May 22, 1928. 1,670,725

L. E. KEEN

METHOD AND APPARATUS FOR FORMING CASTINGS

Filed May 28, 1926 2 Sheets-Sheet 1

Fig. 1.

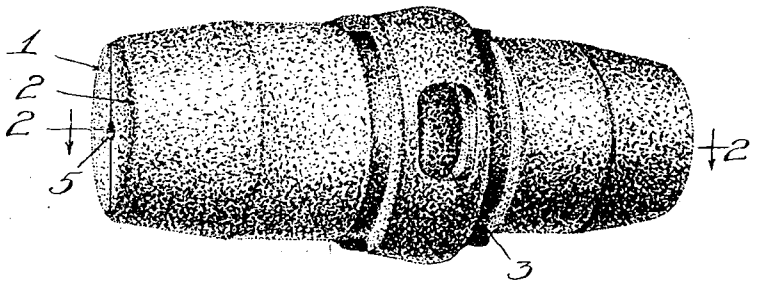


Fig. 2.

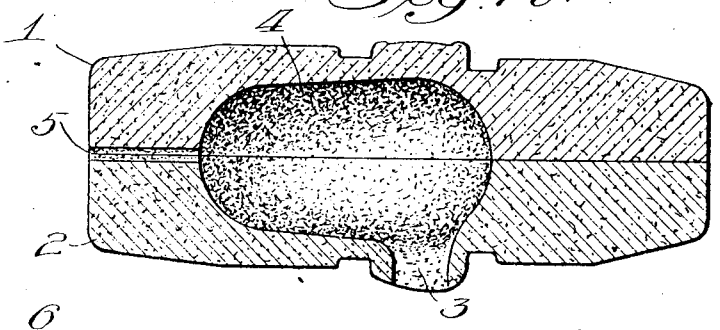
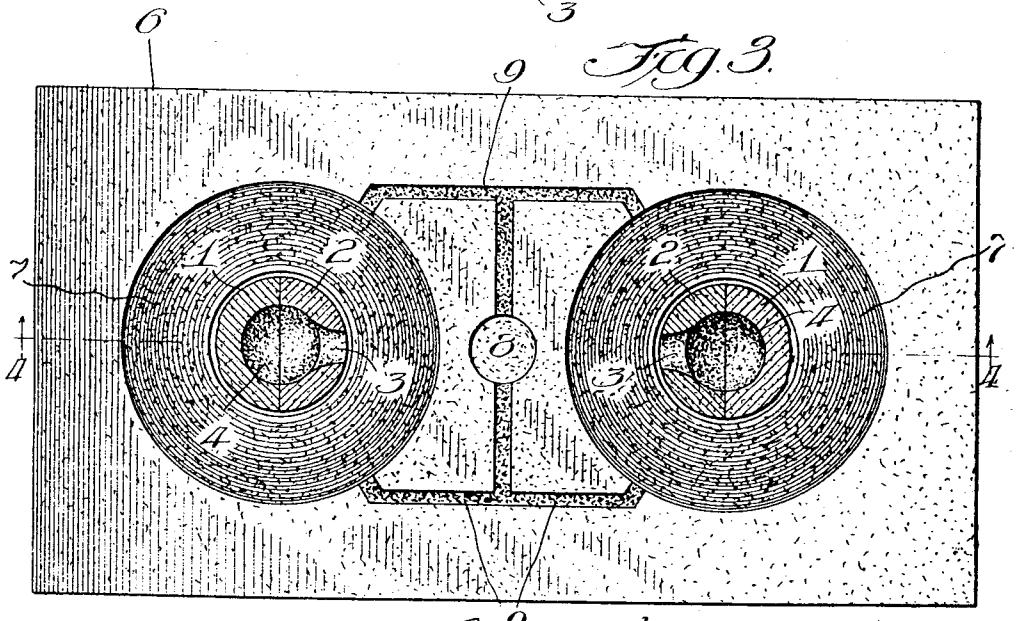


Fig. 3.



