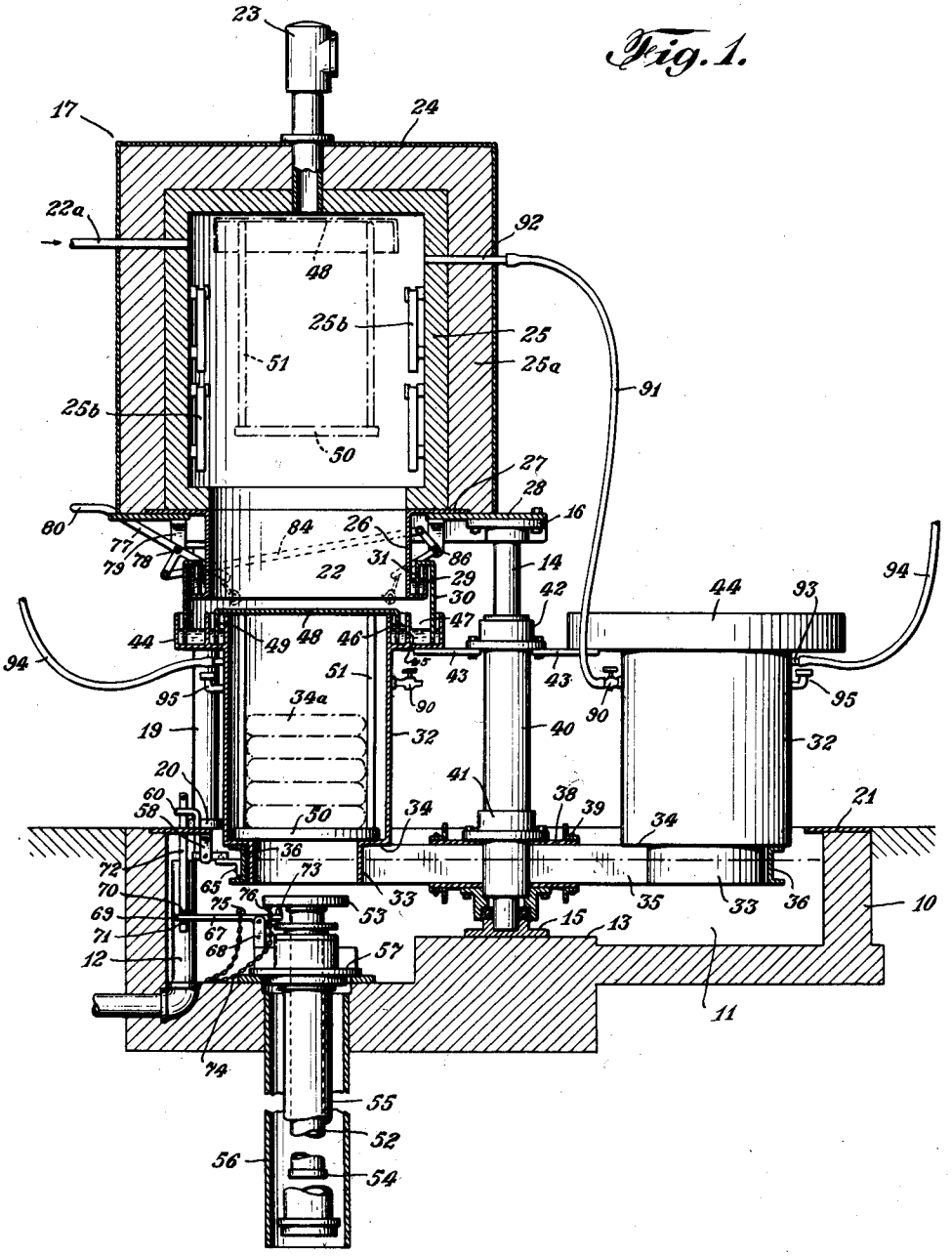
Sept. 13, 1932. C. F. KENWORTHY 1,876,960

ANNEALING FURNACE

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Fig. 1.



