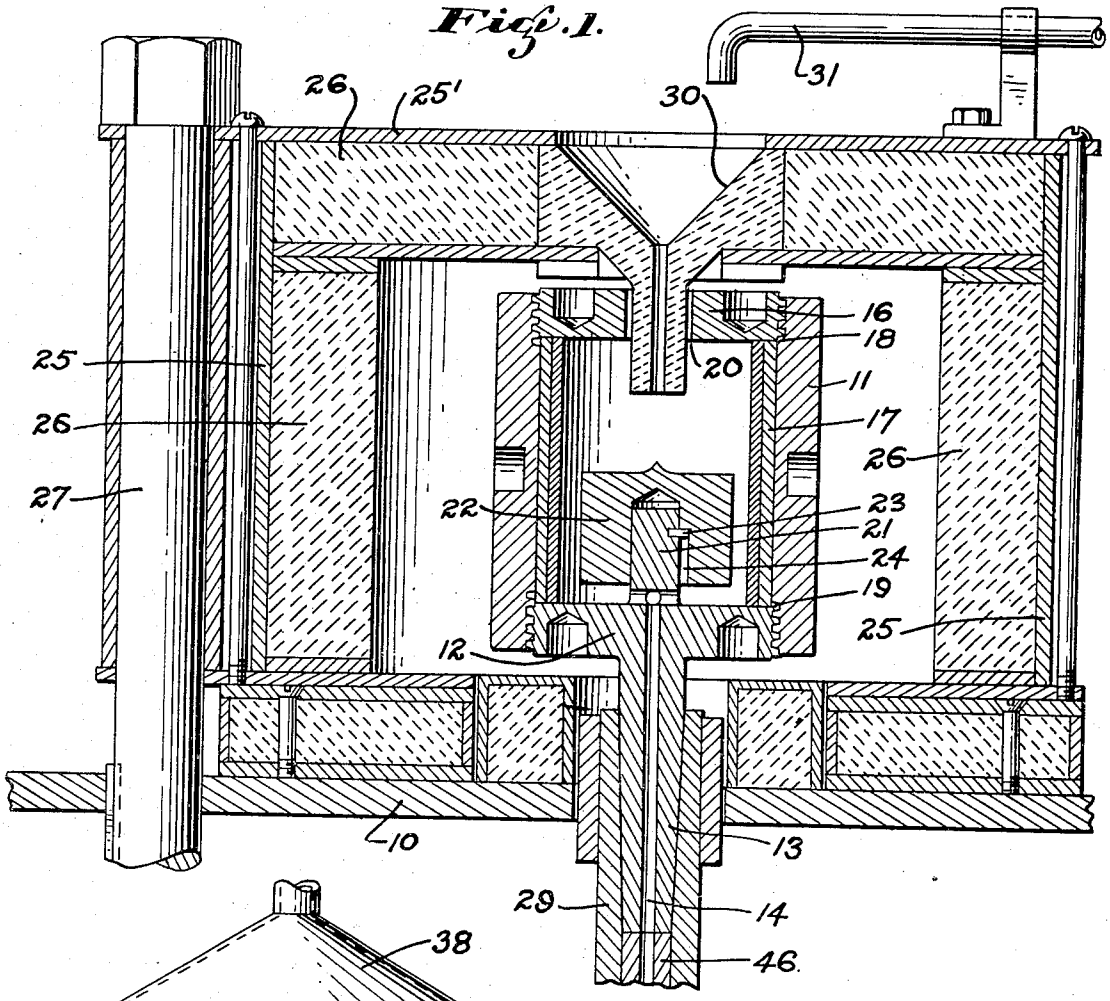
June 2, 1936. R. D. PIKE 2,042,800

PROCESS AND APPARATUS FOR MAKING BEARINGS

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Fig. 1.