Louis E. Keen Inventor

by Rector, Hibben, Davis & Macauley Attys

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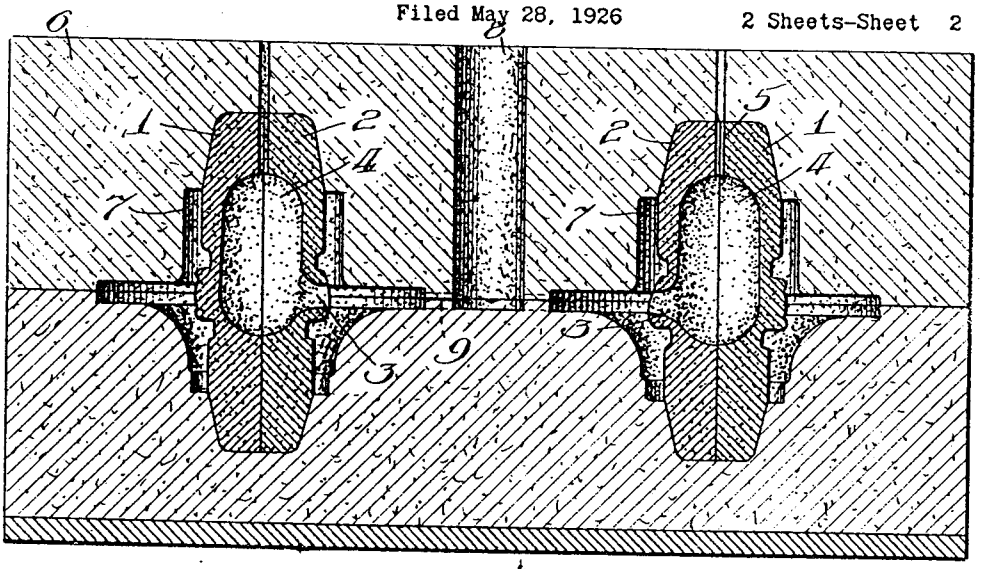

Fig. 4.

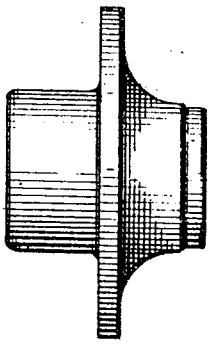

Fig. 5

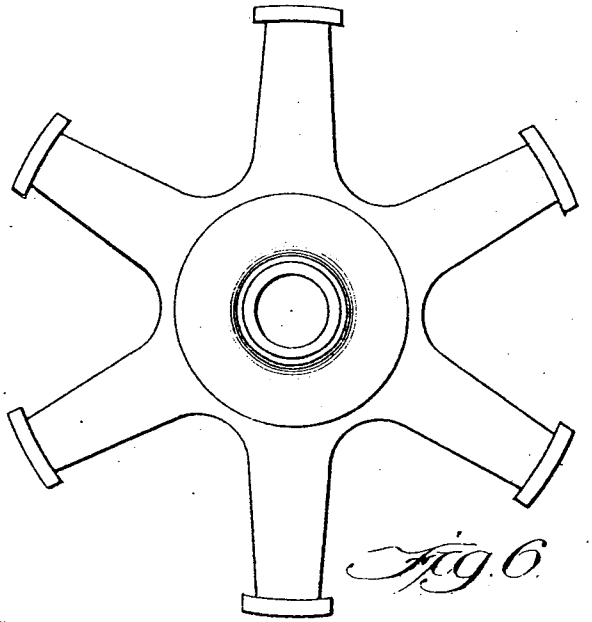

Fig. 6

Louis E. Keen Inventor;

By Rector, Hibben, Davis & Macauley Attys

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UNITED STATES PATENT OFFICE.

LOUIS E. KEEN, OF HAMMOND, INDIANA, ASSIGNOR TO WANNER MALLEABLE CASTINGS COMPANY, OF HAMMOND, INDIANA, A CORPORATION OF DELAWARE.

METHOD AND APPARATUS FOR FORMING CASTINGS.

Application filed May 28, 1926. Serial No. 112,197.

My invention relates to method and apparatus for forming castings and, more particularly, to the formation of what may be termed generally as center core castings wherein shrinkage is compensated for by an internal core feeder.

During the formation of center core castings, for example hub castings such as may be used for various types of vehicle wheels, and particularly immediately following the pouring operation when the molten metal is cooling and setting in the mould, there is a tendency for the metal to shrink with the result that the mould cavity parts are not filled out uniformly, thereby causing a defective casting. That is to say, this shrinkage unless compensated for, causes low spots, cracks, pits, weak places, holes and other defects in the casting which may render it unfit for use.

