

April 23, 1935.

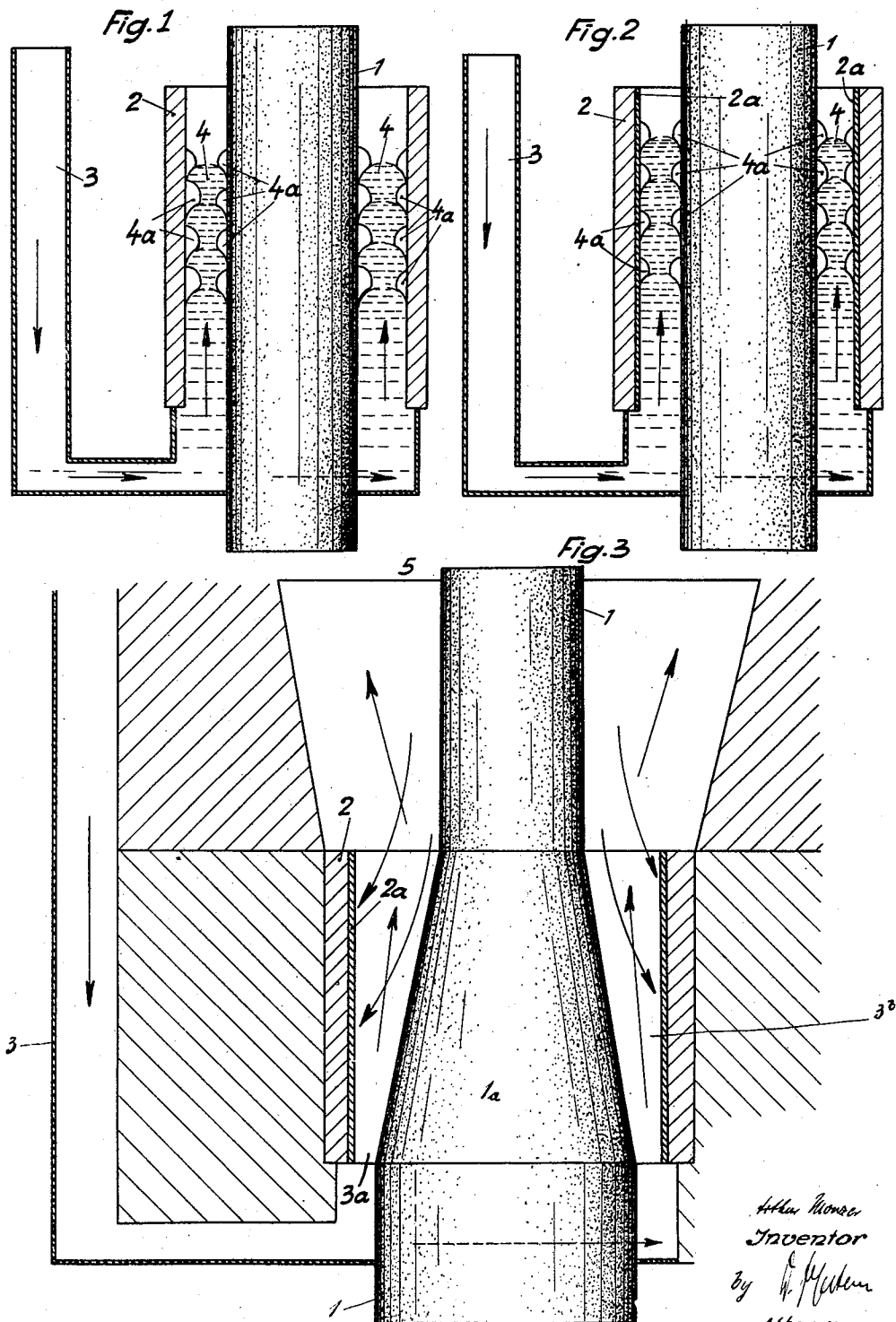
A. MONZER

1,998,516

METHOD FOR UNITING STEEL AND BRONZE INTIMATELY WITH ONE ANOTHER,
AND AN IMPROVED MOLD FOR CARRYING OUT THIS METHOD

Filed Nov. 7, 1933

2 Sheets-Sheet 1



April 23, 1935.