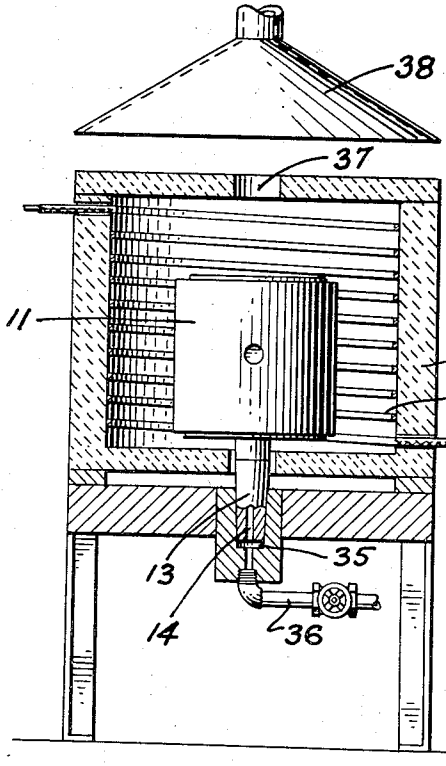


Fig. 2.

INVENTOR.
Robert D. Pike.

BY
Townsend Loftus & Abbett
ATTORNEYS.

June 2, 1936. R. D. PIKE 2,042,800

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Fig. 3.

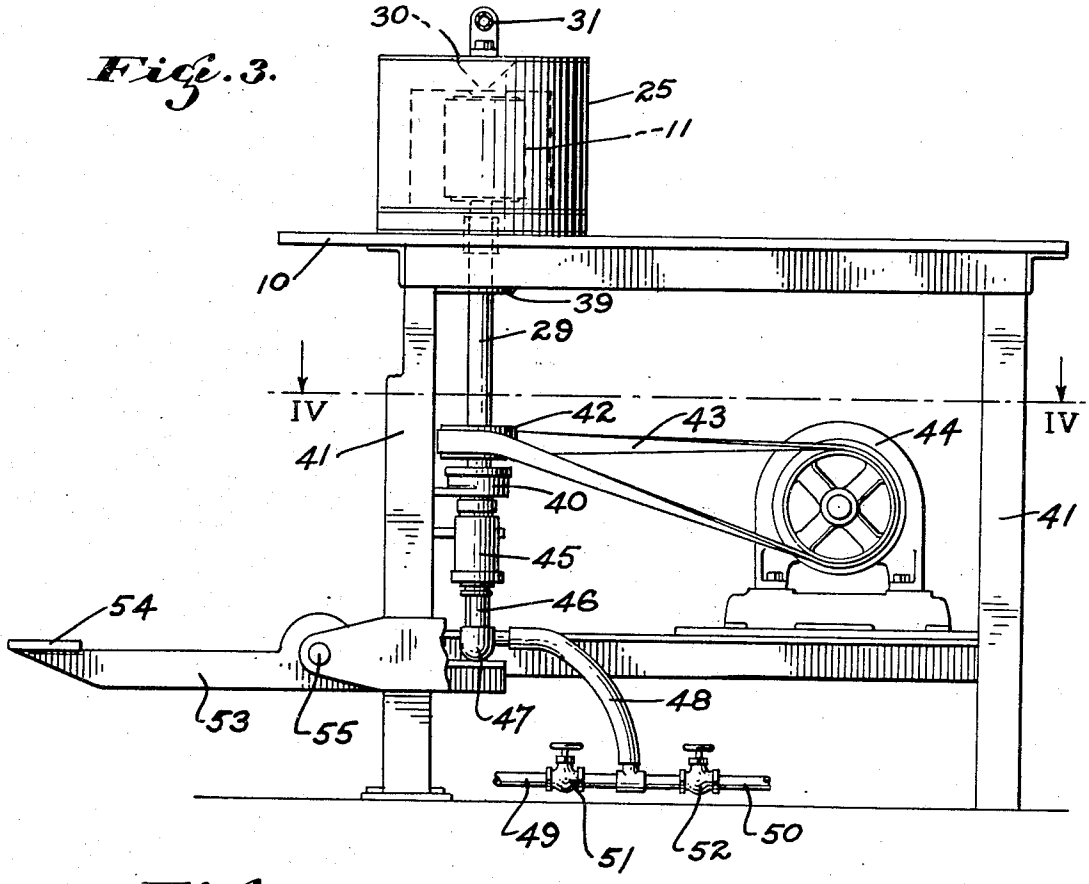
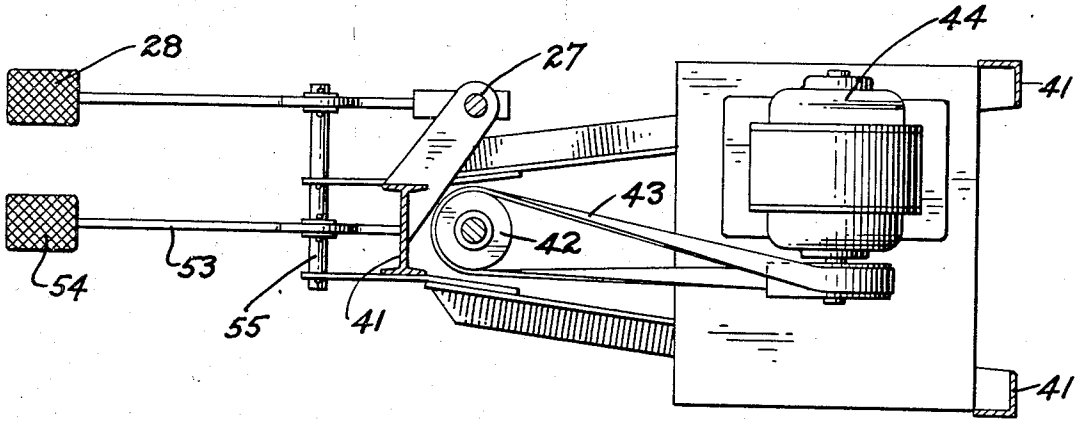


