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APPARATUS FOR CENTRIFUGAL CASTING OF DUAL METAL BUSHINGS

Filed Nov. 22, 1929

2 Sheets-Sheet 1

Fig. 1.

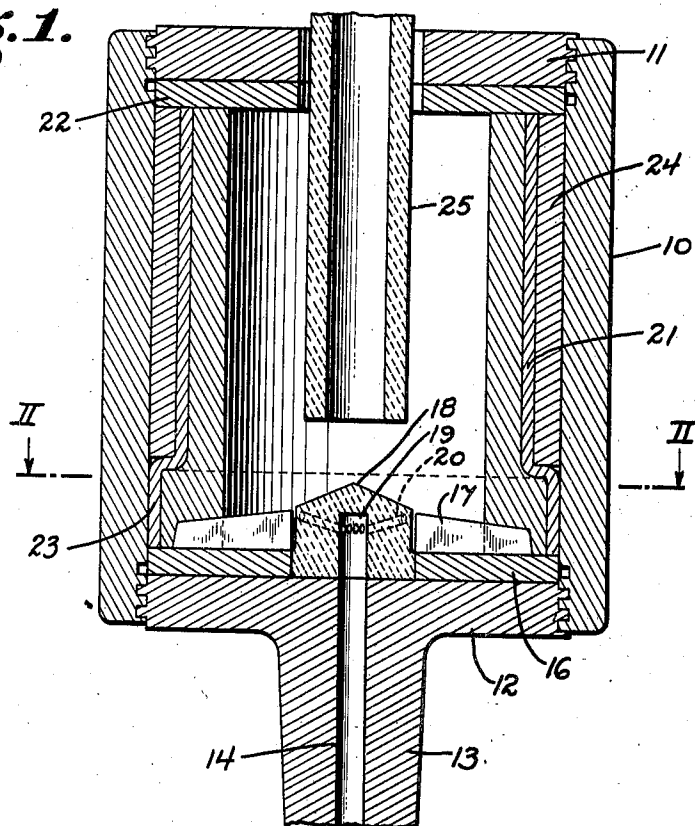
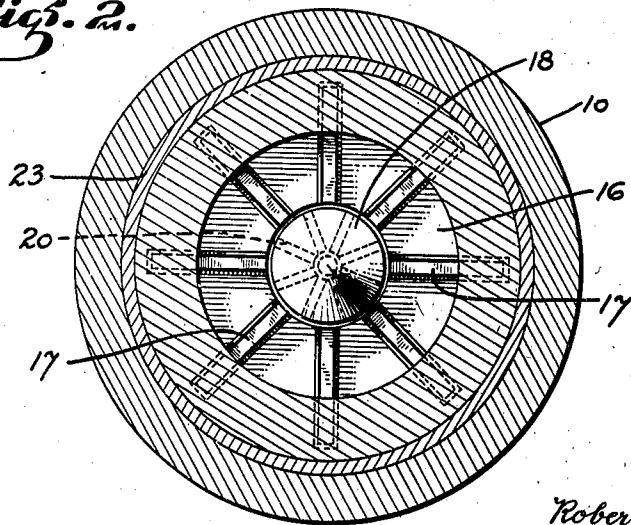


Fig. 2.