INVENTOR.
Charles F. Kenworthy
BY H. G. Manning
ATTORNEY

Sept. 13, 1932. C. F. KENWORTHY 1,876,960

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Fig. 2.

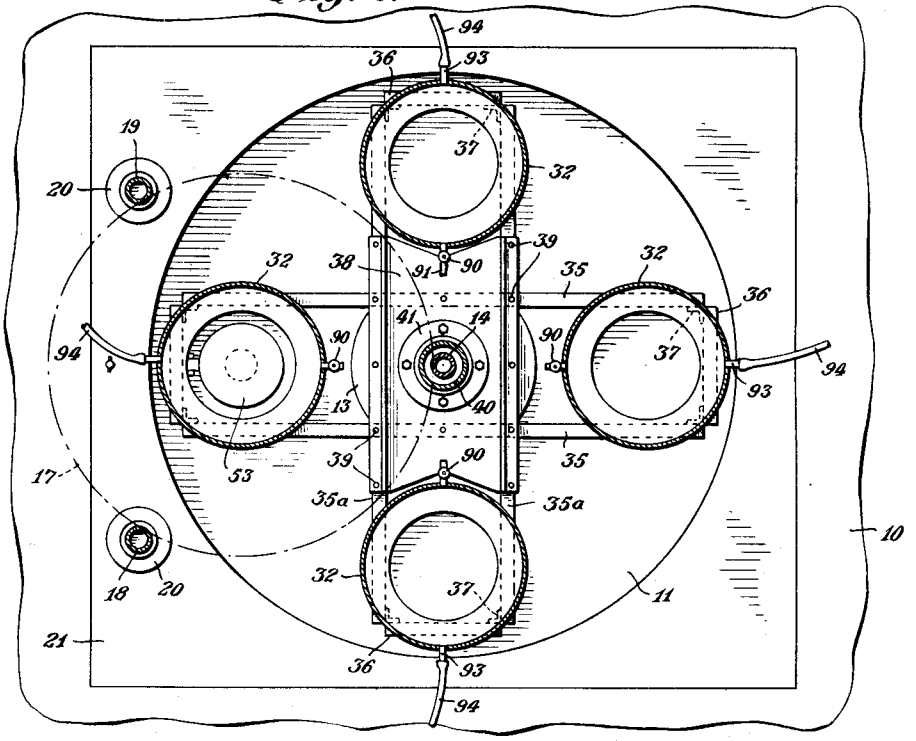


Fig. 3.

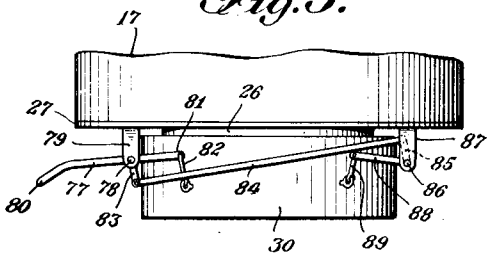
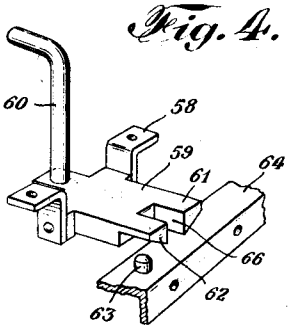


Fig. 4.



