F. INGRAHAM & D. LYNCH.

CONTINUOUS ANNEALING FURNACE.

APPLICATION FILED DEC. 16, 1913.

1,147,731.

Patented July 27, 1915.

2 SHEETS—SHEET 1.

FIG. 2

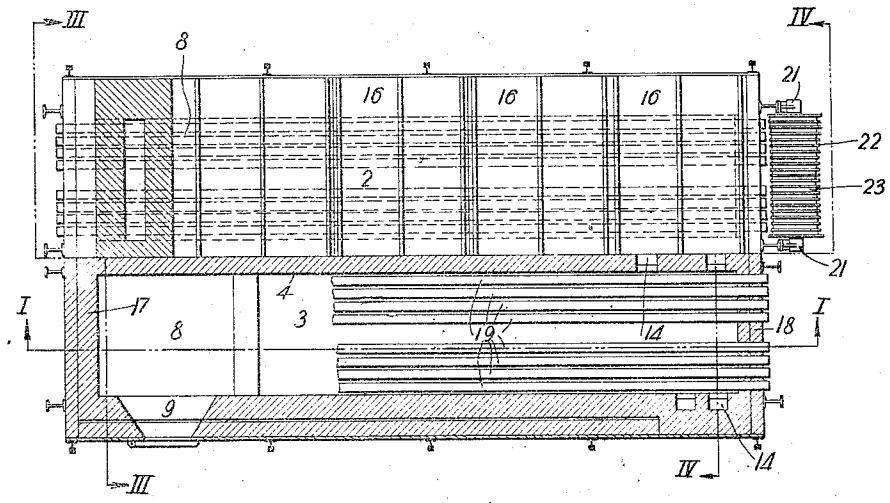
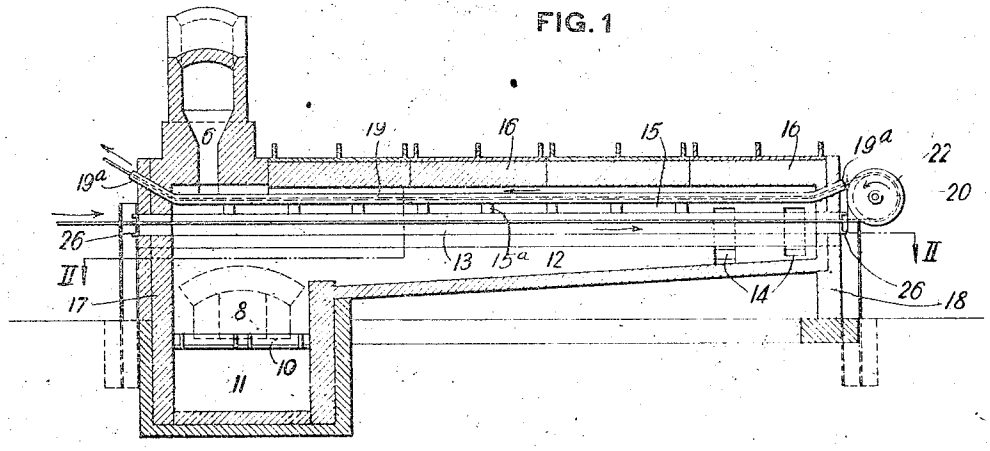


FIG. 1



WITNESSES

Chas. Sopteman.

R. D. Leitch

INVENTOR

Frederick Ingraham

Daniel Lynch

by Leighton Bell & Fuller

their Attorneys

F. INGRAHAM & D. LYNCH.

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2 SHEETS—SHEET 2.