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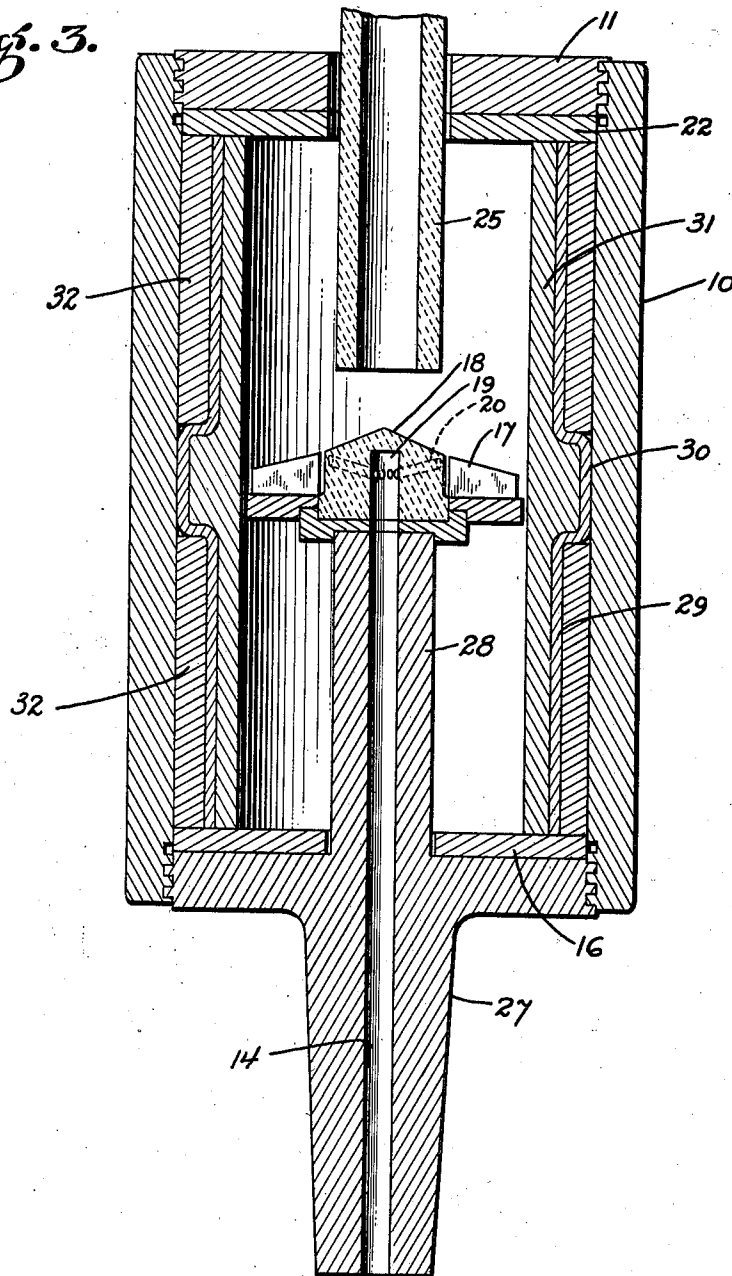
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Fig. 3.



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APPARATUS FOR CENTRIFUGAL CASTING OF DUAL METAL BUSHINGS

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My present invention relates to a method of casting reinforced bearing bushings, and more particularly to a method of centrifugally casting an alloy lining of copper and lead inside of a relatively higher fusion point reinforcing backing.

An object of my invention is to provide a method and apparatus for casting a bearing lining of a suitable alloy in a preformed backing of another metal so that the lining alloy will, when cast, be bound within the reinforcing backing with a welded engagement.

My invention deals particularly with the use of a lining or bearing metal of an alloy of copper and lead containing 23% to 30% of lead, which contains only minor amounts of other elements but is not necessarily limited to the use of such a metal. As a backing metal I prefer to employ a strong metal which has a coefficient of thermal expansion substantially the same as the copper-lead liner and a fusion point as high or higher. I prefer to use as a backing, copper base metals, for example, phosphor bronze, admiralty bronze, or aluminum bronze. It is an object of my invention to cause the high fusion point lining metal to flow under the influence of centrifugal force in a uniform layer without flow or chill lines over the backing metal, and to maintain the condition of the surface of this backing metal and other necessary conditions such that the lining metal becomes securely brazed or welded to the backing metal. I have found that if the back be mounted in a rotor in any well known former manner, whether in a vertical or a horizontal position, and while spinning the molten copper-lead be poured in, a non-uniform poorly welded product having no commercial value will be the result. I am fully aware of well known methods employed for lining bronze or steel backs with babbitt, but these all take advantage of the low fusion point of babbitt which makes it easy to flow the molten babbitt in a uniform layer over the back. As a result of extensive research and manufacturing development, I have found that the following novel conditions should be observed to produce sound, commercially valuable linings of a high fusion

point metal, such as copper-lead, inside a back:

1. The rotor should be elastically mounted so that it will spin without vibration.

2. The rotor back assembly should be heated before spinning to from 490° to 500° C. in an atmosphere of reducing gas substantially free from hydrogen and sulphur, and when transferred to the spinner an atmosphere of this same gas should be maintained while the back is spinning and while the metal is being poured.