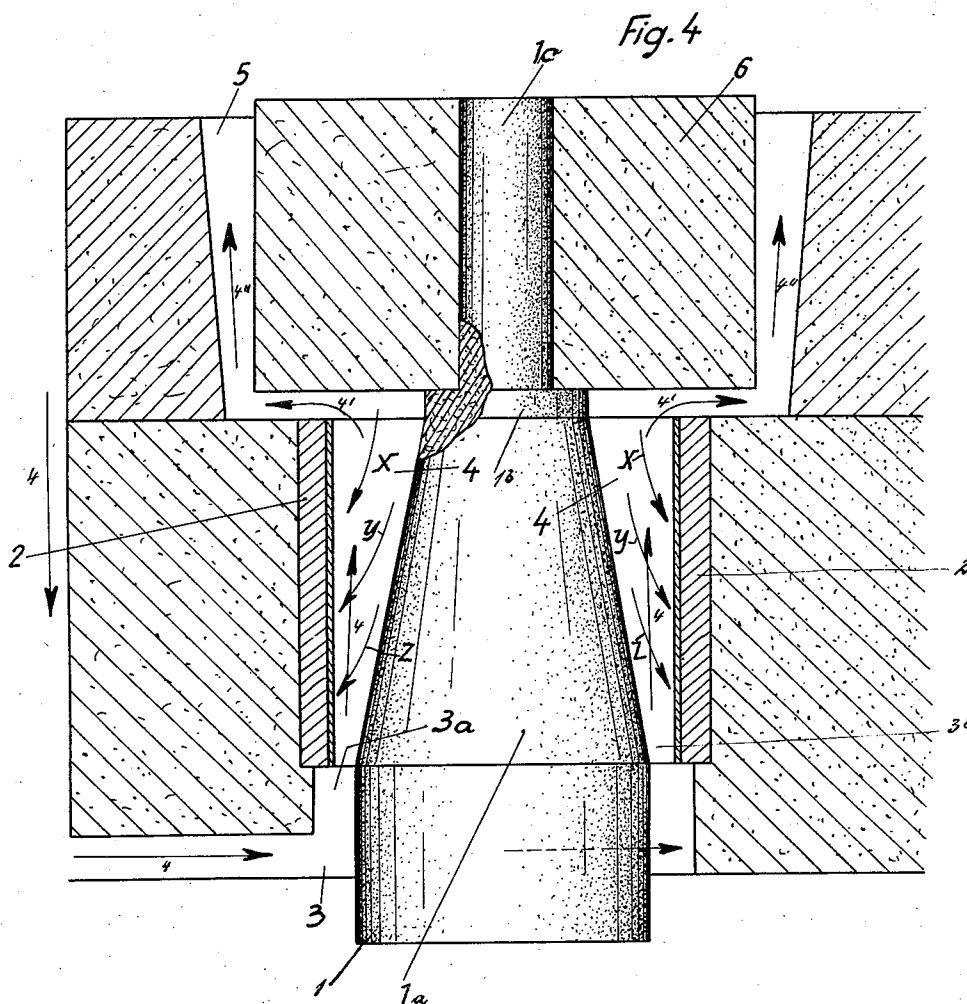
A. MONZER

1,998,516

METHOD FOR UNITING STEEL AND BRONZE INTIMATELY WITH ONE ANOTHER,
AND AN IMPROVED MOLD FOR CARRYING OUT THIS METHOD

Filed Nov. 7, 1933

2 Sheets-Sheet 2



Arthur Monzer
Inventor:

by *H. J. H. H.*
Attorney.

UNITED STATES PATENT OFFICE

1,998,516

METHOD FOR UNITING STEEL AND BRONZE
INTIMATELY WITH ONE ANOTHER, AND
AN IMPROVED MOLD FOR CARRYING OUT
THIS METHOD

Arthur Monzer, Berlin-Pankow, Germany

Application November 7, 1933, Serial No. 696,997
In Germany November 12, 1932

5 Claims. (Cl. 22-203)

This invention relates, in the first place, to a method for the intimate union of steel and bronze, and in the second place to a casting mold for carrying out that method. Methods aiming at the object stated are important for the manufacture of various parts, especially members of machines and engines, as, for instance, piston rings and axle bearings, especially such in which the bearing consists of steel and is to be cast out with a plastic, viz. lead-containing bronze.

It has already been proposed to unite ultimately by welding together a steel axle bearing and plastic bronze, as has been described, for instance, in the French Patent No. 714,180, and it has, furthermore, been already proposed to make use, in connection with the just mentioned welding method, of a metallic intermediate layer, for instance of copper, as has been disclosed in the French Patent No. 680,049, the copper or other intermediate metal or metallic layer effecting a tolerably intimate union between the bronze and a steel skeleton constituting the bearing or the like.

Anyhow, both said methods are deficient. It has been ascertained by experience that an actually reliable, really unobjectionable union between the steel and the bronze cannot be attained if the shrinking of the two metals taking place after the casting and during the congealing is not paid attention to. The intimate union obtained at first, i. e. during the casting and immediately thereafter, is soon broken owing to the different coefficients of expansion of the two metals. The object of the present invention is to obviate that serious deficiency, and I attain the object in view, generally speaking, by providing for a mechanical, as well as a thermic compensation between the several physical constants during the casting and thereafter.

