July 30, 1940. M. E. ANNICH 2,209,502

MOLD FOR AND METHOD OF PRODUCING SOLID METALLIC BALLS

Filed April 17, 1939 2 Sheets-Sheet 1

FIG. 1.

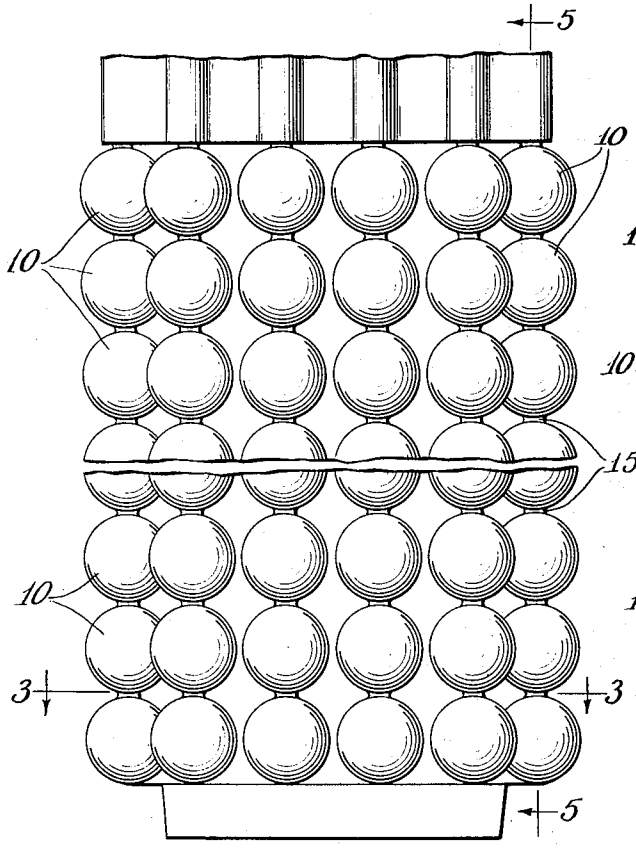


FIG. 2.

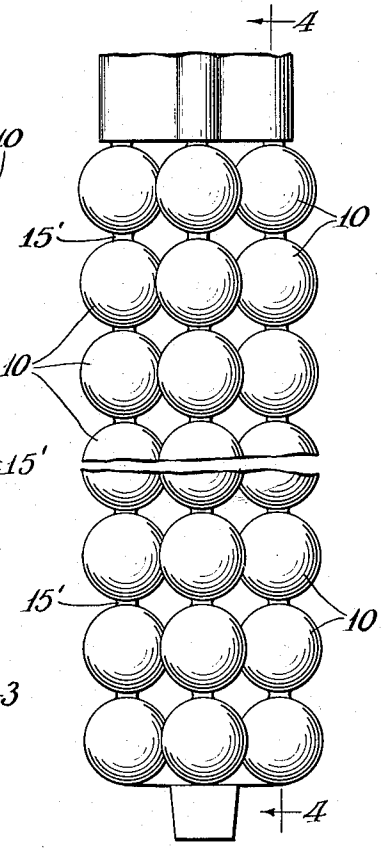
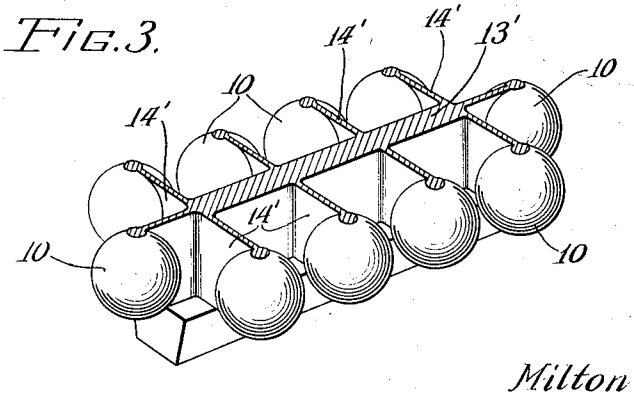


FIG. 3.



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Filed April 17, 1939 2 Sheets-Sheet 2

Fig. 4.