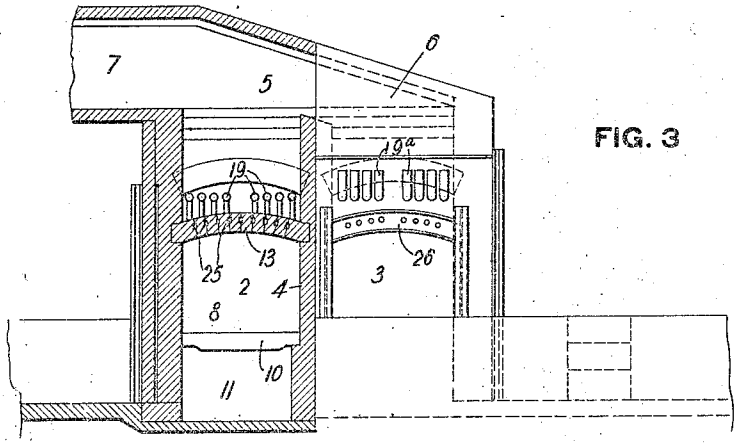


FIG. 3

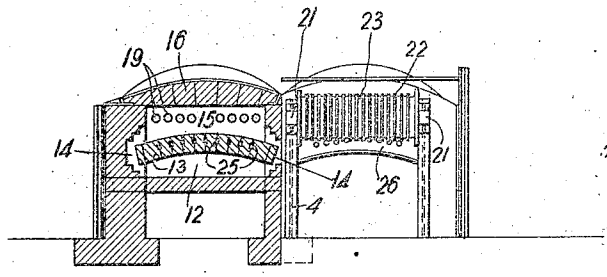


FIG. 4

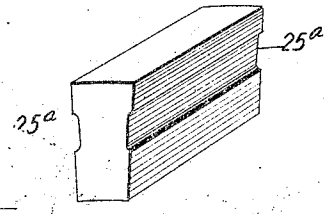


FIG. 5

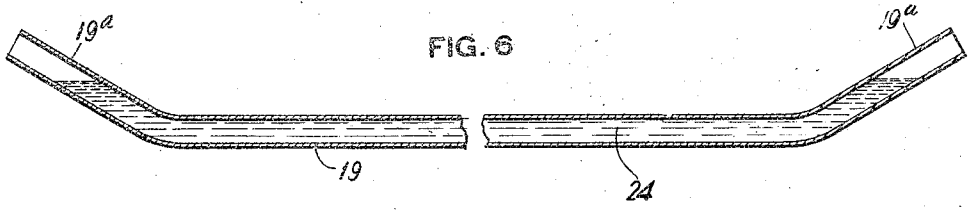


FIG. 6

WITNESSES

Chas. Sopterman

R. Stitt

INVENTOR

Frederick Ingraham

Daniel Lynch

by Lachmann, Peet & Fuller

their attorneys

UNITED STATES PATENT OFFICE.

FREDERICK INGRAHAM AND DANIEL LYNCH, OF JOLIET, ILLINOIS, ASSIGNORS TO THE AMERICAN STEEL AND WIRE COMPANY OF NEW JERSEY, OF HOBOKEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

CONTINUOUS ANNEALING-FURNACE.

1,147,731. Specification of Letters Patent. **Patented July 27, 1915.**

Application filed December 16, 1913. Serial No. 807,114.

To all whom it may concern:

Be it known that we, FREDERICK INGRAHAM and DANIEL LYNCH, both citizens of the United States, and residents of Joliet, in the county of Will and State of Illinois, have invented certain new and useful Improvements in Continuous Annealing-Furnaces, of which the following is a specification.

Our invention relates to heating apparatus employed in the art of annealing, and more particularly relates to apparatus used in annealing black and galvanized wire, flats and similar rolled shapes, chain both black and galvanized, and like flexible materials of small cross section and comparatively great length.

Two types of furnaces have been in general service heretofore in the production of annealed wire. The first and oldest, which is known as the still or pot annealing furnace, is one in which the wire while being annealed is stationary or at rest, the wire being in the form of coils or bundles. The second type of which our invention is an improvement is a continuous heating furnace in the use of which a series of strands of wire are passed continuously through the annealing media, the wire acquiring the proper annealing temperature in traveling through the furnace, and, after emerging therefrom, being wound into coils or formed into bundles.

Two forms of continuous annealing furnaces have been used heretofore, the older of the two comprising a furnace having brick arches constructed to span suitable fire boxes or combustion chambers and flues, with small horizontally extending holes extending through the brick arches lengthwise parallel with the length of the furnace, and the individual wires passing singly through one or another of the series of so formed holes in being heated and annealed. The second type of continuous annealing furnace used heretofore comprises shallow metallic pans or containers mounted above combustion chambers and flues, the pans or containers being filled to a suitable depth with molten lead. In this type of furnace two or more pans or containers are arranged in series so that the wires pass successively through the series of so-formed baths in acquiring the proper degree of heating necessary in annealing, and after leaving the last of the series of molten lead baths being wound into coils or bundles. In using either of the two types of continuous furnaces described, both black and galvanized wire are treated in being annealed. The wire or other product being annealed usually is coated with a film of grease or other lubricant which becomes applied thereto in a prior forming operation, as for example, in the case of wire in the wire drawing operation, and in annealing wire with either of the above types of furnace the grease or lubricant coating is burned off. In the use of shallow pans to form the lead baths large quantities of lead are lost through being oxidized, as well as escape of heat by radiation owing to the large surface of the lead contacting with the atmosphere.

