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METHOD OF CASTING

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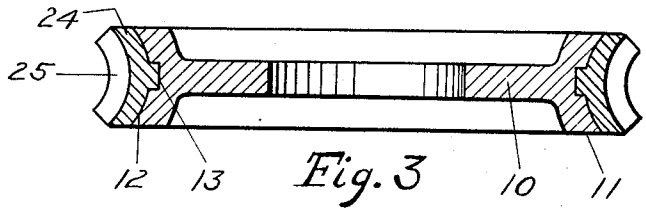


Fig. 3

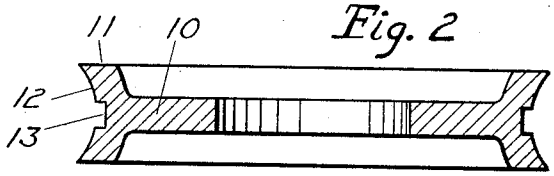


Fig. 2

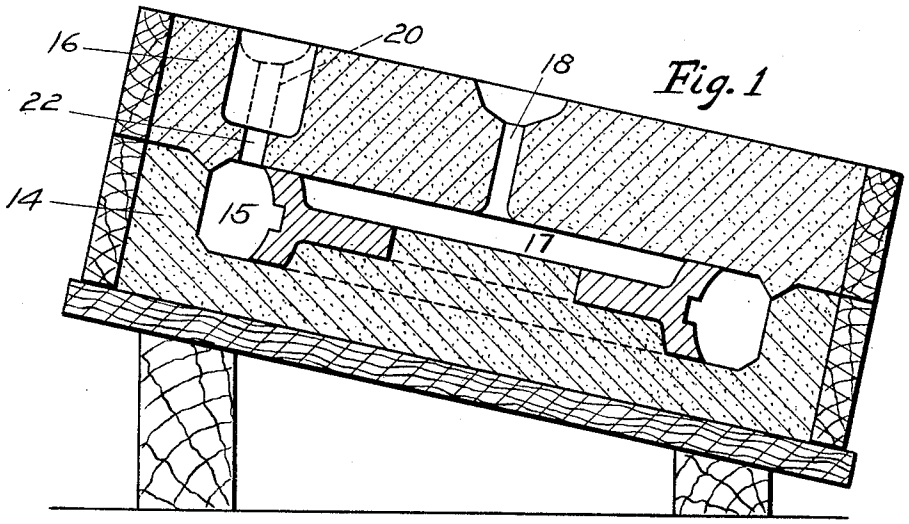


Fig. 1

WITNESSES

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UNITED STATES PATENT OFFICE.

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METHOD OF CASTING.

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This invention relates to a method of casting metal objects such as a gear, made of two different metals which have been cast together.

It has been found that for heavy duty purposes a bronze or brass gear is more suitable than is one made of cast iron, but large gears made entirely of bronze or brass are too expensive for ordinary usage; hence such gears are now ordinarily made of a bronze rim fastened by bolts to a cast iron center. Such a construction is not as strong as is often desired. Also, it is difficult to mount the machined bronze rim exactly concentric with the cast iron center when assembling the parts, and this may result in the gear teeth becoming broken during service. Various difficulties have been met heretofore in the effort to cast a bronze or brass rim on an iron center, particularly if the iron part is large, owing largely to the differences of shrinkage of the two metals and the consequent liability of the iron center to crack during cooling. This cracking seems to be due to the fact that when the molten metal is poured into contact with the comparatively cold rim of the center, the heat is transmitted unevenly therethrough and causes the outer portion of the iron center to expand more rapidly than does the central part.

It is accordingly the main purpose of my invention to overcome these difficulties as heretofore met and to provide a new method of manufacture which enables one to cast such a bronze or brass rim on an iron center and to form a gear or other fabricated article therefrom.

In accordance with my invention I provide a method particularly adapted for casting a rim on a large center, such as a rim of bronze on an iron gear center, by heating the center during the casting operation in such portions and in such a manner that it will expand and contract with sufficient uniformity to prevent cracking. This may be accomplished by pouring molten metal into contact with the central portion of the iron body, as well as around its periphery. In order to make a large gear of the shape shown in the drawings, a mass of molten metal may be poured into contact with the web of the gear at substantially the same time that the bronze rim is poured, the temperature and the amount of the molten metal poured into contact with the gear web being such relative to the temperature and quantity of the rim metal as to cause the iron body to heat and subsequently cool with sufficient uniformity to prevent cracking.

It is desirable, in making a large gear, that the rim be made of a metal of high ductility, toughness and tensile strength.