Fig. 4.



INVENTOR.
Robert D. Pike.

BY
Townsend, Loftus & Abbott
ATTORNEYS.

Patented June 2, 1936 2,042,800

UNITED STATES PATENT OFFICE

2,042,800

PROCESS AND APPARATUS FOR MAKING BEARINGS

Robert D. Pike, Piedmont, Calif., assignor to Kalif Corporation, Emeryville, Calif., a corporation of Delaware

Application March 9, 1929, Serial No. 345,705

5 Claims. (Cl. 22—65)

My present invention relates broadly to a method for centrifugally casting alloys such as the so-called plastic bronzes, and more particularly to the casting of copper-lead alloys which contain relatively high percentages of the latter.

The object of my invention is to provide new and novel apparatus and a method or process of procedure, whereby metal alloys may be successfully cast centrifugally; and particularly to provide a method and apparatus for the casting of bushings and cylindrical linings consisting of an alloy of copper and lead, wherein the lead content is relatively high.

The use of bushings in constructing bearings is quite extensive and these bushings take various forms: for instance, they may be composed of a single metal or of an alloy and in other cases the alloy is reinforced by a stronger metal. In carrying out my invention, I propose to construct my bushings of a high copper-lead base alloy in the form of a thin bushing or lining inside of a reinforcing member of stronger material such as bronze, steel, aluminum alloy, etc., to which my improved copper-lead alloy is securely brazed or welded during the process of manufacture. A series of alloys containing from 65% to 85% copper and from 35% to 15% lead is particularly dealt with here. This series of alloys has a lower coefficient of friction than the best so-called high grade tin babbitts and it possesses a conductivity for heat which is three times greater than the latter. It has about the same hardness as babbitt, but, unlike babbitt, it comprises relatively infusible metals having melting points which range from 890° C. to 950° C. In short, in so far as so-called antifriction properties are concerned, this series of copper-lead alloys is superior to the babbitt alloys; but, when made by methods hitherto known, it is comprised of weak metals which are liable to crack and pound out under heavy duty service when used as a bearing because of dendrites of lead which occur in its microstructure, and this fact has prevented its widespread commercial use. High leaded copper base alloys have hitherto been cast centrifugally, but by present known methods it is impossible to make satisfactory alloys containing more than at the most 20% of lead. By the use of my present invention, I am enabled to centrifugally cast alloys of copper and lead containing over 20% of the latter and having a granular microstructure in which large dendrites of lead are absent, and in which the lead is uniformly distributed in the form of minute particles. This feature of my invention alone effects a great improvement in the physical properties of the alloy, resulting in the making of a virtually new and superior antifriction metal; but of greater importance is the application of my invention to the brazing or welding of a relatively thin layer of my improved high lead-copper base alloys onto a stronger base of bronze, steel, aluminum alloy, or other suitable metal. My invention is particularly adapted to the manufacture of bronze backed steel or aluminum alloy backed bushings used in gas engines for bearings or in cylinder walls.