In order to make my invention more clear, I refer to the accompanying drawings in which are represented vertical axial sections through several casting molds, such used in connection with the known method and such used in connection with my present improved method which will be understood by far better and its merits and the progress made will be appreciated by far more correctly when prior to describing in detail this improved method and the appertaining mold the known methods and the appertaining molds are dealt with.

Figure 1 relates to the casting method in which no intermediate layer between the steel and the bronze is employed.

Figure 2 relates to that casting method in which an intermediate layer is used.

Figure 3 relates to my improved method, as fully described hereinafter.

Figure 4 relates likewise to my improved method, viz. to a modification thereof.

Referring to Fig. 1, 1 denotes a core which is surrounded with a steel skeleton or shell 2. Between the members 1 and 2 is an annular space for the reception of the liquid bronze 4. The inner surface of the shell 2 where the liquid bronze contacts therewith is preferably covered with a metal layer 2a, as shown in Fig. 2 (and also in Fig. 3). The liquid bronze is cast into the mold through the conduit 3.

When the liquid bronze is rising in the tubular space between the core 1 and the shell 2 its upper surface will be convex owing to the friction arising between the liquid metal and the shell on the outer side and the core on the inner side thereof whereby the liquid metal is a little retained on these sides. The convexity can become so great that the elevated portion of the liquid metal tumbles over outwardly and inwardly and in doing so encloses air, as indicated at 4a in Fig. 1. This air, it is true, is carried along upwardly by reason of the further supply of metal from below, but the period of time during which it is in contact with the shell is sufficient to enable the air to exert the detrimental effect that the entire inner surface of the shell is covered with a thin layer of very fine oxide, in consequence of which the bronze unites more with this layer than with the steel of the shell whereby the intimacy of the union is rendered questionable.

Matters are different if the inner surface of the shell 2 is covered with an insulating metallic layer 2a, for instance of copper, as in Fig. 2. In this case the air enclosed in the spaces 4a does not come into contact with the steel of the shell 2, but the copper is melted by the liquid bronze and the molten copper is conveyed upwardly away by and together with the further supplied liquid bronze so that, in the end, this latter comes into contact with the pure steel surface and the desired intimate union between the steel and the bronze is obtained.

It is obtained, it is true, but it is not lasting, in that the union is soon broken firstly by reason of the different coefficients of expansion of the two metals which coefficients become effective during the congealing of the metals, and secondly, on account of the following reason:

It has been discovered that the liquid bronze

cools down the quicker the more it rises in the tubular space between the core 1 and the shell 2, and there arise ununiform bindings and tensions that entail tearing off of the bronze from the steel when the liquid bronze is cooling down and becomes rigid. There is lacking a compensation for the shrinking in mechanical, as well as in thermic respect. This compensation is obtained in my improved process, the greater effect of which is due thereto.

Concerning the temperature at which the liquid bronze is inserted, it is for a casting expert a matter of course that that temperature is to be considerably higher than the fusing temperature of the bronze, and that temperature is also considerably higher than the fusing temperature of copper. Otherwise, the liquid bronze when being introduced into the cold mold would soon solidify at its surface which would prevent its further introduction from below.

An important point to be noted is, however, this that the surface of the layer or lining 2 unites partly with the liquid bronze and forms therewith an alloy, the fusing point of which lies below that of the pure copper. When the liquid bronze is being cooled down by the cold mould the good conductivity for heat of the copper does not play an important part, as the steel shell 2 is embedded into a material which conducts the heat away either only very slightly or practically not at all. If, therefore, the copper lining and the steel shell have been heated by the liquid bronze, the transmission of the heat to the material enclosing the shell is too small to be of any importance.

Referring now to Fig. 3, the core 1 is no more cylindrical, but its active portion is conical, as at 1a, and the sectional area of the passage 3a through which the liquid bronze enters into the space 3b between the core and the covering 2a of the sleeve 2 is possibly narrow. Owing to said space increasing in thickness from its lower portion to its upper one the speed of the entering liquid bronze decreases correspondingly in upward direction. Above the space 3b, where there is the cylindrical portion of the core, a hopper-shaped enlargement 5 is provided into which the surplus of the bronze enters and in which this portion of the bronze acts as a heat accumulator and a heat cushion and besides, exerts a pressure upon the bronze in the space 3b. This pressure becomes active, of course, also at the circumferential inner and outer surface of the space 3b, in consequence whereof the welding procedure going on at said outer surface is mechanically assisted in a considerable degree.

