Oct. 6, 1925. 1,556,138

W. G. WEHR

MOLD AND METHOD OF CASTING

Filed July 30, 1923 2 Sheets-Sheet 1

Fig. 1

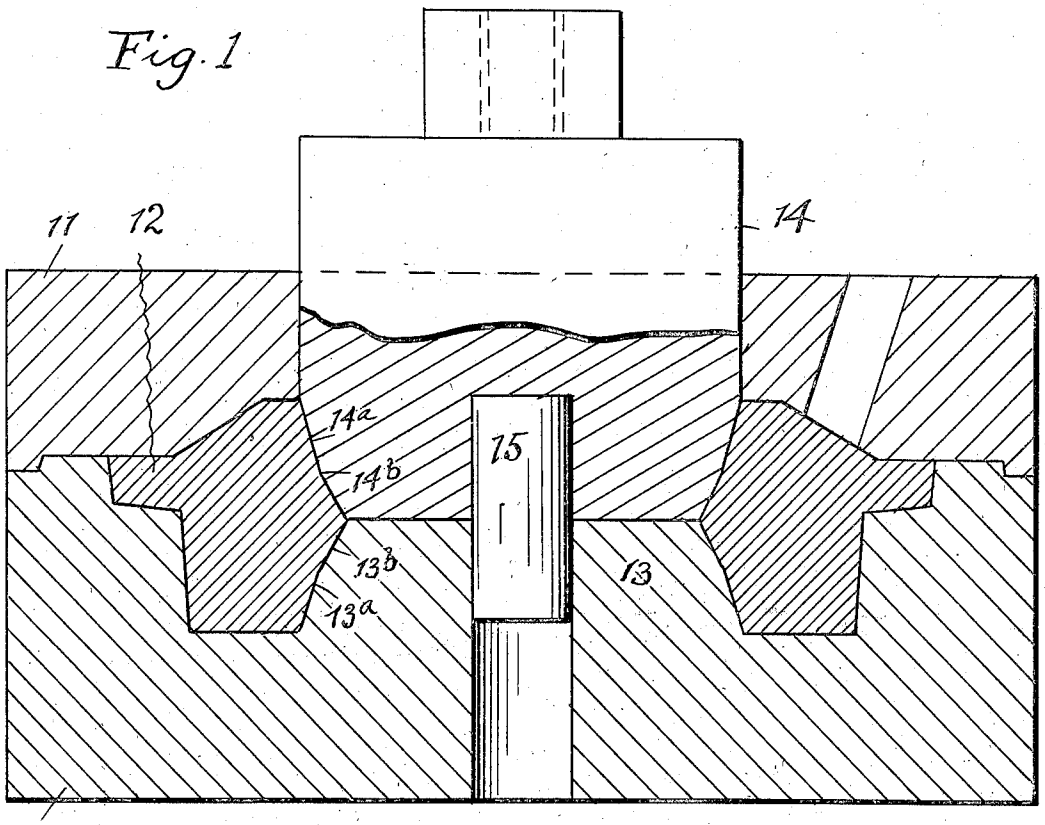


Fig. 2.

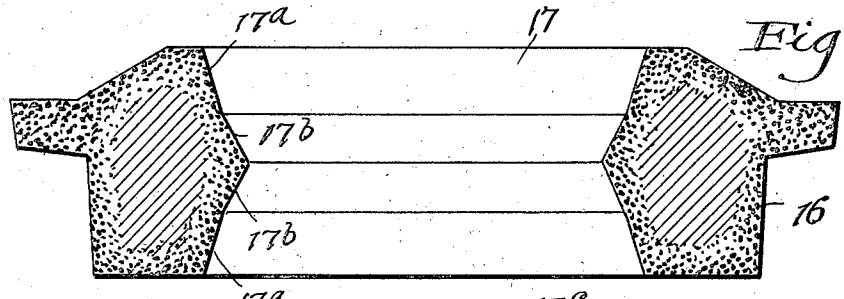
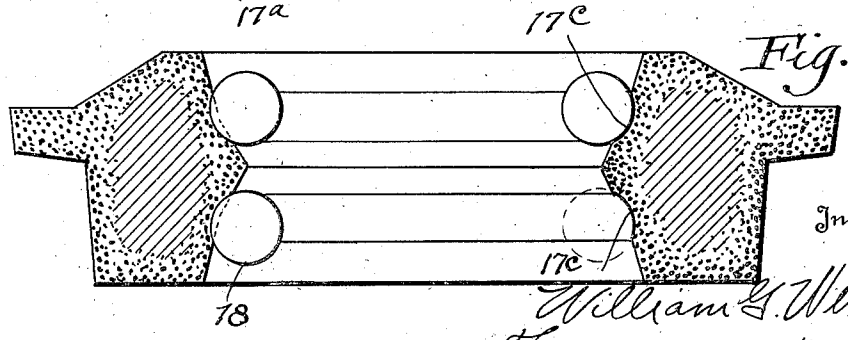


Fig. 3.