One manner heretofore employed in compensating for the shrinkage above referred to is to provide one or more so-called external feeders. These external feeders are located externally of the mould cavity and may take the form of pockets connected to the pouring passage so as to receive and hold a surplus quantity of the molten metal. The object in using such external feeders is to provide a supply of molten metal which will be feed to the mould cavity to supply the molten metal therein to compensate for the shrinkage which takes place as above explained. It has been found that this form of shrinkage compensation is not satisfactory in the formation of center core castings, particularly center core castings of considerable depth, because in the formation of such castings the tendency for greatest shrinkage appears to be at or near the center of the mould cavity and adjacent the center core therein, with the result that the external feeder just referred to is so far removed from the point of greatest shrinkage that the intended compensating effect is lost. One obvious reason for this is that the external feeder is so far removed from the point where shrinkage is the greatest that the molten metal contained therein is cooled excessively thereby resisting the shrinkage draw of the metal with the result that the well-known low spots, cracks, tips and other defects due to shrinkage still appear on the interior and adjacent parts of the resultant casting.

Still another manner heretofore proposed for compensating for such shrinkage is to provide the center core used in making such center core castings with a central passage having outlets leading into the mould cavity and wherein the pouring of the moulten metal for casting is accomplished by pouring the same directly through such central passage and thence into the mould cavity. This manner of compensating for shrinkage has been found unsatisfactory and impractical. This is mainly true because during the pouring operation of the moulten metal through the center of the core particles of the sand forming such core are caused to mingle with the moulten metal and are carried thence directly into the mould cavity with the result that the casting is formed with pits and sand holes and other well-known defects which render such casting unfit for use.

One of the objects of my invention is to provide for full and complete compensation for shrinkage in the formation of castings such as center core castings, wherein all defects heretofore experienced in the formation of such castings are eliminated with the result that successive and fully formed castings may be made with a minimum of loss in time and material.

Another object is to facilitate manufacture of center core castings and reduce the cost of manufacture of the same to a minimum.

A further object is to provide for complete compensation for shrinkage by the use of clean metal supplied directly from the casting mould cavity, such metal remaining at the proper molten and feeding condition throughout the entire period of shrinkage being thereby subject at all times to ready response to the shrinkage draw.

A still further object is to provide for the feeding of a compensating metal at a point where the draw due to shrinkage is the greatest, thus positively insuring full and complete compensation for shrinkage.

Other and further objects and advantages will appear hereinafter by reference to the following description and by reference to the attached drawings.

In carrying out my method, and particularly in the formation of center core castings, I employ a center core of the proper size and shape, such core having a central

pocket therein. I also provide a single opening through the wall of the core so as to provide communication between the mould cavity in which the casting is to be formed and the central core pocket. I preferably employ a sectional core to facilitate manufacture of the same. This core is also provided with a vent leading into the pocket on the interior thereof for a purpose well-known. In further carrying out my invention the casting mould and its mould cavities are prepared in the ordinary manner. The casting mould may be of the usual form and may be of such construction that one or a plurality of castings may be made simultaneously. After the casting mould has been prepared ready for the placement of the center core, the center core is placed in the mould cavity and the mould prepared for pouring of the molten metal in the usual manner. After this the molten metal is poured through the pouring gate from which it flows to the casting mould cavity surrounding the center core. The molten metal upon entering the mould cavity, also enters the pocket in the center core through the opening above referred to as leading through the core wall. As the casting mould cavity is filled, this central pocket in the core is also filled, all of which is indicated to the operator at the pouring mouth of the casting mould. This central core pocket may be termed an internal core feeder. Upon the completion of the foregoing a surplus of molten metal is stored inside the center core and internally of the casting mould and this surplus metal, being surrounded on all sides by the molten metal in the mould, remains in a molten and feeding condition longer than the metal in the mould so that as the metal in the mould cools and shrinkage takes place, such feeder metal is in a sufficiently molten condition to freely respond to shrinkage draw. The shrinking metal is thereby fully and completely compensated for by the metal in the feeder whereby when the metal in the mould has cooled and the casting operation is complete, a fully shaped casting is formed which is free from low spots, cracks, pits, weak places, holes and other defects which would render the castings formed unfit for use. According to my invention, with the shrinkage feeder located internally of the center core, compensation is provided for through the outlet of such feed pockets at the point where the shrinkage draw is greatest and where the greatest compensation needs are required. Furthermore, in carrying out the foregoing operation, both the molten metal which enters the casting mould cavity and that which enters the feed pocket in the center of the center core is clean and free from core sand and the like, which if present, would tend to cause the defects hereinbefore referred to.