One object of our invention is to provide a continuous annealing furnace of improved construction having novel means whereby the wire is heated to the desired annealing temperature and loss of lead or other material forming the molten bath or annealing medium is avoided and overcome.

Another object of our invention is to provide a furnace having novel means whereby the losses through the escape of heat performing no useful service are lessened and prevented.

A further object of our invention is to provide a continuous furnace having novel means for heating the materials being annealed without direct exposure thereof to the oxidizing gases or products of combustion and for increasing the time interval during which the materials are being heated without increase in the overall length of the furnace.

A still further object of our invention is to provide a furnace of novel construction having improved means whereby variations in the temperature to which the materials are heated in different portions of the fur-

nace are made possible, and annealing of different classes, sizes or grades of materials at the same time is effected.

Referring to the drawings forming part of this invention, Figure 1 is a longitudinal side elevation, the section being taken on the line I—I of Fig. 2, showing one form of continuous annealing furnace constructed and arranged in accordance with our invention. Fig. 2 is a plan partly in section of the furnace of Fig. 1, the sectional lower half of the plan being taken on the line II—II of Fig. 1. Fig. 3 is an end elevation, partly in section, the section being taken on the line III—III of Fig. 2. Fig. 4 is a sectional end elevation taken on the line IV—IV of Fig. 2. Fig. 5 is a perspective view showing the construction of the slotted arch bricks used in constructing our improved furnace. Fig. 6 is a detail longitudinal side elevation showing the construction of the bent tubes forming the containers for the molten bath forming part of our improved furnace.

In the accompanying drawings the numerals 2 and 3 designate furnace which are separated by the division wall 4 and each of which furnaces is provided with a stack outlet 5 or 6 by which the combustion chambers are connected through the heating chambers to the flue 7 leading to a stack, (not shown) which is conveniently located at one side of the furnaces. The combustion chambers 8, 8, of the furnaces each have a door 9 through which the fuel is inserted and a rocking grate 10, suitable outlets being provided for the removal of ashes from the ash pits 11. The combustion chambers 8, 8, connect on one side or end into the end of longitudinally extending flues or heating chambers 12 which extend lengthwise for the entire length of the furnace, and the chambers 12 and the combustion chamber connected to one end thereof are provided with an arched roof 13 extending from the furnace side walls and constructed of shape bricks and forming a partition wall as will be described. The rear ends of the chambers 12 are connected by the transverse recesses 14, which are formed in the side walls of the furnace, with the return flues or heating chambers 15, 15, which are located above the arched roof 13 and the outlet ends of the chambers 15 are connected by the stack outlets 5 and 6 to the stack flue 7. The upper heating chambers 15 are each covered with a removable sectional roof, the roof being arched and being made in sections 16 so that one or all of the sections can be readily removed and replaced in position when found necessary or desirable. Located within the upper heating chambers 15 and extending through the end walls 17 and 18 of the furnace is a series of metal tubes or pipes 19, these tubes having bent ends 19ª which extend upwardly, so as to form closed containers for the molten lead or other annealing medium as will best be seen in Figs. 1 and 6. The bent ends of the tubes 19, which are open, extend through the end walls 17, 18 of the furnace to permit the wires or other material being annealed being passed into and through the tubes or containers in a continuous manner. The tubes 19 are supported at intervals in the length thereof by piers 15ª to prevent sagging thereof when heated. Positioned at the rear end of the furnace is a shaft 20 mounted in suitable bearings 21 which are fixed to the buck staves on the end of the furnace and mounted on the shaft 20 is a grooved drum 22 having a series of parallel grooves 23 formed in the periphery thereof at spaced intervals registering with the spacing of the series of bent tubes 19. Molten lead or other fluid heating material 24 is placed within the tubes or containers 19 so as to fill the straight or horizontal portions thereof, the upwardly bent ends 19ª of the tubes preventing the molten lead or other medium from flowing out of the tubes while permitting the materials being annealed being freely passed therethrough at any desired speed.

In our improved furnace construction the only portions of the surface of the molten lead 24 which are directly exposed to the atmosphere are those at the ends of the tubes 19 and as the entire surface of the lead in the horizontal portions of the tubes is in contact with the surface of the tubes, the heat transmitted to the lead through the walls of the tubes is much greater than where open topped pans or containers are employed and the loss from oxidation is greatly reduced.