INVENTOR
Charles F. Kenworthy
BY H. G. Manning
ATTORNEY

Sept. 13, 1932. C. F. KENWORTHY 1,876,960

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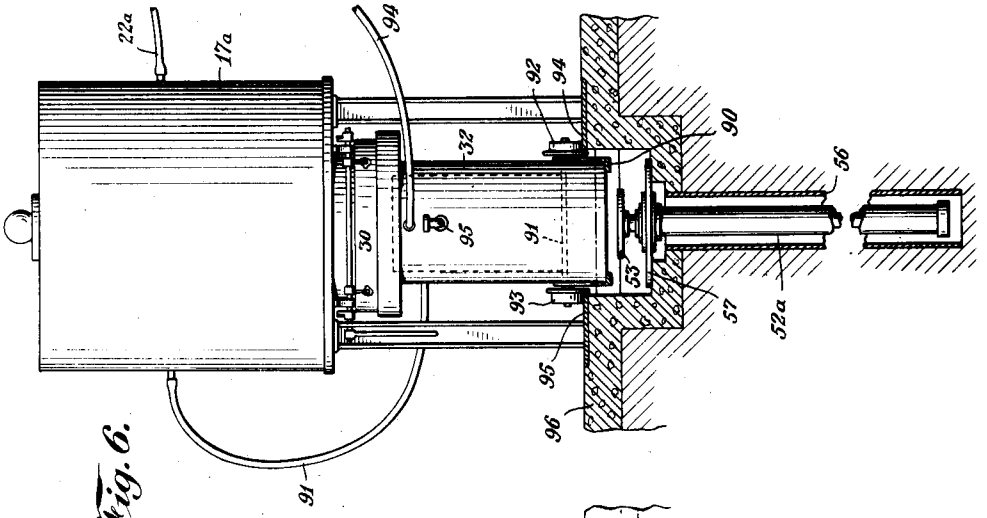


Fig. 6.

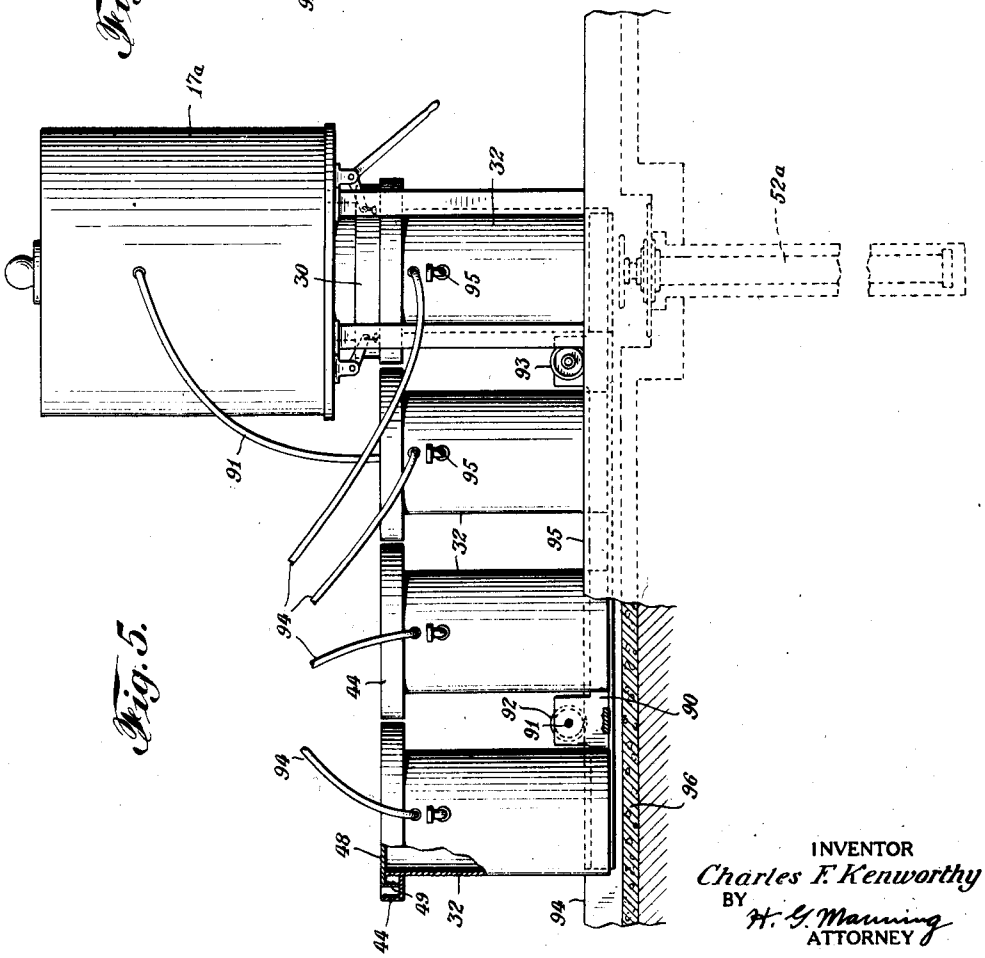


Fig. 5.