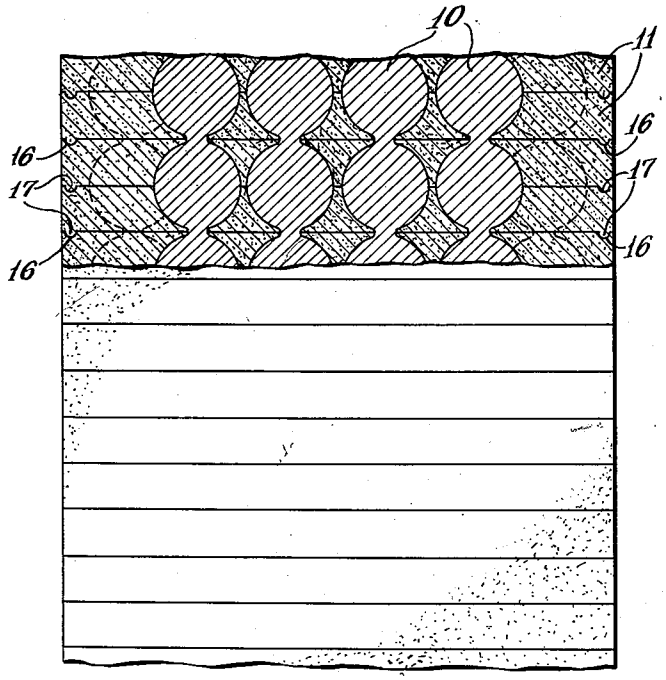


Fig. 5.

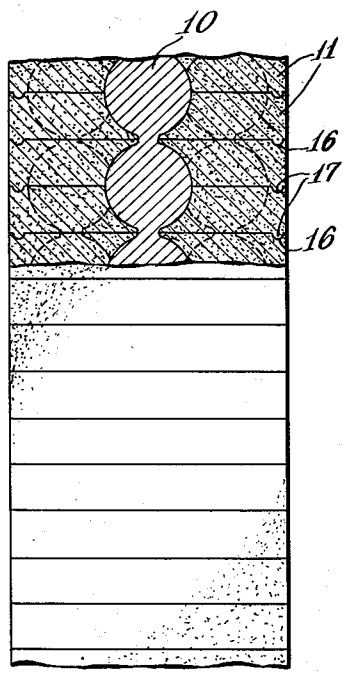
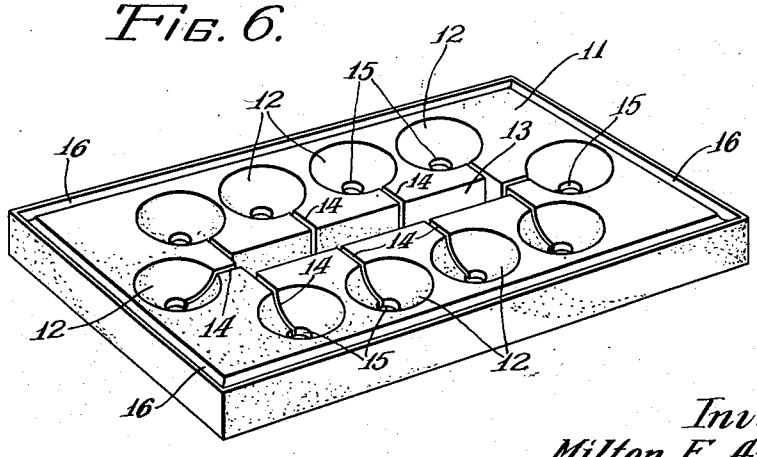


Fig. 6.



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UNITED STATES PATENT OFFICE

2,209,502

MOLD FOR AND METHOD OF PRODUCING SOLID METALLIC BALLS

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Application April 17, 1939, Serial No. 268,168

6 Claims. (Cl. 22—130)

This invention relates to a mold for and a method of casting and particularly to a mold for and a method of casting solid metallic balls.

Prior molds for and methods of casting metallic substantially spherically shaped objects have been generally unsatisfactory and among the difficulties which have been encountered is that such spheres or balls tend to have spongy or hollow centers probably because of excessive shrinkage. This is believed to be due to the fact that the outer surface of a ball, when cast by conventional methods in the past, would solidify and harden first and as further solidification and shrinkage took place, the still molten metal at the center of the ball would be drawn toward the periphery to supplant the deficiency caused by the shrinkage of the outer shell.