As will be seen from Fig. 5 the arch bricks of which the arched roof or partition wall 13 separating the lower heating chambers 12 from the upper heating chambers 15 of the furnace is formed, have lengthwise extending slots or grooves 25ª in each side thereof, so that when the bricks are placed in position to form the roof or wall 13 the adjacent slots 25ª in adjoining sides of the bricks register to form an elongated passage which extends from end to end of the bricks. The openings 25ª in the faces of one brick are arranged to register with those in the faces of the adjacent brick of the next row of bricks, and a series of continuous openings 25 are in this way formed in the arched roof which extend from the side of one to the outside of the other end of the furnace. A casting forming an end plate 26 having openings spaced to register with the openings 25 is secured at each end of the furnace against the end walls thereof.

The furnace shown is provided with two separate and independently regulated sets of annealing chambers connected as shown to a common stack flue.

In the operation of our improved furnace, the desired number of strands of wire or other material to be annealed is passed through the series of passages 25 in the arch bricks forming the roof 13 over the lower heating chamber of the furnace and after being passed around the drum 22 on the rear end of the furnace, are then caused to pass backwardly each through one of the bent tubes 19. The wires after being led through the tubes 19 and after passing over suitably positioned idler sheave wheels to change the direction of travel thereof are connected to a reel or other device by which the wires or other materials are wrapped and formed into coils or bundles.

The products of combustion from the fire boxes 8, 8, pass lengthwise along the lower chambers 12 and then pass sidewise and upwardly through the recesses 14 in the side walls at the rear end of the furnace into the rear end of the return flues or upper heating chambers 15 and then forwardly through the chambers 15 to the front end of the furnace and out of the outlet flues 5 or 6 into the stack flue 7 and then to the stack.

The products of combustion highly heat the arched roof 13 so that the materials being annealed in passing through the openings 25 become heated to or somewhere near the desired annealing temperature while direct exposure to the action of the heated gases is prevented. The wires passing from the discharge ends of the passages 25 in the arched roof 13 then pass over the grooved drum 22 at the rear end of the furnace and pass into one or another of the tubular containers 19 for the molten bath 24, and as the products of combustion heat the large heating surface of these tubes, the molten lead bath 24 therein, which is an excellent conductor of heat, transmits this heat to the wires in their passage therethrough and owing to the length of the furnace completes the heating of the wires and maintains the wires at the annealing temperature. The wires then pass to the reels which are preferably located at sufficient distance from the furnace to allow the materials to cool below the temperature at which it will set, and is thereby formed into bundles or coils.

The advantages of our invention will be apparent to those skilled in the art.

By the use of the top and bottom heating flues, the time during which the materials being annealed are subjected to the heating action of the furnace is materially increased, without adding to the difficulties of inserting the materials in the furnace at the beginning of the annealing operation.

The use of the open ended bent tubes lessens the waste heretofore caused by oxidation of the molten heating medium while the molten bath is more completely brought into contact with the heat and loss by radiation of heat, as in the open pan construction is avoided and overcome.

Modifications in the construction and arrangement of the parts may be made without departing from our invention. A regenerative furnace may be employed instead of the coal fired furnace shown. The length and width of the furnace may be varied as is desired, the construction of the arch separating the bottom and top heating chambers may be changed and other variations may be made within the scope of the appended claims.

We claim:—

1. An annealing furnace comprising a plurality of heating chambers, a combustion chamber to supply heated gases thereto, a partition wall separating the heating chambers, said partition wall having a passage therein opening on the outside of the furnace through which the materials annealed are passed, means connecting the heating chambers to permit passage of heated gases from one to another, and a tubular member within one heating chamber, said tubular member being formed of metal and having bent ends opening outside of said heating chamber and forming a closed container for a molten annealing medium through which the materials annealed are passed in the annealing operations.

2. An annealing furnace comprising a plurality of heating chambers, a combustion chamber to supply heated gases thereto, means connecting the heating chambers to permit passage of heated gases from one to another, a partition wall separating the heating chambers and having a passage therein through which the materials annealed are passed, and a plurality of tubular members within at least one heating chamber, said tubular members having bent ends opening outside of said heating chamber and forming closed containers for a molten annealing medium through which the materials annealed are passed in the annealing operations.

3. An annealing furnace comprising a plurality of heating chambers, a combustion chamber to supply heated gases thereto, a partition wall separating the heating chambers and having a plurality of separate passages therein through which the materials annealed are passed, said passages opening on the outside of the furnace, means connecting the heating chambers to permit passage of heated gases from one to another, a tubular member within one of said heating chambers, said tubular member having bent

ends opening outside of said heating chamber and forming a closed container for a molten annealing medium through which materials annealed are passed in the annealing operations, and means at the end of the furnace for changing the direction of travel of the materials being annealed.

In testimony whereof, we have hereunto set our hands.

FREDERICK INGRAHAM.
DANIEL LYNCH.

Witnesses:
JOHN W. LEWIS,
E. E. WOODS.