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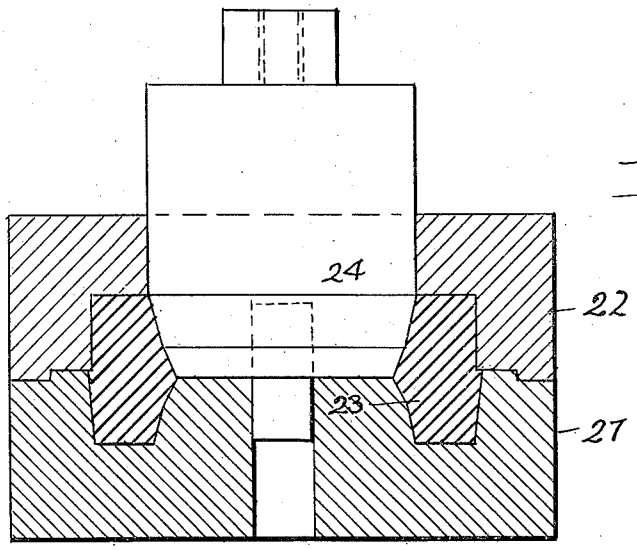


Fig. 4.

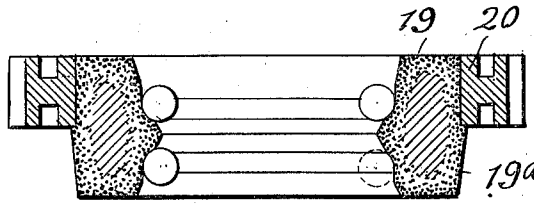
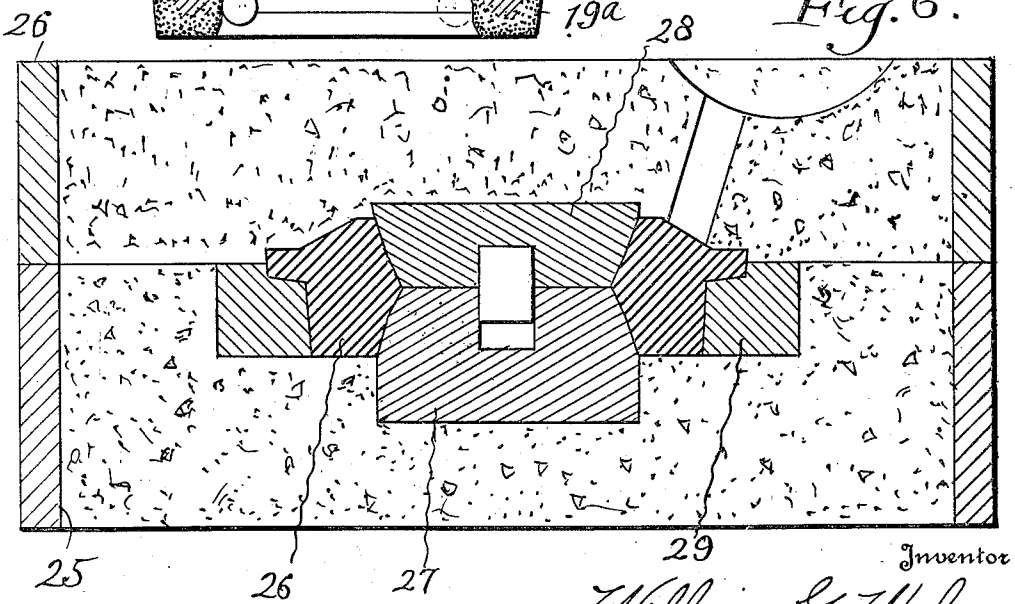


Fig. 5.

Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM G. WEHR, OF EAST CLEVELAND, OHIO, ASSIGNOR TO THE CLEVELAND ELECTRIC TRAMRAIL CO., OF WICKLIFFE, OHIO.

MOLD AND METHOD OF CASTING.

Application filed July 30, 1923. Serial No. 654,560.

To all whom it may concern:

Be it known that I, WILLIAM G. WEHR, a citizen of the United States, residing at East Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Molds and Methods of Casting, of which the following is a full, clear, and exact description.