One form of apparatus which I may employ in carrying out my invention is shown in the drawings wherein,—

Fig. 1 is a perspective view of a center core adapted for use in carrying out my invention, such center core being particularly adapted for use in connection with the formation of hubs such as hubs for automobile wheels.

Fig. 2 is a section taken on line 2—2 on Fig. 1.

Fig. 3 is a horizontal section taken through a casting mould suitable for moulding a plurality of castings simultaneously, and showing center cores, such as shown in Fig. 1, in place in the mould cavities.

Fig. 4 is a vertical section taken on line 4—4 of Fig. 3.

Fig. 5 is a side elevation of a hub casting formed with the structure of Figs. 1 to 4 inclusive.

Fig. 6 is a top plan view of a cast wheel which has the spokes thereof cast integrally with the hub portion, illustrating another application of my invention.

I have shown, and will describe, my invention as applied particularly in connection with the formation of hubs for automobile wheels such as that shown in Fig. 5. However, I do not desire to limit my invention to such hub castings exclusively because it is obvious that the same may be used in connection with the formation of center core castings such as the wheel shown in Fig. 6 and other castings where deep center cores are employed and where the tendency for excessive shrinkage exists.

Referring particularly to the drawings, the center core which I employ may comprise two half-core parts 1 and 2 which are identical in form and size except that core half 2 is provided with an opening 3 at its central portion. Each core half is provided with a half pocket portion so that when the two halves of the core are joined together an internal circular pocket 4 is formed therein. The opening 3 in the core half 2 leads directly into this pocket 4 and serves as the medium through which the molten metal during the casting operation is fed both to and from the pocket 4. Furthermore each core half is so shaped that when they are joined together a vent passage 5 which leads into the core pocket is formed. When the casting operation takes place and shrinkage occurs, the greatest shrinkage draw, and where compensation for the same is needed most, is at about the center of the mould cavity internally thereof. Therefore, in the center core which I employ, the so-called center feeder or internal core which compensates for this shrinkage is located internally of the mould and internally of the cooling metal and the outlet or communication between such feeder and the metal in the

mould cavity is located at about the center of the mould cavity internally thereof at the point where the draw is greatest and where compensation for shrinkage is needed most. Furthermore, since this feeder or compensating metal in the feeder pocket 4 is entirely surrounded by the metal in the mould, it is the last metal to cool with the result that it remains in a proper molten or feeding state throughout the entire period of shrinkage and until the metal in the mould has fully and completely set to the shape of the mould.

In forming a hub casting such as shown in Fig. 5, a casting mould such as shown in Figs. 3 and 4 may be employed. This mould of Figs. 3 and 4 is adapted particularly for the casting of two hubs simultaneously. It may be built up in the usual manner with the use of the proper patterns to form the body 6, mould cavities 7, pouring gates 8 and pouring passages 9. After the mould 6 has been partially prepared in the ordinary manner by the use of patterns, the center cores are set in place in the mould cavities 7 in the manner and in the position shown in Fig. 4, it being understood that the casting mould 6 is preferably formed in sections to permit of ready insertion of such cores. When the center cores have been fixed in place and the mould parts properly adjusted, the mould is then ready for the pouring of the molten metal and the casting of the hub. In the casting operation the molten metal is poured through the gate 8 and it passes through the passages 9 into the mould cavities 7 surrounding the center cores and fills such cavities. As the mould cavities are filled, the molten metal also passes through the openings 3 in the center cores and also fills the shrinkage feed pockets 4 inside such cores. Filling of the mould cavities 7 is indicated to the operator at the pouring gate 8, at which time pouring of the molten metal is discontinued. During the period of pouring there is naturally a slight cooling of the molten metal during its passage through the mould cavities and final cooling takes place rapidly after pouring has ceased. During the final cooling, the cooling metal shrinks, the shrinkage draw being greatest near the center of the mould cavity towards the ends thereof. As the cooling metal shrinks this drawing action draws the metal from the feed pockets 4 inside the center cores through the center core openings 3 and compensates for the shrinkage and thereby maintains uniformly the section of the metal in the mould cavities so that when the casting operation is complete the fully formed casting is free from low spots, cracks, pits and other similar defects caused by shrinkage.