INVENTOR
Charles F. Kenworthy
BY H. G. Manning
ATTORNEY

Patented Sept. 13, 1932 1,876,960

UNITED STATES PATENT OFFICE

CHARLES F. KENWORTHY, OF WOODBURY, CONNECTICUT, ASSIGNOR TO CHARLES F. KENWORTHY, INC., OF WATERBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT

ANNEALING FURNACE

Application filed January 14, 1929. Serial No. 332,307.

This invention relates to non-oxidizing annealing furnaces, and more particularly to a furnace for "bright annealing" non-ferrous metals in the absence of air.

One object of this invention is to provide an annealing furnace of the above nature having an annealing chamber with an open bottom through which the metal charges to be annealed are elevated successively from a plurality of magazines located on a rotatable platform below.

A further object is to provide an annealing furnace of the above nature in which the charge of metal is continuously surrounded by a non-oxidizing atmosphere, such as steam, throughout the annealing and the cooling operations.

A further object is to provide an annealing furnace of the above nature provided with a sealing ring for excluding air from the joint between the bottom of the annealing chamber and the top of the magazine while the charge from the latter is being annealed.

A further object is to provide an annealing furnace of the above nature in which the annealing chamber is supported at a relatively high elevation above the magazines, the latter being maintained at all times on a single level below the annealing chamber.

A further object is to provide an annealing furnace of the above nature having means for locking each magazine successively in registry with the bottom of the annealing chamber so that the charges may be elevated into said chamber.

A further object is to provide a "tell-tale" indicating means for visually informing the operator when the charge of metal has been elevated into annealing position and has been lowered into the magazine after annealing respectively.

A further object is to provide an annealing furnace of the above nature which will be relatively simple in construction, inexpensive to manufacture and operate, clean and cool in operation, easy to install and manipulate, which will be relatively compact, which may be easily and quickly charged and unloaded, and in which the product will be of uniform softness and ductility, clean and free from oxidation, and having a smooth bright finish.

With these and other objects in view there has been illustrated on the accompanying drawings two forms in which the invention may be conveniently embodied in practice.

Fig. 1 represents a side sectional view of the first form of annealing furnace.

Fig. 2 is a top sectional view of the same, the section being taken through the magazines, the position of the annealing chamber being shown in dotted lines.

Fig. 3 is a fragmentary view of the bottom part of the annealing chamber showing the mechanism for raising the sealing ring to permit the magazines to be moved into and out of alignment with the annealing chamber.

Fig. 4 is a perspective view of the mechanism for locking the magazines in alignment with the annealing chamber while the charge is being annealed.

Fig. 5 is a side view, partly in section, of a modified form of annealing furnace, in which the charge-holding magazines are adapted to roll along a straight track toward and away from the annealing chamber.

Fig. 6 is a side sectional view of the same.

In previous forms of non-oxidizing annealing furnaces the annealing chamber was generally located on the same level as the charge-containing magazines, and it was common to lower said magazines into water tanks located sufficiently below the base of the furnace to enable the magazines to be moved directly under the annealing chamber of said furnace. These prior types of furnaces were quite costly to build and the upkeep expense was also high. Moreover, such furnaces were not suitable for annealing hollow articles or wire and flat metal of the finer sizes either in coils or on spools, because the water entrained by the passage through the tank not only was difficult to remove, and thus delayed the annealing period, but also produced "water stains" and caused the adjacent layers of the thin metal to stick together.

By means of the present invention, the above and other disadvantages have been

avoided. This has been accomplished by supporting the annealing chamber in an elevated position with respect to the magazines, thereby permitting the magazines to be readily moved therebeneath. The construction also permits the charge to be directly raised into the interior of the annealing chamber without passing it through water. The present invention thus avoids the necessity of extensive excavations and greatly simplifies the installation and expedites the operation of the furnace.