This invention relates to improvements in molds and to a method of casting, the principal object being to provide means for obtaining a chill on the inner surface, usually an annular surface, of cast iron or semi-steel castings, such as are employed to produce wheels, gears and the like, or hubs of the same.

A further object is to materially reduce the cost of wheels and the like adapted to be fitted with ball or roller bearings, particularly bearings of the combined radial and end thrust type, by forming or chilling the metal around the inner bore on a single or double taper so as to enable raceways to be formed directly in the hub portion. Still further the invention aims to do this in a manner such as to reduce the amount of machining or grinding necessary to provide the raceway groove or grooves.

The art of chilling cast iron by use of metal chills is, of course, old and well known, but as far as I am aware it has not been feasible to chill the metal around an inner annular opening because of the stresses in the contraction of the metal causing the metal to grip the chill and generally resulting in cracking of the casting, or shrinking onto the chill so tightly it cannot be removed. With my invention a metal chill can be used to chill the metal around an inner opening and at the same time the bore is so shaped as to permit the formation of raceways directly in the casting; and therefore to subsequently provide a wheel equipped with a ball or roller bearing which is extremely durable and is produced at a relatively low cost as compared with constructions wherein separate inner and outer raceway members formed of hardened steel are required.

The invention may be briefly summarized as consisting in certain novel details of construction, and combinations and arrangements of parts, and in certain novel steps of the improved method which will be described in the specification and set forth in the appended claims.

In the accompanying sheets of drawings which illustrate my invention in a few of the numerous possible modifications, Fig. 1 is a sectional view through one type of mold which may be utilized, and having a chill formed in accordance with the preferred form of my invention; Fig. 2 is a sectional view through a casting produced by the mold and chill of Fig. 1, and showing conventionally the approximate depth of the chill which in this instance, though not necessarily, extends all about the casting; Fig. 3 is a similar view after the raceways (two raceways in this case) have been ground into the inner chilled surface; Fig. 4 is a sectional view showing a mold in which there is a slight modification in the shape of casting to be produced; Fig. 5 is a sectional view through the casting which in this instance constitutes the hub of a gear, this view showing the raceway grooves after being ground therein, and showing the gear proper shrunk onto the outer surface of the casting; and Fig. 6 is a sectional view showing my invention applied to a sand mold.

My invention finds great utility in the production of wheels for vehicles of many different types, including both track and road wheels, or simply the hub portions thereof, in which event the outer portions of the wheels are designed to be shrunk or otherwise secured to the inner or hub portions which are cast in accordance with the present invention. The invention is applicable also for the production of such other devices as gear wheels, pulleys and the like, all of which are regarded as embraced under the name "wheel" wherever used in the specification.

Additionally the invention is applicable to the production of wheels and like articles of any desired shape or contour. Furthermore, it is immaterial whether the entire surface of the casting is chilled or whether simply the metal surrounding the inner bore is chilled, or whether the metal around the inner bore, and around only a portion of the outer part thereof are chilled. In Fig. 1 a wholly metal mold is utilized, producing a chill for a suitable depth all around the outer surface of the casting. In Fig. 1 a

divided mold is employed having a lower portion or drag 10 and an upper portion or cope 11. The mold cavity is shown filled with metal indicated at 12.

The chill for chilling the metal around the inner bore or opening of the casting in this instance consists of two parts or members 13 and 14, the member 13 being in this instance carried by the lower part 10, and the member 14 in this instance projecting up through the upper part 11 of the mold and being formed separately thereof and slidable up through the top thereof. The two members 13 and 14 of the chill are in alignment and are held so by the equivalent of a dowel-pin 15, which is preferably fitted tight in one chill member, in this instance the upper member 14, and is slidably fitted into an opening in the other chill member.

In accordance with the present invention the chill, i. e. the chill for chilling the metal around the inner bore of the casting is formed with a taper which admits of an axial slippage or relative movement between the chill and the cast metal as it contracts, and thus the gripping of the metal on the chill and danger of the cracking of the casting are avoided.

In this instance the two chill members 13 and 14 have opposite tapers, and, in fact, each has a double taper, one tapered portion of each chill member being at a different angle than the other. However, I do not regard either of these characteristics as essential, though both are preferred, and when used, certain important advantages are obtained. In other words, I regard it within the scope of my invention in its broader aspects to provide a chill composed of one member having a continuous taper in one direction, and I also regard it as within the scope of my invention when two chill members are provided, such as the members 13 and 14, to provide each with a continous or single taper. As I now regard the scope of my invention, it is essential only that the chill member or members have a taper such that when the casting or congealing metal contracts onto the chill there may take place the relative slippage or movement in an axial direction when the radial stresses occur due to the shrinkage of the metal onto the chill.

