May 3, 1938. P. HOFFMAN ET AL 2,116,069

APPARATUS FOR SELECTIVELY QUENCHING FERROUS SECTIONS

Filed Jan. 27, 1936 3 Sheets-Sheet 1

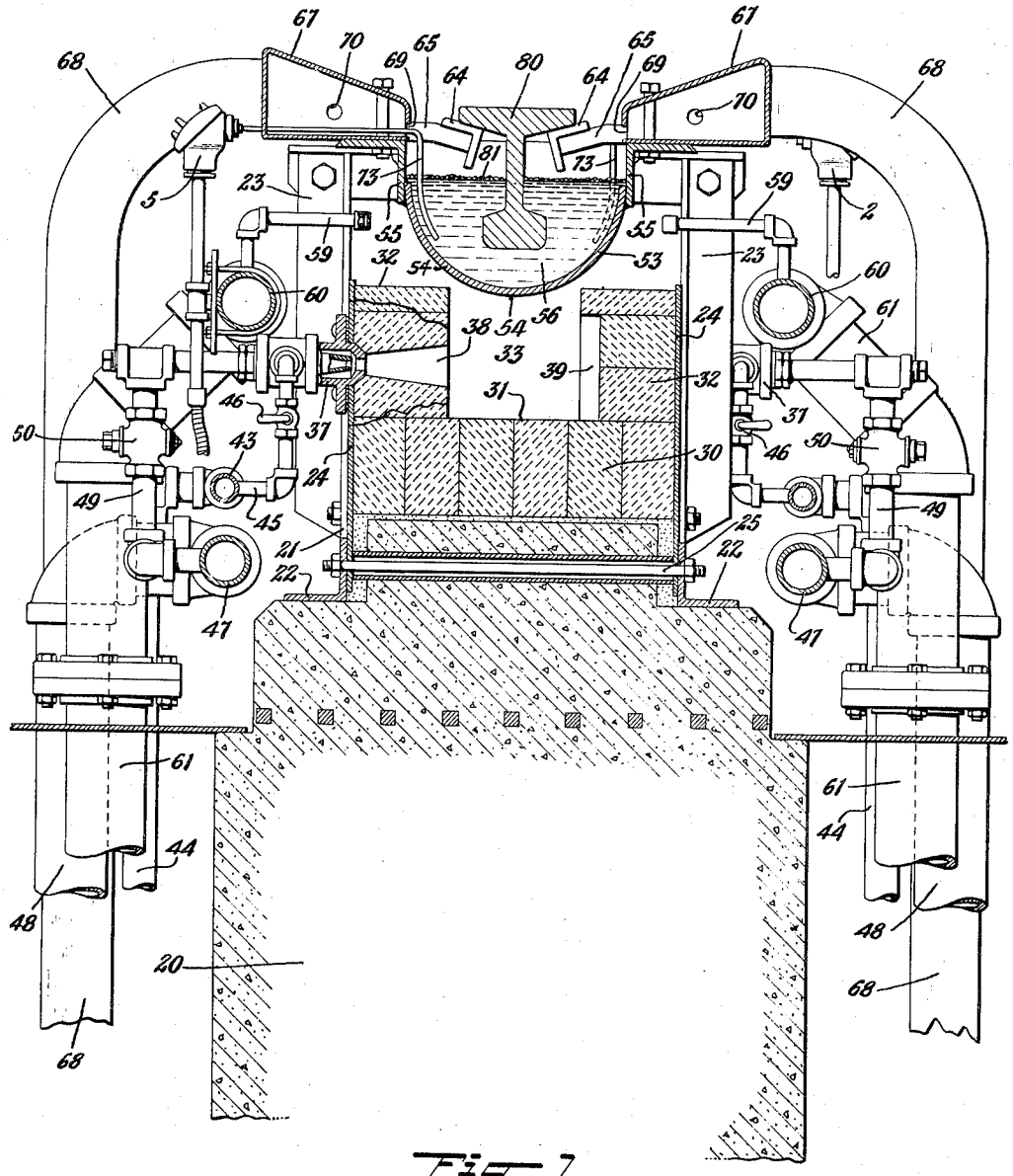


Fig. 1.