Owing to the provision of the conical portion 1a of the core and to the narrowness of the passage 3a, in connection with the heat accumulator constituted by the liquid bronze in the hopper 5, the particular effect is attained that the bronze present in the upper portion of the space 3b is not cooled down earlier than in the lower portion of said space, but that just the reverse is the case. By reason of the above-mentioned pressure exerted by the liquid bronze in the hopper 5, in conjunction with the compensation of the temperature, also as above disclosed, the bronze and the steel are welded together in an absolutely unobjectionable manner.

An important feature is also constituted by the metallic covering 2a which acts deoxidizing with respect to the steel shell 2 and has a fusing point which is not higher than the temperature of the liquid bronze introduced into the mold,

but is also not below the fusing temperature of the bronze employed.

Referring now to the modification shown in Fig. 4. In this constructional form there is above the conical core portion 1a a disk-like prolongation 1b followed by a rod-like extension 1c serving firstly as a guide for a heavy member 6 serving in turn as guide for the liquid bronze passing upwardly from the space 3b and causing it, while still being present in this space, to act especially upon the upper half of the inner surface of the steel shell, in that its direction of flow from the space 3b is to and into the flat space below the member 6 is radially outwardly, as indicated by the arrows 4'. The second purpose of said heavy member 6 is to increase the pressure which the liquid bronze below it exerts upon the bronze in the space 3b. The arrows 4 indicate in general the direction of flow of the liquid bronze in the space 3b, the arrows 4'' indicate the direction of the bronze in the space 5 in which the member 6 is located, and the arrows x, y, z indicate the directions in which pressure is exerted upon the inner surface of the shell 2. The useful effect of all said provisions is that there arise no bubbles whatever between the bronze and the steel, as aimed at.

As slow cooling of plastic bronze tends to promote segregation and quick cooling tends to prevent it, the annular shape of the space 5 is favorable in thermic respect, especially when an alloy is cast into the mold, in that no segregation of any one of the component metals of the alloy can take place by reason of the quick cooling.

I wish it to be understood, as regards the molds, I do not limit myself to the two constructions forms shown in the drawings merely by way of example. It is, for instance, possible to provide the bronze, besides at the inner surface of the steel skeleton or shell, also at the outer surface thereof, in which case the mold must be correspondingly designed and the protective layer of the deoxidizing metal must be provided on both surfaces or sides. It is furthermore possible to provide for a second supply of the liquid bronze into the upper chamber, especially in the case of large castings, the purpose being then to maintain a possibly high temperature of the bronze.

I claim:

1. The method of uniting intimately a steel skeleton and bronze with the aid of a deoxidizing metallic intermediate layer, comprising providing in said skeleton a space, the height of which corresponds with the axial length of said skeleton and the sectional area of which in horizontal direction increases from its lower end to its upper end; providing, further, a chamber located above the said skeleton and communicating with said space, introducing the bronze in liquid state into the said space from below, and continuing the introduction thereof until it has practically filled also said chamber.

2. The method of uniting intimately a steel skeleton and bronze with the aid of a deoxidizing metallic intermediate layer, comprising providing in said skeleton a space, the height of which corresponds with the axial length of said skeleton and the sectional area of which in horizontal direction increases from its lower end to its upper end; providing, further, a chamber located above the said skeleton and communicating with said space, introducing the bronze in liquid state into the said space, from below through a passage which is pronouncedly narrow in proportion

to the horizontal sectional area of the said space, and continuing the introduction of the bronze into the said space until it has practically filled also said chamber.

3. The method of uniting intimately a steel skeleton and bronze with the aid of a deoxidizing metallic intermediate layer, comprising providing in said skeleton a space, the height of which corresponds with the axial length of said skeleton and the sectional area of which in horizontal direction increases from its lower end to its upper end; providing, further above the said skeleton a hopper-shaped chamber, the lower diameter of which corresponds with the outer diameter of the said skeleton and which communicates with said space, introducing the bronze in liquid state into the said space from below, and continuing the introduction thereof until it has practically filled also said chamber.
4. A mold for casting composed bearings, comprising, in combination, a shell, a conical core in the same, an upwardly directed extension upon

said core, a loading member surrounding said extension, an annular body surrounding said loading member, the said shell, core, loading member and body forming between them a tubular space into which the bronze is to be introduced in liquid state from below and the sectional area of which increases in horizontal direction from below to above.

5. A mold as specified in claim 4, in which the bottom face of the loading member is located somewhat remote from the upper edge of the shell and the diameter of said member is greater than the outer diameter of the shell so as to form below its bottom surface a disk-shaped space through which the liquid bronze rising from below is compelled to flow radially outwards; and in which mold, further, the diameter of the space surrounding the loading member is greater than the diameter of this member so as to form an annular passage between this member and the body in which said space is provided.

ARTHUR MONZER.