The two chill members, such as 13 and 14, are preferably employed when the wheel is to be fitted with two sets or series of bearing members, i. e., balls or rollers, and when it is to be fitted with raceways to form a part of a double combined radial and end thrust bearing for end thrust in either direction. As stated above, each chill member 13 and 14 is provided with a double taper. In Fig. 1 the lower taper of the member 13 is designated 13^a, and the upper taper is designated 13^b. In a similar fashion the corresponding tapered portions of the upper member 14 are designated 14^a and 14^b. It will be observed that the taper of the portions 13^a and 14^a is somewhat steeper than the taper of the portions 13^b and 14^b. That is to say, the inner portions 13^b and 14^b are inclined to a somewhat greater extent than the portions 13^a and 14^a. The purpose of this will be explained presently.

When the metal is poured into the mold cavity 12 the metal as it congeals begins to contract around the inner chill. But by tapering the chill members the latter and the casting or contracting metal slip relatively instead of binding tightly and without causing the casting to be cracked as would occur if the taper were not provided. This slippage or relative movement occurs in an axial direction and the effect is to push the upper chill member 14 upwardly slightly through the upper mold member 11, and the casting itself rises up onto the lower chill 13, lifting slightly the upper mold member 11. The upper chill 14 might be formed integral with the upper mold member 11 in the same manner that the lower chill 13 is formed integral with the lower mold 10, but by forming it separately, as shown in Fig. 1, the metal or casting 12 has less weight to lift when it slips upwardly on the lower chill member 13.

As the result of the use of the mold and the method of chilling as described above with the mold shaped as shown in Fig. 1, there is produced a casting such as shown at 16 in Fig. 2. In this figure I have indicated by stippling, the approximate depth of the chill, and although the chill extends all around the casting, as already stated such need not be the case as will appear subsequently. It will be noted that this casting has a central bore or opening 17 which is tapered in opposite directions from the central plane which is at right angles to the axis of the casting. Likewise it will be noted that each tapered portion has two distinct tapers 17^a and 17^b due to the fact that each chill member has portions tapered at different angles. The effect of this is to produce a casting with an inner or hub portion having a bore which is of minimum diameter at the central plane or where the taper in opposite directions begins (which may or may not be in the center plane) and each tapered wall having a general concave shape. That is to say, each wall is not only tapered but dished inwardly somewhat.

As far as the chilling effect is concerned, the same results would be obtained if each chill member had one continuous taper, but by providing the two tapers on each chill member and thus causing the inner wall of the casting not only to be tapered in opposite directions but to have a general concave form, less grinding or machining is required, i. e. less metal is to be cut away, when the

hub or inner annular wall is to be provided with raceway grooves such as shown at 17c in Fig. 3; Fig. 3 differing from Fig. 2 in the respect that in the latter figure the raceway grooves have been cut.

It will be understood from the above, that the casting is to be provided with oppositely tapered portions, each of a general concave nature. This is produced (as shown in the drawings and as described above) by giving each chill member two conical or tapered portions tapered at different angles with respect to the axis of the mold, but it will be obvious that the same results could be obtained if each chill member had more than two conical tapered portions or if the tapered portion were in the form of a continuous curve. Such modifications I regard as being clearly within the scope of the present invention.

The casting such as shown in Figs. 1, 2 and 3 has been produced by me in great numbers, and is generally employed for the wheels of certain types of cranes and when thus employed the wheel is mounted on a pin or axle preferably provided with hardened steel inner raceway members. When the wheel itself is cast in the manner described above and is provided with raceway grooves, which in the instance shown accommodates ball bearings indicated at 18, the metal forming the grooves is exceedingly hard and desirable in all respects to form bearing raceways, and I am thus able to do away with the necessity of separate outer raceway members. The chill at the periphery of the wheel is desirable to provide a hardened tread. By casting the wheel in the metal mold no machining at all is necessary except that required to grind the raceway grooves.

As previously stated, the exterior shape of the wheel or wheel hub may be anything desired, and in Fig. 4 I show a mold used quite extensively by me for the production of a casting 19, the inner part of which is chilled and shaped like the casting shown in Figs. 2 and 3, but the outer or peripheral part has a portion on which a gear 20 is shrunk, and a portion designated 19a which serves as a tread to run along a trackway. The device shown in Fig. 5 is employed by me as a driving gear on an electrically propelled crane trolley. In Fig. 4 the lower and upper mold members are designated 21 and 22, and the chills are designated by the reference characters 23 and 24. The function of these chills and the method of casting are precisely the same as previously described, and further description of the construction and operation is therefore unnecessary.