A suitable composition which I may employ for this purpose is known as a manganese bronze, although it is more properly termed a brass, and may consist of the following ingredients in the proportions given:

	Per cent.
Copper	57
Tin	0.75
Zinc	40
Iron	1
Aluminum	0.5
Manganese	0.25

The tensile strength of this particular manganese alloy is from 70,000 to 75,000 lbs. per square inch as compared with a strength of from 26,000 to 32,000 lbs. for the ordinary bronze. The Brinell hardness number is from 109 to 119 as compared with 49 to 55 for the usual type of bronze. The elongation in tension of this manganese bronze for a piece two inches long is from 20 to 35% while ordinary bronze gives an elongation of from 15 to 20%. The ordinary bronze, it may be noted, is made up of 85% copper and 5% each of tin, lead and zinc.

In accordance with one phase of my invention, I may make a gear which has a rim of such manganese bronze cast on a cast iron center by employing the following method as illustrated in the drawings:

In the drawings, in which like reference numerals indicate like parts:

Fig. 1 is a vertical sectional view of a sand mold containing an iron center and ready for the pouring operation;

Fig. 2 is a vertical section of the iron center before casting the rim thereon; and

Fig. 3 is a similar view of the completed gear.

A cast iron center is first made by well known methods, and this center is preferably formed with a central web 10 and a flange 11 having a hollow peripheral portion 12 which is further provided with a groove 13 designed to aid materially in holding the

bronze rim in position. This iron center is placed in the lower half 14 of a sand mold with a pattern arranged to form the space 15 within which the bronze rim is to be cast and the upper half 16 of the mold is suitably formed for the casting operation. In order to prevent uneven expansion of the iron center and thereby cracking the same, I pour a molten metal into contact with the iron center and particularly adjacent to the inner side of its flange at substantially the same time that the manganese bronze is poured into the casting space provided for the gear rim. This assures heating the rim of the center thoroughly throughout and to a considerable extent uniformly so that the molten alloy on the outside will not send its heat unevenly through the flange of the center and cause uneven expansion and cracking.

To this end, I remove the sand from the space 17 above the iron center and form a sprue 18 through the upper half of the sand mold which permits pouring molten metal into this space 17. In order to pour molten metal into the space 15 a further sprue 20 is provided in accordance with the well-known practice. Also a second opening 22 is formed to serve as a riser for removal of slag and to provide a reservoir to supply metal under pressure to the casting space. By pouring the metal through the two sprue openings at substantially the same time, I insure heating opposite sides of the flange 11 substantially evenly and thereby raise the temperature of the iron center to a degree comparable with that of the molten rim being cast. It will be understood that the usual foundry practice is to be followed in carrying out the required operations, both in forming the mold and in making the casting.

Various types of metal may be employed to fill the space 17 but I prefer to utilize the manganese bronze provided for the rim since it will shrink considerably and so draw away from the iron and make it easy to remove the same from the center when the casting operation is finished. The manganese bronze is very ductile and has a shrinkage of some 50% more than has the iron center, hence as it shrinks in the space 15 it draws tightly against the iron center during cooling and forms substantially an integral union therewith. It is found upon examination that the union between the iron center and the bronze rim 24 is so close as to look as if there has been an intersolution of the metals at the contacting surfaces. The grooves 12 and 13 also aid materially in holding the rim in position.

After the casting has been cooled and the bronze removed from the central portion of the center, the cast article may then be machined to form gear teeth 25 or it may be otherwise fashioned into a suitable article of commerce as lies within the scope and spirit of my invention. If gear teeth are to be cut, it is obvious that they may be cut concentric with the iron center and there will therefore be no danger of breakage due to such lack of concentricity.

It will be understood furthermore that the term "gear" is to be construed broadly and that the term "bronze" as herein used is intended to cover the brasses or other alloys which are adapted for the purpose of my invention. Also the center on which the rim is cast may be made of various ferrous compositions and their equivalents.

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

1. The method of making a gear comprising the steps of providing an iron center, placing said center in a suitable mold, casting on said center a rim of bronze, and pouring molten metal into contact with the center to heat it and cause it to expand and contract substantially evenly during the operation.

2. The method of making a gear having a flanged iron center and a bronze rim, comprising the steps of placing the center in a suitable mold, and pouring molten bronze substantially simultaneously into contact with both the inside and the outside of the flange on the center, and, thereafter, removing the bronze which was cast on the inside of the flange.

3. The method of making a gear having an iron center and a bronze rim comprising the steps of casting the rim on the iron center in a sand mold while simultaneously pouring molten metal into contact with the center to heat the same and prevent it from being cracked.

Signed at Worcester, Massachusetts, this 5th day of March, 1926.

CARL H. RICH.