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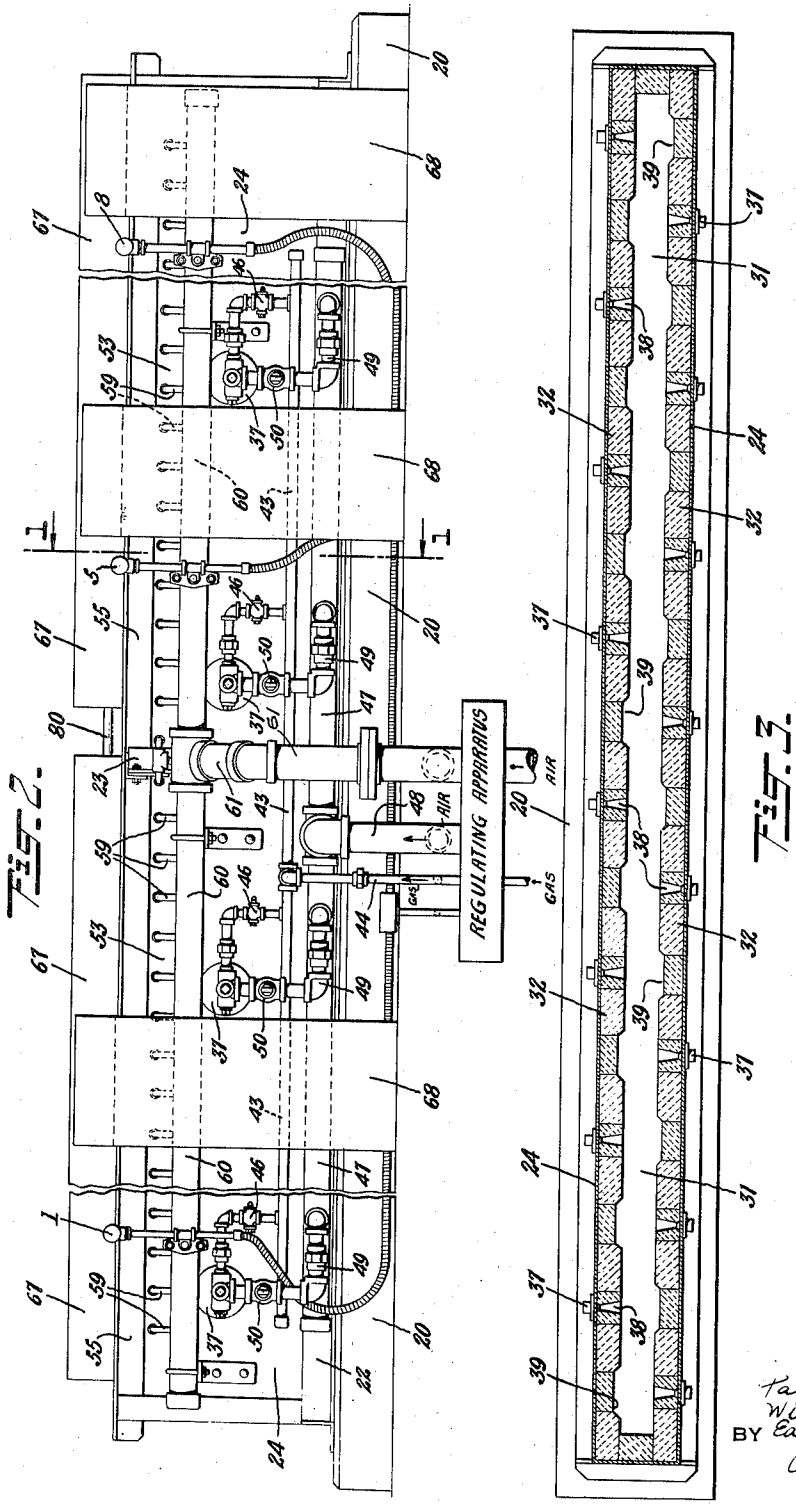


Fig. 2.