In the figures so far described, metal molds are shown, but as already stated, my method may be utilized with sand molds, and in Fig. 6 I have illustrated one way in which this may be done. The flask here shown has a drag 25 and a cope 26. In this instance the chill for chilling the metal around the inner bore of the casting, which is here designated 26, consists of two members as before, i. e. a lower chill 27 carried by the drag, and an upper chill 28 carried by the cope. In this instance I employ also an outer chill 29 for chilling a portion of the periphery of the casting, but this is not essential, and, if desired, only the metal surrounding the inner bore may be chilled in accordance with my invention.

With this mold the metal surrounding the inner bore is chilled precisely the same way as before described by a slippage or relative movement in an axial direction between the shrinking cast metal and the chill members 27 and 28. To permit or accommodate this, the chill members may be forced outwardly into the sand a slight distance, or the cope may be lifted slightly from the drag when the relative movement occurs, or both may occur, this depending to a large extent on the manner in which the sand is rammed.

It will thus be seen that I have provided an improved mold and an improved method of casting having very important advantages in the production of certain kinds of castings, particularly wheels designed to be equipped with roller or ball bearings, for as explained at considerable length above, the shape of the chill members not only permits the metal around the inner bore to be chilled and therefore effectively hardened, but the consequent shape imparted to the inner chilled portions of the castings is such as permits the production at low cost of a wheel adapted to be fitted with ball or roller bearings because of the little machine work and small waste of material, while at the same time, raceways are provided, admirably adapted for this purpose by their wear resisting qualities.

As before stated, this invention is very useful in the production of cast iron or semi-steel castings, but particularly of cast iron castings preferably of low silicon content to get the desired depth of chill.

While I have shown the preferred form and certain modifications of my invention, I do not desire to be confined to the precise details shown, but aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention as defined in the appended claims.

Having described my invention, I claim:

1. A mold having a chill for chilling the metal around the wall of an inner opening, said chill being tapered at an angle such that there will be a relative axial movement between the chill and the casting as the latter contracts upon the chill in cooling.

2. A mold having a chill for chilling the metal around an inner opening, said chill being tapered in such a manner as to produce in the casting a tapered opening with a general concave form.

3. A mold having a chill for chilling the metal around an inner opening, said chill having inner and outer portions tapered at different angles, the inner portion having a greater taper than the outer.

4. A mold having a chill for chilling the metal around an inner opening, said chill serving to impart to the chilled metal a double taper, the two portions being tapered in opposite directions and each being of general concave form.

5. A mold having a chill for chilling the metal around an inner opening, said chill composed of two aligned tapered members having a taper such that they are caused by the gripping action of the cooling casting to have relative movement during the chilling operation in a direction axially of said opening, said members imparting oppositely disposed tapers to the chilled metal.

6. A mold having a chill for chilling the metal around an inner opening, said chill composed of two aligned tapered members relatively movable during the chilling operation in a direction axially of said opening, said members imparting oppositely disposed tapers to the chilled metal, each tapered portion being of a general concave form.

7. A mold composed of upper and lower members, each carrying a chill adapted to be arranged end to end and having inner ends tapered at an angle such that the gripping action of the cooling casting will cause the chills to move apart.

8. A mold composed of upper and lower members, each having a tapered chill for chilling the metal around an inner opening of the casting, the chill carried by one member being movable relative to said member during the chilling operation in a direction axially of said opening.

9. A mold composed of upper and lower members and a chill for chilling the metal around an inner opening of the casting, said chill composed of two parts, one fixed into the lower member and the other movably supported in the upper member.

10. The method of producing a chill in the metal around an inner opening of a casting, which comprises pouring the metal in a mold around a chill and permitting a slippage between the contracting metal and chill to prevent the metal gripping the chill and cracking the casting.

11. The method of producing a casting with a chilled portion around an inner opening, which comprises pouring the metal in a mold cavity around a chill and preventing cracking of the casting by causing the forces incident to contraction to produce a relative movement in an axial direction between the contracting metal and chill.

12. The method of producing castings having a chilled wall around an inner opening which consists in pouring the metal in a mold cavity around a chill and utilizing the forces incident to contraction of the metal to cause a relative shifting between the cast metal and chill in a direction axially of said opening.

In testimony whereof, I hereunto affix my signature.

WILLIAM G. WEHR.