Since it is not necessary to pass the metal charge through the water, the furnace can be used to anneal hollow metal articles, fine wire and thin metal ribbon with no danger of water staining or stickiness.

Referring now to the drawings in which like reference numerals denote corresponding parts throughout the several views, the numeral 10 indicates a concrete base provided with an interior shallow tank 11 for containing a small quantity of water, the level of which is maintained by an overflow pipe 12 so as to seal the lower ends of the magazines at all times.

At the central part of the tank 11 the base 10 is slightly elevated at 13 to form a support for a tubular shaft 14 seated in a flanged pedestal 15 resting on the section 13. The top of the shaft 14 serves as one of the supports for an annealing chamber 17 of refractory material. The chamber 17 is also partly supported by a pair of tubular posts 18 and 19 having flanged bases 20 seated upon a rectangular metal floor platform 21 mounted upon the concrete base 10.

The annealing chamber 17 resembles an inverted bottle, having as it does an open bottom 22. A relief valve 23 is located at the top of the chamber 17 for permitting the escape of steam and other vapors therefrom, said steam being admitted through a pipe 22*a*. The chamber 17 is provided with an outer protective casing 24 of metal or other suitable material, and has the usual inner lining of fire brick 25 surrounded by heat insulation 25*a*.

Heat is supplied to the annealing chamber 17 by a plurality of electric heating elements herein disclosed as vertically spaced insulated ribbons 25*b* of nichrome alloy, said ribbons being preferably wound in a sinuous manner to provide a uniform supply of heat for the interior of the furnace. Depending from the bottom of the annealing chamber 17 is a neck section 26 having an upper horizontal flange 27 resting upon a base plate 28 mounted upon the shaft 14 and the posts 18 and 19. The interior of said neck section 26 is of sufficient diameter to permit the charge to pass readily therethrough, as will be described later.

In order to exclude air from the annealing chamber while the charge is being annealed, the neck section 26 has an outer annular sealing trough 29 for containing a supply of water, sand, or other suitable material, said trough being integral with the lower edge of the depending neck section and having a movable sealing ring 30 of inverted L-shaped cross-section depending therefrom. The upper inner portion 31 of the sealing ring 30 extends downwardly and is adapted to rest upon the bottom of the trough 29 during the annealing operation, while the lower outer portion of the sealing ring dips below the surface of the sealing liquid in the magazine now to be described.

In order to convey the metal to be annealed into charging position below the annealing chamber 17 and to hold said metal during the succeeding cooling operation, provision is made of a plurality of hollow cylindrical magazines 32, four in this instance, said magazines having reduced open lower ends 33 forming annular shoulders 34 adapted to support the charge 34*a* and its elevating platform 50. Each of the magazines 32 is adapted to be supported on its sides by a pair of parallel channel members 35 and 35*a*, and at its outer end by a channel member 36 located at right angles to said channel members 35 and 35*a*, said channels 36 being connected to said channels 35 and 35*a* as by angle brackets 37. The channel members 35 which support two of the opposed magazines 32 extend clear across the tank 11 at either side of the central shaft 14, whereas the channels 35*a* supporting the other two opposed magainzes 32 terminate short of the channels 35, and are connected to a flat plate member 38 resting upon the top of the channels 35, as clearly shown in Fig. 1. The plate member 38 and both sets of channel members 35 and 35*a* are united as by rivets 39 and 40 to form a rigid rotatable magazine supporting turntable.

In order to permit the magazine turntable thus formed to rotate upon the shaft 14, provision is made of a tubular housing 40 surrounding said shaft, upon which is mounted a base flange 41 connected as by bolts to the plate member 38. The housing 40 is also connected to an upper flange 42 having horizontal radially extending strips 43 for supporting the enlarged sealing troughs 44 provided at the tops of each of the magazines 32. The sealing troughs 44 preferably have vertical partition members 45 for dividing said troughs into two concentric chambers 46 and 47, the inner chamber 46 being adapted to receive a cover member 48 having a depending rim 49 for excluding air from the top of the magazine 32. The outer chamber 47 is adapted to receive the lower end of the sealing ring 30 during the annealing operation and has a supply of liquid or other material to prevent the entrance of air through the joint between the annealing chamber 17 and the reservoir 32.