In applying my invention, it is necessary to carefully control the essential elements of time and temperature entering into the process. In making a bronze or steel backed bushing, the back may be first machined to accurate dimensions, tinned by dipping in a solder of half lead, half tin, and placed in a suitable mold or holder; or the inside may be copper-plated. In this latter case, it should have a fine thread cut in the inside face. These threads, I have found, improve the weld. I may also proceed by merely threading the inside face of the backing and cleaning it thoroughly. If the back is an aluminum alloy, I prefer to merely thread and clean it thoroughly, as suggested above, and then heat the backing before casting the lining to a temperature not in excess of 200° C.

The mold back assembly is then placed in a suitable furnace, preferably of the electric resistance type, and heated to from 200° C. to 500° C. During the heating, a steady stream of reducing gas is passed through the mold and across the exposed face of the bronze back to prevent the formation of a film of metallic oxides, which would interfere with the subsequent process of welding the copper-lead to its inside face. When at the proper temperature, the mold containing the back is transferred to a spinning device which holds the axis of the back in a substantially vertical position. The spinning device is so arranged that while spinning, a stream of neutral or reducing gas passes through the back. In the meantime the copper-lead alloy is held in a furnace which is preferably of the coreless induction type. The alloy is held at a temperature of 1093° C. to 1230° C., depending upon the size of bushing cast, the higher temperatures pertaining to the smaller bushings. While in the furnace, the alloy is covered with a suitable protective slag to prevent oxidation. When the centrifugal spinner is up to speed, a measured amount of the molten copper-lead alloy is drawn into a ladle,

which should be at substantially the same temperature as the metal, and is quickly poured into the spinning back, the spinner being rotated at a very high rate of speed. For example, a bearing which is to have an inside diameter of 2.625 inches is rotated at from 2500 to 4000 revolutions per minute, and other sizes in proportion. The molten metal drops vertically into the spinning back, through the neutral or reducing atmosphere contained therein, and hits the center of a deflector or distributor, which has the same rotational speed as the back. This rapidly rotating distributor breaks the metal into a fine, high velocity spray, which hits the inside face of the back and distributes itself thereover in a thin, uniform layer. This layer has the desired fine granular microstructure and is securely brazed or welded to the back.

If it is desired to cast a bushing of the copper-lead base alloy without any backing, the same procedure is followed, except that the back described above becomes in effect a mold. I have found that a desirable form of mold is a steel bushing whose inside face has been calorized. The high copper-lead base metal does not stick to the calorized surface and may be pushed out by any suitable means.

Having stated my invention in general terms, I shall now describe, by reference to the drawings, an example of its application in practice.

In the drawings—

Fig. 1 is a vertical, fragmentary view in section, showing the detail assembly of the spinning mold and back,

Fig. 2 is a vertical, sectional view of a furnace suitable for use in preheating the mold-back assembly,

Fig. 3 is a side elevation of the assembled spinning apparatus, and

Fig. 4 is a sectional view taken on line IV—IV of Fig. 3.

In the drawings, 10 designates the top of a suitable support for a centrifugal spinner or casting machine, as herein illustrated, this support being as shown in Fig. 3 of the drawings in the form of a metallic table. The rotary element or mold in the present instance is shown as composed of an outer steel shell 11 having a bottom closure member 12 which is threaded into the shell 11. This bottom closure member 12 is shown as provided with a downwardly projecting tapered shank 13. The shank 13 has a hole or gas duct 14 extending axially therethrough which communicates with the interior of the mold. At the upper end of the shell 11 there is also provided a top closure member 16 which is also threaded into the shell 11. In the present instance, there is shown a backing member 17 located within the shell 11. This backing member 17 may be of bronze, steel, aluminum, or other suitable metal and is machined to fit loosely within the shell 11 and is securely held in place between the bottom member 12 and the top member 16 when they are screwed toward each other in the shell 11. When the backing 17 is in place, the top closure member 16 will be screwed into the shell 11 by means of a suitable spanner wrench which will exert a sufficient pressure upon the backing 17 to produce tight joints between the backing 17 and the top and bottom closure members at the points 18 and 19 respectively so as to prevent any escape of the molten metal to be cast beyond the inner surface of the shell 17. The top closure member 16 is provided with an opening 20 near the center thereof and the bottom closure member 12 is provided with an upwardly projecting shank 21 which is adapted to carry a distributor 22. This distributor 22 may be made of any suitable material such, for example, as graphite or cast iron. It is constrained to rotate with the shank 21 by means of a pin 23 which engages in a slot 24 formed therein. When the mold has been prepared for casting, as above suggested, it is surrounded by a suitable guard which carries insulation. In the drawings this guard is shown as having a vertically extending cylindrical metallic wall 25 and a horizontally extending top cover 25'. These members carry a suitable heat insulating material 26, the insulating material 26 being provided for the purpose of preventing a too rapid escape of the heat from the mold which is preheated, as will hereinafter appear. The guard 25 is mounted upon a post 27 so that it may be raised and turned out of the way when the mold assembly proper is being set up and removed from the spinning apparatus, the raising of this guard being effected by means of a foot pedal 28 (see Fig. 4).