3. The surface of the back must be entirely free from non-metallic elements and should preferably be either sand-blasted or tinned by dipping in solder in the usual well known manner.

4. A definite centrifugal force should be employed consistent with the desired lead content on the finished face of the bushing and this centrifugal force should be smaller as the bushing becomes larger.

5. The copper-lead alloy should contain about 27.5% lead and should be poured at a temperature ranging from 1200° to 1250° C. The first metal poured into the back should be accumulated in an annular ring or puddle which should be filled with hot metal before any metal actually flows onto the inside face of the back proper. As the metal flows into the puddle under the influence of centrifugal force, it should have imparted to it before it actually reaches the puddle substantially the full rotational speed of the back. This latter precaution is necessary to prevent the molten copper-lead from whirling around inside the back which would cause chilling, flow cracks and lead segregation. By bringing the molten metal up to full rotational speed before it reaches the puddle, the metal which overflows the puddle will cover the inside face of the back with maximum speed and minimum turbulence.

6. A sufficient amount of copper-lead must be poured to raise the temperature at the boundary between the liner and the back high enough so as to effect a strong weld. The surplus of metal is bored out and remelted. This amount of metal is also chosen so that the lead content on the finished machined face will be not less than 23%.

With the above and other objects in view, I shall now describe my improved method and apparatus in connection with the drawings which accompany this specification. These drawings are prepared for the purpose of illustration and are not to be taken as limiting my invention in any manner or degree, as the invention may be carried out with various other types of apparatus and methods of procedure.

In the drawings:

Fig. 1 is a vertical section taken through a preferred type of vertical mold after the bearing lining has been cast,

Fig. 2 is a plan view in section taken along line II—II of Fig. 1, and

Fig. 3 is a modified form of my invention shown in arrangement whereby extremely long bearings or two shorter bearings may be cast at one and the same time.

Before proceeding with a description of the apparatus shown in the drawings, it is thought that some reference should be made to the type of apparatus which it is contemplated using as a rotation imparting means for my improved molds. An apparatus which is particularly well adapted and preferred by me for spinning my molds is illustrated in my prior application Serial Number 345,707, filed March 9, 1929. In this application I have disclosed a centrifugal mold assembly, somewhat similar to my present mold, as mounted in a tapering socket formed in the upper end of a vertically disposed rotating spindle. In this disclosure the spindle is shown as mounted upon suitable yielding supports so that when it is rotated at high speed, the spindle and mold will be able to center itself and compensate for any unbalance in the mold set-up and, as a result, the mold will be rotated in a substantially vibrationless manner. In this disclosure there is also shown means in the form of a pipe which is adapted to project up centrally through the bottom of the mold for the purpose of introducing a suitable gas into the mold during the preheating operation and during the casting operation, as will hereinafter appear.

For the purpose of adapting my present molds to a rotating mechanism of the character described in my prior application and outlined above, I provide downwardly extending tapered extensions upon the molds. With this method of mounting, I have provided a means whereby a single spinning mechanism may be used in connection with any number of molds, as the molds can, after preheating, be transferred from the heating oven directly to the spinning apparatus and, after the casting operation, removed from the spinning apparatus in a convenient manner so that other molds can be mounted upon the spinning apparatus and the operation repeated. From the above, it will be seen that

the capacity of a plant for casting bearings in accordance with my method will only be limited by the number of molds available and the time required for cooling and removing the already cast bearings from the molds to render them available for a subsequent casting.