Fig. 3.

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Filed Jan. 27, 1936 3 Sheets-Sheet 3

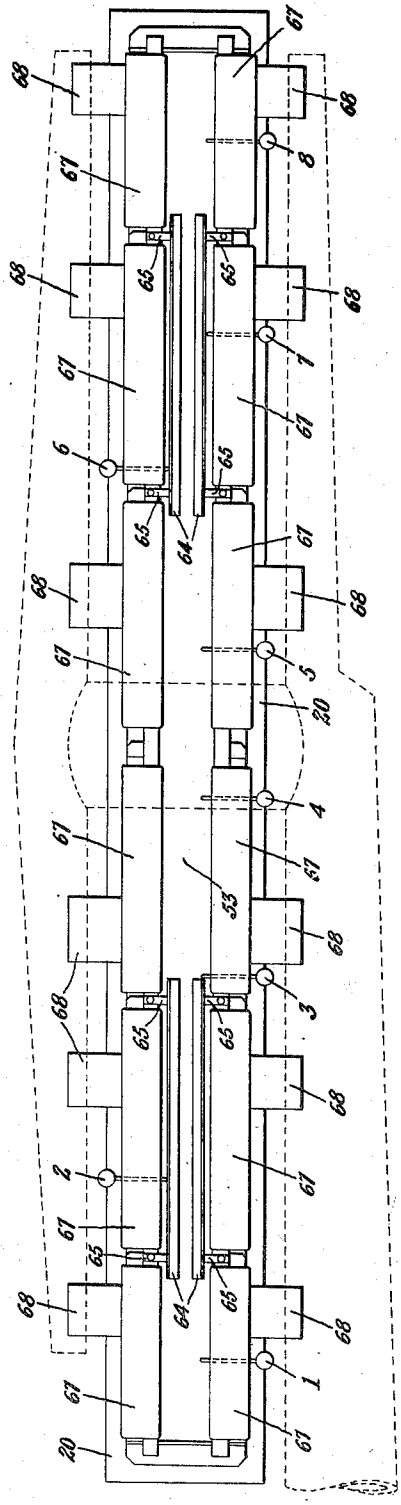


Fig. 4.

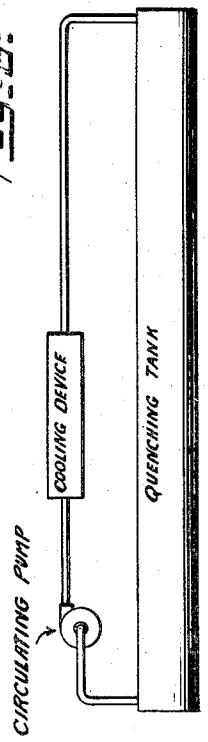


Fig. 5.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR SELECTIVELY QUENCHING FERROUS SECTIONS

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Application January 27, 1936, Serial No. 60,990

5 Claims. (Cl. 266—6)

The invention relates to apparatus for heat treating metals, and more particularly to a container for maintaining a quenching bath at elevated temperature.

According to the invention an elongated pot or container is provided for holding the liquid bath, such as lead, at a suitable elevated quenching temperature. This container is of comparatively shallow and narrow cross section and of sufficient length to accommodate the member to be heat treated which, for example, may be a length of steel railway rail.

The pot or container may be supported by a suitable structural framework above an open top elongated furnace. This furnace may be made up of the usual brickwork construction and supported by the same framework which supports the pot or container.

The bath container may be heated by gas burners distributed on opposite sides of the furnace along the length of the container so as to provide substantially uniform heating of the entire bath. Burners for burning either fuel gas or oil are built into the side walls of the furnace along the length thereof and are preferably disposed with the burners on opposite sides in staggered relation with respect to one another.