Thus, an important object of this invention is to avoid shrinkage at the periphery of a spherical object in the casting thereof to thereby avoid a spongy center by affording a source of hot metal at the periphery of the objects whereby the center thereof may cool more rapidly than the periphery.

Another object of this invention is to enable the casting of solid substantially spherically shaped articles cheaply and in large quantities and at the same time to insure that the structure of the metal will be of uniform quality throughout each individual article.

Further objects are to arrange the molds in which such articles are to be cast in stacked relation so as to make available a high ferrostatic or other static pressure on the fluid metal in the casting; to provide for slow, even feeding of the molten metal into the mold cavities so as to improve the quality of the casting; and to retard the dissipation of heat from the casting in order that such slow feeding of the metal can be satisfactorily accomplished.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment and the principle thereof and what I now consider to be the best mode in which I have contemplated applying that principle. Other embodiments of the invention embodying the same or equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings,

Fig. 1 is an elevation showing a stack of metal balls in the form in which they are cast;

Fig. 2 is an end view of the stack of balls shown in Fig. 1;

Fig. 3 is a perspective view taken substantially on the line 3—3 on Fig. 1;

Fig. 4 is a vertical sectional view taken substantially on line 4—4 on Fig. 2, but showing the locations of the balls in the sand after the casting operation has taken place;

Fig. 5 is a view similar to Fig. 4 and taken along the line 5—5 on Fig. 1 and

Fig. 6 is a perspective view of a mold which is used in the casting process.

As shown in Fig. 1 the metallic balls 10 are preferably cast in clusters and as many as one hundred of these balls may be successfully produced in a single casting operation. The mold bodies 11 in which the metal is shaped are of the form shown in Fig. 6 and each of these molds is adapted to produce a half-layer of the balls. Each mold body 11 comprises a series of hemispherical depressions or mold cavities 12 which are suitably produced in the molding sand or the like. The depressions 12 are grouped around a central gate or riser 13 and are connected thereto by thin or restricted vertically extending gates 14. I prefer to make the molds out of core sand and to bake them in an oven, in the manner well understood in the art, so as to avoid the use of flasks in the casting operation.

It will be noted that each of the gates 14 affords communication to its respective cavity 12 along the entire vertical length of that part of the surface of the cavity which is nearest the central gate 13. Each of the cavities or depressions 12 has a small opening 15 which is situated at the top or bottom thereof depending on whether the mold 11 is to be used in forming the upper or lower half of a layer of balls. The openings 15 serve as risers between the balls in successive layers.

It will be understood that the mold for the upper half of each layer of balls is complementary to the mold for the lower half, one of which molds is shown in Fig. 6. The various molds 11 are stacked as shown in Figs. 4 and 5, starting with a mold for the bottom half of a layer of balls, then a mold for the top half of this layer of balls, then another mold for the bottom half of another layer of balls, and so on until a stack of the desired height, containing the desired number of layers, is attained. Proper alignment of the molds is assured by providing interfitting grooves 16 and ribs 17 near the edges

of the molds, and in the illustrated form of the invention each mold has a rib on its underside and a groove on its topside to enable such interfitting and alignment of the various molds. The result of such alignment of the various molds is to bring the central gates 13 of the various molds into alignment with each other as well as the openings 15 and the wall gates 14 of the various molds. The risers provided by the openings 15 afford communication between the top half of each layer and the bottom half of the next higher layer.

It is a well-known fact that a solid metallic ball can be cast with a fair degree of success by applying an extremely high pressure on the metal in the casting while it is still in the fluid state. This is customarily accomplished either by providing a relatively tall channel or riser which makes available a ferrostatic or other static head, dependent upon the metal being cast, and produces the requisite pressure; or by applying pressure by mechanical means. This ferrostatic or like pressure is obtained in the present instance by reason of the stacking of the molds, one on the other. However, while this feature is of material importance, it is not alone responsible for the success of the present process, for if this principle of pressure casting alone were to be relied upon, it would be necessary to provide much higher pressures than are employed herein.

Thus, in addition to resorting to pressure I also utilize slow pouring. This effect is obtained by employing the thin or restricted gates 14 between the central gate or riser 13 and the cavities 12. This arrangement permits slow and even feeding of the metal, which enables sound and solid castings to be produced. The width of each wall gate 14 is such as to permit this slow pouring to be accomplished but at the same time the opening is large enough to enable enough metal to flow therethrough to prevent freezing of the metal before it has filled the mold cavity.