In the drawings 10 designates an outer cylindrical shell or housing threaded at its top and bottom to receive top and bottom closure members 11 and 12, respectively. The bottom closure member 12 is shown as having the previously-referred to tapered shank, designated by the numeral 13, extending downwardly therefrom. The tapered shank 13 is also illustrated as having a central opening 14 therethrough. Located in the bottom of the housing thus formed and resting upon the bottom closure member 12, there is shown an annular plate member 16 upon which there is formed a plurality of radial vanes 17. The plate 16 and the vanes 17 formed thereupon are preferably made of some well known highly resistant alloy of iron, chromium, and nickel. Located centrally of the plate 16 and vanes 17, there is shown a spreader or cone-topped member 18 which is preferably made of graphite. The spreader 18 is provided with a central cavity 19, from which there extends a plurality of conduits 20, the conduits 20 terminating at their outer ends between adjacent vanes 17. The cavity 19 registers with the opening 14 in the shank 13 and is adapted to receive any gas introduced therethrough and direct it out through the branch conduits 20 into the interior of the mold assembly. An alternative form of construction for the above elements may be provided by casting the plate 16, the vanes 17, and the spreader 18 integrally of one piece of resistant metal.

In preparing the above mold assembly for a casting operation, I place a precast backing member 21, which is preferably of bronze or some other relatively stiff metal, within the housing 10 with its ends abutting at the bottom upon the plate 16 and at the top against a disc 22 of cast iron or other suitable material. The backing or reinforcing element 21 is provided at its lower end with a bell or enlarged extension 23 which, as will be seen, creates an annular space of larger diameter than the major portion of the bearing backing 21. This bell-shaped extension on the lower end of the backing member 21 will, when the mold is in operation, provide what might be termed a puddle cavity from which the alloy of the bearing lining proper will flow, as will hereinafter appear. In order to center the backing 21, I have shown a filler or sleeve 24 which extends between the shell 10 and the main portion of the backing 21. Formed centrally through the top closure member 11 and the disc 22, I show

an annular opening, through which a suitable pouring spout 25 may be projected.

Before the above assembly is set up, I prepare the reinforcing backing 21 by sand-blasting or cleaning and tinning the inside surface thereof. After the assembly is completed as above outlined and prior to the casting operation, the complete assembly is inserted in a suitable furnace, where the whole is heated up to a predetermined temperature which ranges somewhere between 400° and 500° C. While the particular type of furnace used is not material to my present invention, I have found that one of the so-called electric resistance type is particularly well suited to this use. The furnace should also and preferably be provided with means whereby a producer gas which is free from hydrogen and sulphur may be introduced into the interior of the mold while it is being heated up. In addition to a preheating of the mold assembly, it is also desirable that the casting pipe 25 be heated substantially red hot before the molten metal is poured into the mold. This is extremely important where castings containing small amounts of alloy are being made.

From the above, it will be seen that the casting pipe 25 is so disposed that when the molten alloy is poured, it will direct a stream of the molten alloy directly upon the center of the spreader 18. This alloy will then flow out between the radial vanes 17 and, by reason of their radial disposition, be thrown radially into the puddle cavity previously referred to. It will be evident that as the metal is engaged by the vanes 17, it will be divided into radial streams of metal to which there will be imparted circumferential movement, and that by the time the metal reaches the puddle cavity, it will have acquired a circumferential velocity equal to the circumferential velocity of the inner surface of the mold and, as a result, a rotary motion will be imparted to the molten metal directly by the vanes 17 and not as a result of frictional engagement between the molten metal and the inner annular surface of the lining 21. As a result of the molten metal engaging the inner surface of the lining 21 at the same circumferential velocity as the backing member, there will be no turbulence or circumferential swirling set up in the molten metal and, consequently, no separation of the individual metals which comprise the alloy will be possible.