In addition to the burners for supplying the necessary heat to raise the temperature of the bath to the desired value, suitable cooling devices may also be provided to cool the bath in case it exceeds the desired temperature. These cooling devices may take the form of spaced nozzles distributed along the length of the container on opposite sides thereof and supplied with air.

Suitable automatic controlling devices may be provided for turning on the fuel burners when the temperature falls below a predetermined limit and for turning off the fuel burners and turning on the air nozzles when a predetermined temperature is exceeded. Suitable thermocouples may be immersed in the bath adjacent the point at which close regulation is desired for automatically controlling the turning on and off of the fuel burners and of the air nozzles.

While the apparatus may be used for heat treating various forms and kinds of metals, it may be especially adapted for heat treating steel rails. Suitable supports may be provided at the top of the container between which the head of the steel rail may be inserted head downward for the selective immersion of the head and either part or all of the web into the liquid bath, the base of the rail resting on these supports. These supports may be so spaced lengthwise along the container and may have such physical length as to provide any predetermined supporting action to the rail to assist in controlling warping or cambering of the rail.

Although the apparatus may be used to carry out different methods of heat treatment, it is essentially adapted for carrying out the method disclosed in copending application Serial No. 374, filed January 4, 1935.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a transverse cross section through the treating bath taken on the line 1—1 of Fig. 2;

Fig. 2 is a side elevation;

Fig. 3 is a horizontal section taken through the burners;

Fig. 4 is a top plan view of the bath.

Fig. 5 is a diagrammatic view illustrating positive circulating devices.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosures of the invention are made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspects of the invention.

Referring now to the drawings, and more particularly to Fig. 1, the bath construction, in general, comprises a suitable foundation 20 supporting a steel framework 21 and suitable brickwork 30 forming the furnace chamber 33. Above the furnace chamber is the elongated body 53 which contains the bath 56 of molten lead or other suitable material. The article being treated is shown as a steel railway rail and is indicated by 80. This rail rests on the supports 64 and has its head immersed in the bath, as shown.

The foundation 20 supports a suitable steel

framework indicated in general by 21. This framework 21 includes longitudinal angle irons 22, upright structural members 23, side plates 24 and tie rods 25. Supported by this framework is the brickwork 30 which comprises a bottom 31 and sides 32 forming the furnace chamber 33. The details of the construction of the steel framework 21 and of the brickwork 30 will be in accordance with accepted and approved methods commonly used for furnace construction.

Disposed in the furnace walls 32 are a plurality of burners 37. These burners are disposed in opposite sides of the furnace and are in staggered relation. Each burner has a tapered mouth 38 and a special recess 39 is provided in the opposite wall as indicated in Fig. 3.

The burners may be of standard construction and may be adapted for burning either gaseous or liquid fuel. The burners 37 are supplied by gas headers 43, one on each side of the furnace, which in turn are supplied by feed pipes 44 extending to the fuel supply. Branch pipes 45 having manual control valves 46 connect the respective burners 37 with the headers 43.

For supplying each burner with the necessary air for combustion, air headers 47 are provided, each of which is supplied by a feed pipe 48 which extends to a supply of air under pressure. Branch pipes 49 having valves 50 connect the respective burners 37 with the air headers 47.

The lead pot or container 53 may be conveniently manufactured from a half of a ten inch steel pipe indicated by 54. This pipe is welded to angle irons 55 which in turn are supported by the framework uprights 23. The pot 53 is filled with the bath indicated by 56 which may be of any desired substance maintained at any desired temperature.

For carrying out the process for which the present apparatus was especially arranged, the bath 56 may comprise an alloy of lead and antimony in the proportion of approximately 7/8 lead and 1/8 antimony by weight. The bath may be of such limited cross section that only 5000 lbs. of molten metal is necessary for the preferred heat treating operation. It is obvious that baths of other proportions of lead and antimony and of other materials may also be used.

For cooling the bath when it becomes overheated, a plurality of air jets 59 are provided, extending along the length of the pot on opposite sides thereof. These air jets 59 are supplied from air headers 60 which in turn are supplied from feed pipes 61 connected to a suitable source of air under pressure.