After the mold back assembly has been prepared and is ready for the casting of the lining of an alloy in accordance with my invention, it will be preheated and assembled with the spinning apparatus, the shank 13 thereof being inserted into a suitable socket in the upper end of a vertical shaft 29. The guard 25 will then be placed over the mold with a suitable pouring spout 30 which is secured to the guard member 25' projecting into the interior of the mold through the opening 20 formed therein. In order to heat the spout 30, I have shown a gas burner 31 as arranged to project a gas flame into the spout cavity.

In Fig. 2 of the drawings, I have illustrated a furnace 33 suitable for preheating my improved centrifugal mold carrying assembly. This furnace is adapted to be heated to a temperature of approximately 600° C. by a resistance heater coil 34. In this figure of the drawings, the shank 13 of the mold back assembly is shown as resting in the socket 35 formed in the bottom of the furnace. The socket 35 is shown as communicating with a pipe 36 through which a reducing gas can be introduced into the mold assembly as it is heated, the gas so introduced passing upwardly through the mold back assembly and out through the opening 20 in the cover thereof and escaping via the vent 37 formed in the top of the furnace and then to the ventilator hood 38. I have found that hydrogen or gases containing much hydrogen are unsuitable as a reducing gas, because the hydrogen becomes absorbed by the metal surface and is released when the copper-lead alloy is cast, making the latter porous. I therefore prefer to employ a hydrogen-free producer gas made by blowing air through hot coke.

I shall now describe, in connection with Figs. 3 and 4 of the drawings, the mechanical rotation-producing means contemplated by me. In these figures of the drawings, the shaft 29 is shown as mounted vertically in bearings 39 and 40 which are secured to a suitable steel supporting frame 41. The shaft 29 is provided with a pulley 42 about which a belt 43 driven by a motor 44 passes. The shaft 29 is provided with a stuffing box 45 at its lower end below the bearing 40. This stuffing box 45 cooperates with a stationary upwardly projecting tube or pipe 46, by means of which gas may be introduced into the mold while it is rotating, this being possible

as the upper end of the pipe or tube 46 communicates with the opening 14 formed in the tapered shank 13 of the mold assembly. The pipe 46 is shown as having a suitable fitting 47 which connects by means of a flexible tube 48 with suitable valve controlled gas conduits 49 and 50. The particular gas used may be of any suitable nature, but in carrying out my method of procedure I prefer to use two different gases, the sources of which, when connected as shown in the drawings, may be independently controlled by valves 51 and 52. The two preferable gases and their sequence of application are as follows: First, when the mold back assembly has been taken out of the heating furnace 33 and placed upon the spinning shaft 29, I pass the above referred to hydrogen-free producer gas therethrough for a few seconds. This serves to reduce any oxide which may be formed on the inside face of the backing member 17 during transition from the electric furnace to the spinner; and secondly, after this circulation of hydrogen-free producer gas has been completed and just before casting, the carbon monoxide bearing gas is swept out of the mold back assembly by passing commercially pure nitrogen therethrough. The mold will then be ready for a casting of the alloy lining or bushing.

In connection with the use of the above gases, I have found that it is possible to cast very good bushings of copper-lead alloy in an atmosphere containing as much as 25% carbon monoxide, but the molten metal has a tendency to absorb carbon monoxide and to expel it upon solidifying. On the other hand, the metal will absorb little, if any, nitrogen and, as a result, I find it to be of advantage in making castings of the highest grade to spray the metal, as will hereinafter appear, through an atmosphere of commercially pure nitrogen. The pipe 46, in addition to serving as a means of introducing the above gases into the interior of the mold, also serves a further purpose in that it may be used to dislodge the tapered portion of the mold carrying assembly from the shaft 29. This additional function of the pipe 46 is accomplished by supporting the member 47 at the lower end thereof upon one end of a pedal-operated lever so that when pressure is exerted upon the pedal, the pipe 46 will be forced upwardly and thus raise the mold back assembly so that it can be taken out of the shaft 29. The above lever and pedal are designated in the drawings respectively by the numerals 53 and 54, the lever 53 being pivoted upon a shaft 55 supported upon the frame 41. It will be understood that the shaft 46 will not be operated in this manner until after the spinning operation has terminated.