In the embodiment of my invention illustrated in Fig. 3, it will be seen that the shell 10 is made considerably longer than the similar element illustrated in Fig. 1, and that the bottom closure member here designated by the numeral 27 differs from the closure member 12 in that it is provided with an upwardly extending extension 28 upon which the distributor head with its spreader 18 and radial

vanes 17 will be supported substantially midway between the ends of the mold. In this embodiment, instead of providing a bell end as illustrated in connection with the backing member 21 of Fig. 1, the backing member designated by the numeral 29 is here shown as having a bulge midway its ends, the bulge being formed by a portion 30 which extends outwardly so as to form a puddle cavity, as previously described. In this embodiment of my invention it will be understood that when the molten metal is introduced through the casting pipe 25 it will, upon striking the distributor head, be thrown out radially into the puddle cavity and will, after the puddle cavity has been completely filled, flow outwardly in both directions toward the ends of the backing member 29 so that in this manner a relatively long bearing, or two shorter bearings, may be cast at one and the same time. If two shorter castings are desired, it will be understood that the portions of the finished casting which form the puddle area may be turned off, or, if desired, the casting may be cut in half, leaving what might be termed a finished flange having a bearing surface at one end of each bearing. In connection with this embodiment, it will be noted that the vanes 17 of the distributor head terminate short of the inner surface of the alloy casting proper designated by the numeral 31. This is so as to permit an easy removal of the finished casting from the casting mold.

In the embodiment illustrated in Fig. 1, however, it will be noted that the vanes 17 extend out into the puddle cavity and as they are chamfered so as to provide draft clearances, they may be readily withdrawn from the end of the finished casting after it has cooled. Inasmuch as such withdrawal would be impossible in the structure illustrated in Fig. 3, it is necessary that these vanes do not extend into the casting area or puddle cavity. In Fig. 3 there are also shown spacing sleeves 32 which serve to hold the ends of the reinforcing backing 29 concentric within the sleeve 10. In this embodiment of my invention the mode of operation is substantially the same as that to be described in connection with Fig. 1.

As an example of the operation of my invention, I shall describe the manufacture of a bronze backed bushing which will finish at 2.75 inches inside diameter by 3 inches long. In the preferred embodiment of my invention I have found that approximately 1¼ to 2 pounds molten copper-lead alloy is required for each pound in weight of the brass or bronze backing member 21. Experience has also shown that the volume of molten alloy in the puddle should be about .1 cubic inch for each pound of lining metal poured per inch of height of the bronze backing member. After the rotor mold with the prepared bronze backing member in place is heated to 500° C. with the stream of hydrogen and sul-

phur free producer gas flowing therethrough, it is then quickly transferred to the spinning apparatus where the same gas is continuously passed therethrough while the assembly is rotated at approximately 2,000 to 3,000 revolutions per minute. I then introduce into the mold through the casting pipe 25, the alloy which has been previously brought to the required temperature. I have found that a preferred type of alloy which will produce superior bearings is one containing copper and lead, the lead content being roughly 27½% and the balance copper. With such an alloy I find that the casting can best be made by introducing this alloy into the mold at a temperature ranging from 1200° to 1250° C. In heating the alloy, I have found that the well known high frequency induction type of furnace is particularly well adapted to this problem. It is also beneficial to heat the alloy beneath a suitable protective slag.

After the mold has been preheated and otherwise prepared and the molten metal heated to the required temperature, a measured amount of the molten alloy is quickly poured into the spinning rotor. This molten alloy falling through the casting pipe 25 strikes centrally of the spreader 18 and is immediately thrown or pumped radially by the rapidly rotating radial vanes 17 into the puddle cavity. The first metal which enters the puddle cavity will be relatively cool because of having passed over relatively cool parts of the apparatus. These parts of the apparatus will, however, become rapidly heated by the passage of molten metal, and by the time the puddle has become filled enough metal will have flowed over the various parts with which it comes in contact to heat them up so that no detrimental cooling of the final and lining forming alloy will result. It should be also borne in mind that the metal in the puddle, as a result of the vanes 17, is rotating at the same circumferential speed as the rotor. As soon as the level of the metal in the puddle coincides with the inside surface of the bronze backing proper, the additional metal poured will flow under the influence of the high centrifugal force with great speed over the inner surface of the backing. In other words, the molten metal, as it flows over the inner face of the backing proper, will pursue a strictly axial flow because, as stated above, it is at the time rotating at the same speed as the back, with the result that it will cover the inner face of the backing so rapidly and so smoothly that the entire operation will be completed almost instantaneously and before any of the alloy has had an opportunity to solidify.