The castings are removed from the mould 6 in the customary manner. In this connection another advantage of my invention may be noted in that, by providing the pocket 4 in the center cores, the walls of said cores are comparatively thin, such walls being readily softened by the molten metal so that they crumple very readily. This condition greatly facilitates the removal of the center core part from the casting after its formation. Upon the completion of the foregoing, the casting is in condition for final treatment for the use intended.

My invention may also be employed in connection with the formation of wheels such as that shown in Fig. 6 and wherein the hub and spokes are cast integrally. In the formation or casting of a wheel such as shown in Fig. 6, the same conditions relative to shrinkage exist and unless such shrinkage is compensated for in a definite and positive manner, the defects hereinbefore set forth must necessarily exist. In employing my invention in casting such a wheel, the ordinarily occurrent defects due to shrinkage are positively eliminated.

From the foregoing it will be seen that I have provided method and apparatus for forming center core castings such as hubs for automobile wheels and the like wherein full and complete compensation for shrinkage is provided and wherein defects ordinarily prevalent in the formation of such castings are positively eliminated, at the same time, facilitating and reducing the cost of manufacture.

Having thus described my invention, what I claim is:

1. The method of forming center core castings which comprises feeding molten metal into a mould cavity surrounding a center core and thence internally of said center core.

2. The method of forming center core castings which comprises feeding the molten metal into a mould cavity surrounding a center core, causing part of said molten metal fed to said mould cavity to enter the interior of said center core, permitting the molten metal in said mould cavity to cool, and compensating for shrinkage during cooling of said mould cavity metal by metal fed in a molten state from the interior of said center core to said mold cavity at substantially the inner central portion thereof.

3. The method of forming center core castings which comprises feeding molten metal into a mould cavity containing a hollow center core, feeding molten metal from said mould cavity through an opening into said center core, allowing the metal in said mould cavity to cool, and rendering shrinkage draw effective during said cooling action to cause feeding of molten metal contained in said core back through said opening into said mold cavity to maintain the section of the metal therein.

4. The method of forming center core castings which comprises feeding molten metal into a mould cavity surrounding a center core having a centrally disposed cavity therein in communication with said mould cavity, feeding molten metal from said mould cavity into said core cavity, the molten metal in said core cavity being fed back into said mould cavity during the cooling of the metal therein to maintain the section of said metal.

5. In a center core for forming center core castings, a centrally disposed chamber therein for receiving molten metal directly from the mould cavity in which it is carried during the casting operation, said chamber being in communication with said mould cavity through a single opening, for feeding molten metal both to and from said core chamber.

6. The method of forming a center core casting which comprises forming a mould cavity and placing a center core therein, feeding molten metal to said mould cavity and thence to the interior of said center core to fill said mould cavity and core interior, permitting the metal in said mould cavity to cool and maintaining the section of the casting to be formed in said mould cavity during said cooling period by metal fed in a molten state from the interior of said center core to said mould cavity.

7. The combination with a mould having a mould cavity for forming a center core casting, of a center core adapted to be carried in said mould cavity, said center core having a pocket formed therein, a single metal feed opening in said core communicating only with said pocket and said mould cavity and an air vent for said pocket.

8. The combination with a mould having a mould cavity for forming a center core casting, of a hollow center core having its ends closed, a vent adapted to communicate the hollow portion of said core with atmosphere, and a combined metal feed and delivery opening in said core between the ends thereof through which molten metal is fed from said mould cavity to the hollow of said core from said mould cavity and vice versa.

9. In a core adapted to be received in a mould cavity, a molten metal receiving pocket in the core body in communication with said mould cavity only and through an opening intermediate the ends of said core, said opening being disposed centrally of said mould cavity, and means for connecting said pocket with atmospheric air.

10. The combination with a casting mould having a mould cavity therein for forming a center core casting, of an internal feeder means for compensating for shrinkage during the cooling of the metal in said mould cavity to maintain the section of the casting formed therein, said feeder means including a core having a pocket with a single feed opening adapted to be fed solely by molten metal from said mould cavity.

In testimony whereof, I have subscribed my name.

LOUIS E. KEEN.