For supporting the base flange of the rail being treated, when it is immersed head down in the bath, suitable pairs of supports 64 are provided. These supports may take the form of angle irons resting on bars 65, in turn supported by the main framework of the apparatus. The angle irons may extend along the length of the bath a sufficient distance to give the desired supporting effect to the rail to assist in limiting the cambering or warping of the rail due to heat treatment. These rail supports are a sufficient distance apart to permit entry of the head of the rail, but are close enough together to engage the base of the rail as illustrated especially in Fig. 1.

For removing any lead fumes or other obnoxious gases which may be formed, a special exhaust system is provided. It will be understood that ordinarily the temperatures used are well below the volatilization points of the metals in the bath, but the exhaust system is provided as an extra precaution.

The exhaust system comprises a plurality of exhaust boxes denoted, in general, by 67 connected by exhaust pipes 68 to suitable exhaust fans (not shown). The exhaust boxes are provided with slots 69 at the edge of the pot and suitable holes 70 in the ends of the boxes for carrying away any obnoxious gases which may be given off during the heat treating operation.

Provision is made for close automatic temperature regulation. A series of thermocouples denoted by 73 (Fig. 1) are immersed in the bath. These thermocouples are of standard construction and are preferably immersed so that they are disposed close to that part of the member undergoing heat treatment whose temperature should be most closely controlled. In the illustration shown for treating a steel rail, the thermocouples 73 are disposed close to the head of the rail.

For maintaining a uniform temperature throughout the length of the bath, a plurality of thermocouples may be used which may be disposed on opposite sides of the bath. For example, referring to Fig. 4, eight thermocouples may be used, indicated by 1 to 8. Couples 1, 3, 4, 5, 7 and 8 may be disposed on one side of the bath while couples 2 and 6 may be disposed on the other side of the bath. It will be understood that these couples are connected up to suitable regulating apparatus (shown diagrammatically in Fig. 2) which controls the flow of fuel to the burners 37 and the control of air to the jets 59. The specific structure for exercising this automatic control is old and well known in the art and of itself forms no part of the present invention, but the technique of applying the automatic control to the particular furnace is new.

Couple 3 may be used for controlling the supply of gas to all burners; couple 4 may be used for checking the operation of couple 3 on the gas control; couple 6 may be used for controlling the flow of cooling air to the jets 59, while couple 5 may be used for checking the control of couple 6.

Couples 3, 4, 5 and 6 may be connected to meters reading the instantaneous temperature registered by these couples; couples 1, 2, 7 and 8 may be connected to recording meters which record the temperature at these points and act as a check on the temperatures indicated by the other couples so that a uniform temperature may be maintained along the entire length of the bath.

The operation of the temperature control is such that when the temperature of the bath drops below a predetermined temperature which, for example, may be 500° F., all of the burners 37 are turned on and all of the air jets 59 are turned off. When the temperature rises above this predetermined temperature of, say, 500° F., the burners are automatically turned off and the air to all of the jets is turned on. In case the various couples distributed along the length of the bath show different temperature readings, manual adjustment of the valves 46 is made to individually adjust the burners to make the temperature uniform along the length of the bath.

It will be understood that suitable pilots may be provided for igniting the burners. Or, if desired, the burners may burn with a small flame, which generates practically no heat, when the burners are in their "off" condition, thereby obviating the necessity for pilots.

It is obvious that the present construction may be used to carry out various forms of heat treat-

ment. In addition to the heat treating method disclosed in the copending application above referred to, the following heat treating method, which has been found to be especially effective for certain kinds of steel rails giving certain desired structural characteristics, will be briefly described.

The entire rail may be heated in a special heating furnace throughout its entire section to a point above its critical temperature, for example, to about 1500° F. This rail is then removed from the heating furnace and is immersed head downwardly in the bath as indicated in Fig. 1 with the base flange resting on the supports 64. The level of the bath 56 may be such as to reach a point on the web of the rail, as indicated. This point may be the neutral axis of the rail, or in some cases, may be about one inch below the bottom of the head.