It should be pointed out here that it is essential that the casting operation be carried out very rapidly, as it has been found that where any appreciable interval of time is taken in flowing the lining alloy, this will be

absolutely fatal to the securing of satisfactory results. In other words, I have found that it is necessary that the casting of the lining be carried out with almost instantaneous rapidity in order to accomplish the best results. It should be noted that with the above arrangement, and particularly the radially disposed vanes 17 at the bottom of the mold, there is virtually provided a centrifugal pump for the molten metal which discharges the latter at full rotational velocity onto the inner face of the backing member. In connection with the introduction of the reducing gas into the mold, it should be noted that the disposition of the conduits 20 is such that none of the molten metal may escape there-through.

After the lining has been cast, the rotation of the mold is kept up for approximately 30 seconds. The rotor can then be stopped and set aside to cool. After cooling, the lining metal may then be turned out to suitable dimensions and the enlarged or puddle end cut off. This will provide a cylindrical bushing and a substantially uniform lining of homogeneous alloy.

While I have, for the sake of clearness and in order to disclose my invention so that the same can be readily understood, described and illustrated specific devices and arrangements, I desire to have it understood that this invention is not limited to the specific means disclosed but may be embodied in other ways that will suggest themselves, in view of this broad disclosure, to persons skilled in the art. It is believed that this invention is broadly new and it is desired to claim it as such so that all such changes as come within the scope of the appended claims are to be considered as part of this invention.

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

1. An apparatus for casting cylindrical bushings by the centrifugal method which comprises a vertically disposed centrifugal mold having an annular cavity provided at one end of a larger outside diameter than the inside diameter of the casting to be made, and means for projecting molten metal into said annular space as said mold is rotated.

2. An apparatus for casting cylindrical bushings by the centrifugal method which comprises a vertically disposed centrifugal mold having an annular cavity of a larger outside diameter than the inside diameter of the casting to be made, a distributor arranged for projecting molten metal into said annular cavity as said mold is rotated, and means carried by said distributor adapted to project the molten metal radially into said cavity and at a circumferential velocity equal to that of the cavity walls, whereby turbulence in the molten metal will be avoided.

3. An apparatus for casting cylindrical

bushings by the centrifugal method which comprises a vertically disposed centrifugal mold having an annular cavity provided at one end of a larger outside diameter than the inside diameter of the casting to be made, a distributor arranged to project molten metal into said annular cavity as said mold is rotated, and radially extending vanes upon said distributor adapted to project the molten metal radially into said cavity at a circumferential velocity equal to that of the cavity, whereby turbulence in the molten metal due to rotation of the mold will be avoided.

4. In a centrifugal casting machine, the combination of a vertically disposed rotary mold adapted to be rotated at high speed, means at the upper end of said mold for the introduction of molten metal, a distributor disposed opposite said means for directing the molten metal in radial paths toward the walls of said mold, and means in said mold whereby a quantity of molten metal in excess of that required for the bushing may be introduced and from which the molten metal forming the bushing will flow during the final stages of the pouring operation.

5. A centrifugal casting machine, which comprises a centrifugal mold having an annular cavity of a larger outside diameter than the inside diameter of the major portion of said mold, and means for imparting a circumferential velocity to molten metal equal to that of the cavity walls and to project it into said annular cavity as the mold is rotated.

6. A centrifugal casting machine, which comprises a centrifugal mold having an annular cavity at one end thereof of a larger outside diameter than the inside diameter of the major portion of said mold, and means for imparting a circumferential velocity to molten metal equal to that of the cavity walls and to project it into said annular cavity as the mold is rotated.

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