The method of procedure and operation of apparatus herein discosed is as follows: It will be assumed that it is desired to cast a copper-lead base alloy containing, for example, 75% copper and 25% lead, and that this alloy has been melted to a temperature of from 1093° C. to 1230° C. in a coreless induction furnace under a protecting slag, as suggested above. A suitable backing member such as the member 17 will then be assembled in the mold in the manner as stated above and placed into a furnace such as the furnace 33, where it will be brought to a temperature of about 400° C., a reducing gas being passed through the mold assembly during this operation. The mold is then removed from the furnace and placed in position upon the end of the shaft 29. The guard 25 will then be lowered over the mold and the whole assembly will then be started in rotation while the reducing gas, such as the hydrogen-free producer gas, will then be passed through the mold for a few seconds. At the end of this time the nitrogen gas will then be turned on and the molten alloy, which it will be assumed has in the meantime been drawn into a hot ladle of known capacity, is immediately poured through the spout 30 and into the interior of the mold assembly. As the metal is discharged from the spout 30, it will fall upon the surface of the distributor 22, where it will, as a result of the rotation of the spinner, be broken up into a fine spray which will impinge at a high velocity on the inner surface of the backing member 17 and become distributed thereover in a uniform thin and dense layer by reason of the great centrifugal force due to the high rotative speed of the mold. After spinning the mold for about thirty seconds following the pouring of the molten alloy, the assembly may be removed from the spinning apparatus and cooled, and the backing 17 with its alloy lining may then be removed from the mold.

In my co-pending application Ser. No. 345,706, filed at the same time as this application, I claim, inter alia, the feature of the quickly removable mold.

In conclusion, I wish to state that I have constructed apparatus and produced bushings in accordance with the above disclosure which I have found to possess many characteristics superior to bushings now available in that such bushings are much cheaper to manufacture and more serviceable than those manufactured in accordance with present known practice.

From the above, it will be seen that I have provided new and novel apparatus and a method of procedure for forming bushings and linings of the copper-lead alloys and, while I have specified above certain preferred proportions of copper and lead in the alloy, I desire to have it understood that the term "copper base alloy" as used in the claims is intended to embrace all alloys containing 60% or more copper; and that the term "bushing" is intended to embrace any hollow cylinder produced in accordance with the above, irrespective of how and for what purpose it is employed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. The method of casting bushings and the like which consists in assembling a metallic backing member in a suitable mold, preheating the mold while passing a reducing gas therethrough to reduce any oxide formed on the inside of said backing member, and thereafter passing nitrogen through said mold to sweep away any existing carbon monoxide, and thereafter pouring the metal while maintaining a flow of said nitrogen gas through the mold.

2. An apparatus for centrifugally casting bushings and the like, which comprises a vertically arranged rotating mold having means whereby a suitable preformed backing member may be retained therein, a distributor located substantially midway the ends thereof adapted to rotate with said mold and spray the molten metal outwardly into contact with the backing member by centrifugal force, and means for introducing a suitable gas into said mold while the metal is being poured.

3. The method of casing a copper-lead alloy, which comprises heating a mold, passing a reducing gas therethrough to reduce any oxide

formed on the contact surface of the mold, then removing said reducing gas and filling the interior of the mold with an atmospsere free of oxidizing material and of material absorbable by the molten copper-lead alloy, and pouring said molten alloy therein.

4. The method of casting a copper-lead alloy, which comprises heating a mold, passing a gas containing carbon monoxide and free of hydrogen therethrough to reduce any oxide formed on the contact surface of the mold, then removing said gas and filling the interior of the mold with an atmosphere of nitrogen free of oxidizing material and of material absorbable by the molten copper-lead alloy, and pouring said molten alloy therein.

5. In the method of lining steel bearing shells, those steps which consist in treating the surface of the shell with a molten metal and casting a coating of lining metal on the surface of the shell while maintaining the shell substantially free from contact with the air.

ROBERT D. PIKE.