The charge of metal 34*a* which is herein shown as a plurality of wire coils is elevated from its magazine 32 by means of a platform 50 having a plurality of supporting rods 51 extending upwardly therefrom and encircling the charge 34*a*.

Elevating mechanism

In order to raise the platform 50 into the annealing chamber, provision is made of a hydraulic ram 52 having an upper head 53 for engagement with said platform 50. The lower end of the ram 52 has a piston 54 adapted to fit within a cylinder 55 located within a surrounding pipe 56 depending from the base 10. In order to prevent water from the interior of the tank 11 from entering the pipe 56, provision is made of suitable packing glands, generally indicated by the numeral 57.

"Tell-tale" mechanism

For indicating to the operator when the platform 50 with its charge of metal has reached the proper annealing position within the chamber 17 and also when the head 53 of the hydraulic ram 52 has passed down below the lower end of the magazine 32 after depositing an annealed charge of metal therein, provision is made of a "tell-tale" mechanism now to be described. As most clearly shown in Fig. 1, this mechanism comprises a horizontal lever 67 fulcrumed on a vertical post 68 and having its outer extremity 69 located between a pair of pins 70 and 71 of a vertical "tell-tale" rod 72 extending up through the floor platform 21 into a position to be visible to the operator. The inner end of the lever 67 has an enlarged upwardly extending projection 73 adapted to be engaged by the head 53 of the hydraulic ram 52 when the latter has dropped to its lowermost position, as shown in full lines in Fig. 1. The "tell-tale" rod 72 will thus be raised. A chain 74 is connected at one end to an eye 75 on the lever 67 between the fulcrum 68 and the tell-tale rod 72, the other end of said chain being connected at 76 to the head 53 of said ram 52. The length of said chain is so chosen that when the platform has been raised to annealing position within the chamber 17, shown in dotted lines of Fig. 1, the chain 74 will pull upwardly upon the eye 75, thereby again raising the "tell-tale" rod 72.

Turntable locking mechanism

For the purpose of locking each magazine 32 in correct properly alined position, with respect to the annealing chamber 17, provision is made of a turntable locking mechanism more clearly shown in Fig. 4. This locking mechanism includes a bracket member 58 adapted to be secured underneath the floor platform 21, said bracket pivotally supporting a lever 59. The outer end of the lever 59 has an angle-shaped handle member 60 adapted to extend upwardly through an opening in the floor platform 21 for convenience in manipulation by the operator.

The inner end of the lever 59 is bifurcated and has a pair of wedge arms 61 and 62 beveled inwardly on their lower surfaces. The beveled surfaces of said arms 61 and 62 are adapted to ride up over a vertical pin 63 formed on the horizontal upper arm of a bracket member 64, the vertical arm of said bracket being secured to the channel member 36 as by rivet 65 (see Fig. 1).

It will thus be seen that whenever a magazine 32 containing a charge to be annealed is swung on its turntable into alignment with the inverted chamber 17, one of the wedge arms 61 and 62 will engage the pin 63, causing the lever 59 to be automatically raised about its pivot in the bracket 58, and said lever will drop down by gravity so that the pin 63 will be held within the slot 66 between said arms 61 and 62. Whenever it is desired to rotate the turntable to bring the first magazine 32 out of alignment with the chamber 17, it will be only necessary for the operator to grasp the handle member 60 and force it in a counter-clockwise direction, as viewed in Figs. 1 and 4.

Mechanism for raising sealing ring

To allow the sealing ring 30 to be raised upwardly so that its lower end is above the chamber 47 of the sealing trough 44 of each magazine 32 which is necessary for permitting the turntable to be rotated to successive charging positions, provision is made of a lever 77 rigidly mounted on a shaft 78. The shaft 78 is pivoted in a bracket 79 depending from the upper flange 27 of the neck member 26. The lever 77 has a handle 80 at one end and has its other end 81 connected to a link 82 joined to one side of the sealing ring 30.

