube B. In order to operate the furnace effectively, it is necessary to have a gas fuel containing the proper amount of air necessary for combustion because the burners are placed in close proximity to the tube in order to heat the tube by radiant heat alone and without depending upon any outside air for combustion. Under these conditions, the forging area of the tube is covered by burnt gases which practically exclude oxygen having contact with the heated tube surface. By this arrangement the tube is heated to forging temperature with practically no scale. Moreover the tube is rapidly and uniformly heated to high forging temperature and thus the optimum heating condition is obtained.

In Fig. 1 which is the type of furnace preferable for large tubes the heat is applied by radiant burners both inside and outside of the tube. In the larger tubes the wall thickness is naturally greater, and by this arrangement the larger and thicker tubes may be heated in practically the same time as the smaller and lighter tubes.

Now referring to Fig. 6, this optional type of furnace is for smaller and lighter tubes. The inside burners are omitted and in place of the hydraulic mechanism for raising and lowering the mechanism there is substituted a counter-balanced manual mechanism. Counter-weights 60 supported by cables 61 and pulleys 62 are attached to the brackets 31' as shown. The counter-weights are adjusted so that when the mechanism is in upward position it will drop slowly unless supported by other means. This support is ar-

ranged by a catch lever 75 having dog extension 75' extending over the stop collar 29. Under normal conditions a spring 76 would release the dog 75' and permit the mechanism to drop, but when the electric circuit is formed by the switch 45 and 46 to drive the motor 57 and friction pulley 58, a solenoid valve 74 in the same circuit having a rod extension 74' bears against a lower extension 75' of the latch lever 75 and holds the mechanism in upward heating position with the bomb B being rotated by the turn-table 37 and with full gas pressure being applied to the radiant burners 24 and 25. When the mechanism is raised to upward position as shown in Fig. 6, a conventional time switch 70 is set to the desired position by means of an arm 71, a rod 72 and a thumb nut 73 on the rod 72 abutting an extension of the bracket 31'. The time switch can be adjustably set by the thumb nut 73 to any desired length of time as determined by the dial on the time switch 70. It will be understood that the time switch will automatically turn off at the expiration of the set time and thereupon the electric support will be broken, the solenoid 74 will fail to hold the latch 75 in position and the mechanism will drop to place the bomb in lowered discharge position. The drop of the mechanism will be cushioned by springs 69 around the support tubes 11 and will be held in lowered position by the latch lever 63 having a dog 63' engaging a latch bracket 68 as clearly shown in Fig. 7. This latch lever 63 is pivotally supported on the bracket 31 by pivot pin 64. It is urged downwardly into latching position by a compression spring 67 and stopped in locked position by the boss 65. When it is again desired to heat a bomb tube, the tube is placed on the turn-table 37, the operator grasps the latch lever 63 and with a slight upward effort disengages the latch dog 63' from the latch 68 and moves the mechanism to operating position.

Now I desire to disclose and explain that the burner arrangement in the bell furnace is proportioned to deliver on the forging area of the tube a large excess of heat over that normally considered necessary or advisable. As a matter of fact, the amount of radiant heat delivered by the burners is such that if the tube were not present within the bell the refractory face of the burners and the fire brick would be extremely short-lived, and the furnace would prove quite impractical. This excess of heating capacity is provided in order to heat the forging area very rapidly by radiant heat. In fact, at a sufficiently rapid rate to bring the temperature of the forging area up to forging heat before the heat can be conducted along the tube. By this method, a sharp line of differentiation is made between the heated and unheated portion of the tube. With the forging area of the tube at forging temperature (about 2200° F.), two inches below the forging area the tube will be black and will not greatly exceed 500° F. in temperature. This permits rapid nosing of the tube without danger of collapse at the point where the ogive meets the straight section of the wall.

It will further be appreciated that by directing this excess volume of radiant heat and gases on the tube over the forging area, with said gases being completely burnt and oxygen free, the forging area of the tube is enveloped in these gases to the exclusion of free oxygen, and therefore the tube is heated with practically no scale.

It will be also appreciated that the heat is so rapidly delivered by radiation into the tube at the forging area that unless the tube is removed

promptly when the forging temperature is reached, the tube will be heated beyond the forging temperature and damaged by melting or burning.

I claim:

1. In a tube-nose forging furnace, a base, supports on said base, an inverted bell-like heating oven mounted on the supports, radiant gas burners inserted in the bell projecting radially toward and closely adjacent the tube heating area, a slidable tube base mounted on the supports for supporting the tube in upper heating position and lowered loading-discharge position, means to slide the tube base between upper and lower position including automatic means for lowering the base, a turn-table on the tube base for rotating the tube, means to rotate the turn-table, automatic means to control rotation of the turn-table to cause rotation in upper position and to stop rotation in lower position, automatic means to operate the gas burners at full capacity in upper position of the turn-table and idle the burners in lowered position and means for timing the automatic movements to permit the tube to be heated to desired forging temperature and then lowered to discharge position.

2. In a tube-nose forging furnace, a base, supports on said base, a bell-like heating oven mounted on the supports, radiant gas burners inserted in the bell projecting radially toward and closely adjacent the tube heating area, a slidable tube base mounted on the supports for supporting the tube in heating position and in loading-discharge position, means to slide the tube base between heating and discharge positions, a turn-table on the tube base for rotating the tube, means to rotate the turn-table, automatic means to control rotation of the turn-table to permit rotation in heating position and to stop rotation in discharge position, automatic means to operate the gas burners at full capacity in heating position of the turn-table and idle the burners in discharge position and means for timing the automatic movements to permit the tube to be heated to desired forging temperature and then moved to discharge position.

3. In a tube-nose forging furnace, a bell-like heating oven, radiant gas burners inserted in the bell projecting radially toward and closely adjacent the tube heating area, means to insert the tube into the bell for heating, automatic means to remove the tube to discharge position when heated to forging temperature, automatic means to operate the radiant burners at full capacity in heating position and to reduce the operation to idling capacity in discharge position, and means for timing the automatic movements to permit the tube to be heated to desired forging temperature and then moved to discharge position.

4. In a tube-nose forging furnace, a bell-like heating oven, radiant gas burners inserted in the bell projecting radially toward and closely adjacent the tube heating area, means to insert the tube into the bell for heating, automatic means to remove the tube to discharge position when heated to forging temperature, automatic means to rotate the tube when in heating position and to stop rotation in discharge position, and means for timing the automatic movements to permit the tube to be heated to desired forging temperature and then moved to discharge position.

5. In a tube-nose forging furnace, a bell-like heating oven, radiant burners utilizing premixed

gas-air fuel inserted in the bell projecting radially toward and closely adjacent to the tube-nose heating area, the arrangement providing sufficient radiant heat on the tube-nose to rapidly heat the tube to forging temperature, and automatic means to adjust the burners to full heating capacity when the tube is inserted and to idling capacity when the tube is withdrawn from the bell, the proportions and arrangements providing extremely high heating capacity when the tube is inserted, the excessive heating capacity

being beyond the economic range of gas consumption and refractory life, and with the success of the arrangement depending on reducing the burners to idling capacity when the tube is withdrawn.

- 5 6. A tube-nose forging furnace as specified in claim 5; with the burners being arranged to envelope the tube-nose in oxygen free gases to exclude free oxygen and to prevent the formation of scale on the forging area of the tube.

10
NICHOLAS L. ETEN.