The bath is preferably composed of ⅞ lead and ⅛ antimony by weight and may be maintained at a temperature of about 500° F.

If desired, a one-half inch layer of crushed coke, indicated by 81, may float on the bath. This carbonaceous material is used to keep the lead bath from sticking to the rail; it provides a reducing agent; it heat insulates the bath from the higher temperature of the rail flange and helps keep the bath from freezing.

After the rail is subjected to this selective quenching operation for the desired length of time, which may be ten minutes, it is removed and the entire rail subjected to retarded cooling.

The use of a bath of small cross section minimizes the amount of material in the path and consequently makes the temperature control easier. Furthermore, there is less volatilization with a small amount of bath material.

The provision of a small cross section bath assists directly in the quenching effect. The immersion of the rail at approximately 1500° into the bath at 500° causes eddy currents in the bath which keeps the liquid circulating. The centering of the head of the rail in the bath with substantially equal amounts of lead under the head and on the sides of the head equalizes the heat treatment on the top and side faces of the rail head.

Referring to Fig. 5, if desired, positive means may be provided to circulate the molten bath to accelerate the heat flow from the rail, thereby increasing the quenching rate to obtain greater hardening. For example, an external circulatory system including a pump may be provided for withdrawing the molten bath from one end of the container and returning it, after cooling in a suitable cooling device, to the other end.

Thus, a lead pot is provided which is comparatively inexpensive to construct and comparatively inexpensive to operate. The distribution of heating burners along the length of the pot and the constant temperature control reduces the warping of the pot and also reduces warping of the rail. The comparatively small volume of bath material minimizes the investment in bath material and provides easier temperature control.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A quenching tank comprising an elongated framework having an elongated furnace chamber, the bottom and side walls of the furnace chamber being made up of fire-brick, an elongated bath-containing pot supported by said framework above the open top of said furnace chamber, said furnace chamber having a plurality of fuel burners applied thereto and distributed along the length of the furnace for heating said pot, a plurality of air jets distributed along the length of the furnace, and means for mounting said jets adjacent said pot and above the furnace walls to cool said pot.

2. A quenching tank for heat treating steel rails and the like comprising a comparatively long shallow container holding a quenching bath, sets of spaced supports near opposite ends, each set being sufficiently long to contact a substantial length of the base flange of the rail to reduce cambering, the supports of each set being spaced apart to permit vertical insertion of the rail head therebetween and immersion of the head into the quenching bath, said sets being spaced apart longitudinally and the rail being unsupported between said sets, said container and said supports both being stationary, said supports being located above the container and so related thereto that, with the base flange of the rail resting upon said supports, the head of the rail is immersed in the bath.

3. A quenching bath for long steel sections and the like comprising a comparatively long narrow container for holding the bath liquid, means for heating said container and separate means for cooling said container, both said means being distributed along the length of the container to uniformly control the temperature of the bath liquid.

4. A lead pot comprising a comparatively long and shallow container, a series of individual heat sources distributed along the length of and under the container, a series of cooling sources distributed along the length of and outside of the container, a series of thermocouples immersed in the lead bath and distributed along the length of the container, and means governed by said thermocouples for controlling said sources.

5. A quenching tank comprising an elongated framework having an elongated furnace chamber, the bottom and side walls of the furnace chamber being made up of fire-brick, a bath-containing pot comprising a half of a round iron pipe supported by said framework above the open top of said furnace chamber, both side walls of said furnace chamber having a plurality of fuel burners disposed therein and distributed along the length of the furnace, a plurality of air jets distributed along the length of the furnace and located on opposite sides of said pot and above the furnace walls for cooling said pot, said pot having sets of rail supports, said supports supporting the base flange of a rail immersed head down in the bath, the content of said pot being of small cross section, and a plurality of thermocouples secured to the side of the pot and distributed along the length of the pot, said thermocouples being immersed in the bath between the side walls of the pot and the side of the rail head for controlling said fuel burners, and said air jets.

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