Rigidly connected to the shaft 78 is a Z-shaped lever comprising a short arm 83, a long inclined rod 84 extending across beneath the furnace, and a short vertical arm 85 rigidly connected to a shaft 86 journaled in a depending bracket 87. An inwardly extending rod 88 is rigidly mounted on the shaft 86 and at its free end has a link 89 connected to the sealing ring 30.

Breather pipe

In order that the annealed charge of metal may be rapidly cooled off by the application of cooling means, such as air or a water spray to the exterior of the steam-filled magazine 32 without causing a vacuum therein, said magazine is provided with a hand-operated valve 90 connected to a flexible "breather pipe" 91 leading to an outlet pipe 92 located in the side of the annealing chamber 17. This

breather pipe 91 prevents the formation of the vacuum which might otherwise be sufficient to draw air into the magazine through the water seals. The provision of this breather pipe 91 thus renders the operation of the furnace practically "fool-proof".

Each magazine is also provided with a separate steam inlet 93 joined to a flexible steam pipe 94 below which is a relief valve 95.

Operation

In operation, the metal to be annealed will first be hoisted to a position above one of the magazines 32, and then lowered therein until it rests upon the platform 50 therein. The cover 48 will then be placed upon the top of the reservoir with its depending rim 49 seated in the trough chamber 46, the liquid therein thereafter serving to exclude air from said magazine. The operator will then push upon the magazine 32, causing the turntable upon which it is supported to be rotated about the shaft 14 until it comes into register with the annealing chamber 17, at which time the lever 59 will ride up over the pin 63 on the bracket 64, said pin 63 entering the slot 66 and locking the first magazine 32 detachably in aligned position.

The operator will then push up upon the handle 80 of the lever 77, forcing the cross-rod 84 to the right, as viewed in Figs. 1 and 3, and lowering the links 82 and 89 connected with the sealing ring 30. The sealing ring 30 should be lowered until its lower edge rests upon the bottom of the outer trough chamber 47, the liquid therein thereafter sealing the joint between the furnace 17 and the magazine 32. The operator will then actuate the hydraulic ram 52 by any suitable mechanism not shown, such as a three-way valve, causing the ram 52 to rise until the head 53 comes into contact with the platform 50. Continued upward movement of the ram 52 will elevate the platform 50 (with the cover 58 resting upon the top of the rods 51) into the interior of the annealing furnace from the position shown in full lines to the position shown in dotted lines in Fig. 1. The "tell-tale" rod 72, due to the pull of the chain 74 on the lever 67, will then indicate to the operator when the platform has risen to this position. The first charge will then be allowed to remain in the furnace for sufficient time to completely anneal it,—generally about 45 minutes.

Before elevating the charge into the annealing chamber 17, all traces of entrained air must be driven out. For this purpose steam will be admitted to the magazine 32 through the pipe 94 just as soon as the charge is placed therein, the air being driven out of the magazine through the relief valve 95. Steam will be continuously admitted to the annealing chamber through the steam pipe 32*a* so that the charge will be maintained constantly in a non-oxidizing atmosphere, the excess vapor being exhausted from said annealing chamber through the relief valve 23 located at the top of said chamber 17.

After the charge has been heated to the proper temperature, the operator will manipulate suitable mechanism, such as the three-way valve previously mentioned, to lower the ram 52 and carry the platform 50 down from the dotted to the full line positions shown in Fig. 1 where said platform 50 will again rest upon the shoulder in the bottom part of the magazine 32. The ram 52 itself will continue to descend, leaving the platform and hot metal charge in the magazine until the head 53 of said ram passes below the bottom of said reservoir and under the surface of the water in the tank 11. This position will be indicated to the operator by a second rising of the "tell-tale" rod 72 due to the engagement of the projection 73 of the lever 69 by the bottom of the head 53.

The operator will then pull down upon the handle 80, causing the sealing ring 30 to be raised to its uppermost position out of alignment with the sealing trough 47 of the magazine 32. He will then manipulate the handle of the lever 60 to raise the lever 59 out of engagement with the pin 63. The magazine-supporting turntable will then be rotated as a unit turning all four magazines around the pivot shaft 14 for a quarter of a revolution or until the locking lever 59 has snapped over the pin 63 of the next or second magazine 32. This second magazine will then be held in register with the open bottom of the annealing chamber 17 exactly as was the case with the first magazine 32.

After the magazine containing the hot freshly annealed charge has been rotated out from alinement with the annealing chamber, steam will again be admitted through the pipe 94 and will rapidly cool the charge. When the temperature of the charge has fallen to 212 degrees, further cooling thereof will be accomplished by spraying water on the outside of the magazine. Just prior to starting the water spray, the breather pipe valve 90 will be opened connecting the magazine 32 with the annealing chamber 17, and thereby preventing the formation of a vacuum in said magazine.

All danger of air being sucked in through either the top or bottom seals will thus be avoided. The water spray will be continued until the charge has assumed substantially the temperature of the room. It will be understood that the four magazines 32 will be used in rotation, a new cold charge being placed in a magazine immediately after an annealed charge has been removed therefrom, thus permitting the process to be continuously carried on.

In the modified form of the invention shown in Figs. 5 and 6, the construction of the furnace 17 and hydraulic elevator mech-

anism 52*a* is identical with that of the first form previously described. The magazines, however, are constructed in a somewhat different manner, being in this instance mounted upon carriage members 90, each of which carries an axle 91 having wheels 92 and 93 at its extremities, said wheels being adapted to roll upon tracks 94 and 95 supported upon a concrete base 96 leading in a straight line from both sides of the furnace 17*a*.

By means of this construction it will be seen that the rotating platform is entirely eliminated and that the charging magazines may be pushed in one direction, continually entering from one side of the furnace and leaving at the other side, thereby considerably simplifying the process of annealing. In other respects the operation is similar to the first form of the invention.

While there have been disclosed in this specification two forms in which the invention may be embodied, it is to be understood that these forms are shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosures but may be modified and embodied in various other forms without departing from its spirit. In short the invention includes all the modifications and embodiments coming within the scope of the following claims.

Having thus fully described the invention, what is claimed as new, and for which it is desired to secure Letters Patent, is:

1. In an annealing apparatus, an annealing furnace, a magazine for holding the metal before and after annealing, means for supplying a non-oxidizing gas to said furnace, a breather connection between said magazine and said furnace whereby no vacuum will be produced in said magazine during the succeeding cooling operation.

2. In an annealing apparatus, an inverted annealing furnace open at the bottom, a magazine, a receiver in said magazine for the metal to be annealed, means to exclude air from the top of said magazine, and means for elevating said receiver and said air excluding means into said furnace.

3. In an annealing apparatus, an inverted annealing furnace open at the bottom, a magazine, a receiver in said magazine for the metal to be annealed, a sealing cover to exclude air to the top of said magazine, and means for elevating said receiver and said air excluding means into said furnace.

4. In an annealing apparatus, an inverted annealing furnace open at the bottom, a magazine for holding the metal before and after annealing, means to elevate the metal from said magazine directly into said furnace, the bottom of said furnace and the top of said magazine having liquid-containing troughs, and a sealing ring having depending edges adapted to dip into said troughs to exclude air from said furnace and magazine.

5. In an annealing apparatus, an inverted annealing furnace open at the bottom and supported in an elevated position, a plurality of magazines located below said furnace for holding the metal before and after annealing, means to move said magazines successively into a position directly beneath and in alinement with said furnace, means to elevate the metal from said alined magazines successively into said furnace, and means to prevent the access of air to the interior of said furnace and said magazines.

6. In an annealing apparatus, an inverted annealing furnace open at the bottom and supported in an elevated position, a plurality of magazines located below said furnace for holding the metal before and after annealing, means to move said magazines successively into a position directly beneath and in alinement with said furnace, means to elevate the metal from said alined magazines successively into said furnace, and a sealing ring to exclude the air from the joint between the furnace and the magazine beneath it.

In testimony whereof, I have affixed my signature to this specification.

CHARLES F. KENWORTHY.