I also resort to hot feeding, that is, hot metal is gradually fed to the mold cavity as the metal therein is undergoing cooling and shrinking. This is accomplished in the present instance by reason of the risers afforded by the vertically aligned openings 15. As each layer of balls cools, hot metal will be fed down through the risers 15 from the layer above, and the shrinkage which would otherwise occur is compensated for by the supply of hot fluid metal from an upper layer to the layer therebelow. Moreover, by continually supplying hot metal in this way, while the cast substantially spherical object is cooling, the periphery thereof will tend to cool at the same rate as the center, and therefore, cracks and other defects such as might otherwise arise from resulting thermal stresses are avoided.

In addition to pressure casting, slow pouring and hot feeding I also utilize heat retention in the production of cast metal balls in accordance with my invention. The whole arrangement of the balls in the stack is so organized as to dissipate a minimum amount of heat, thereby keeping open and still not unduly enlarging all constricted areas, such as the gates 14 between the cavities 12 and the central gate 13, and the openings 15 between the various layers of balls. Hence, the entire mass cools uniformly and slowly.

After a casting operation has been effected in the above described manner and the balls or the like produced therein have cooled sufficiently, they are removed from the molds, preferably by breaking away the molds. Thereafter the balls may be separated one from the other by breaking the restricted connections therebetween afforded by metal solidified in the openings 15. The balls or the like are also separated from the central body of metal 13', formed in the central gate 13, by breaking the narrow webs 14', produced in the gates 14. Thereafter the castings are tumbled or otherwise handled to remove objectionable fins or other projections thereon and they are then ready for use.

It will be understood that the above described apparatus and method for casting can be utilized in a wide variety of instances where it has heretofore been difficult to obtain uniform and solid castings. Thus, while I have illustrated and described a preferred embodiment of my invention it is to be understood that this is capable of variation and modification and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the ambit of the following claims:

I claim:

1. A mold for casting solid spherically shaped bodies and the like that includes a body portion having a substantially centrally located vertically extending opening therein providing a riser and a plurality of spherical mold cavities disposed about such opening, certain of such cavities being arranged one above the other, said body portion having a gate of restricted width between each mold cavity and the central opening, each such gate leading substantially to the vertical diameter of the mold cavity with which it communicates to thereby open into such cavity throughout the vertical extent thereof, and said body portion having openings therein respectively extended from the upper portion of each mold cavity to the lower portion of the mold cavity immediately thereabove, said centrally located opening, the mold cavities, the gates and the plurality of openings being so located in said body portion and said body portion being so arranged that, when molten metal is poured into said central opening to first flow into the lowermost cavities and thereafter into the higher cavities successively, the rate of the dissipation of heat during the pouring of molten metal into the mold cavities is substantially uniform throughout the mold.

2. A mold for casting solid spherically shaped bodies and the like that includes a body portion having a substantially centrally located vertically extending opening therein providing a riser and a plurality of layers of spherical mold cavities, the mold cavities in each layer being arranged about the centrally located opening and each cavity in one layer being vertically aligned with a cavity in the next higher layer, said body portion having a gate of restricted width between each mold cavity in each layer and the central opening, each such gate leading substantially to the vertical diameter of the mold cavity with which it communicates to thereby open into such cavity throughout the vertical extent thereof, and said body portion having openings therein respectively extended from the upper portion of each mold cavity to the lower portion of the mold cavity immediately thereabove, said centrally located opening, the mold cavities in each layer, the gates and the plurality of openings being so located in said body portion and said body portion being so constructed and arranged that, when molten metal is poured into said central opening to first

flow into the cavities in the lowermost layer and thereafter into the cavities in the higher layers successively, the rate of the dissipation of heat during the pouring of molten metal into the mold cavities is substantially uniform throughout the mold.

3. A mold for casting solid spherically shaped bodies and the like that includes a body portion comprising a plurality of mold bodies each having a plurality of substantially hemispherically shaped recesses therein arranged about a substantially centrally located opening extended through the body, the recesses and openings being located in corresponding positions in each of said mold bodies whereby when a given mold body is arranged with the recesses therein faced upwardly and another mold body is arranged thereover with the recesses therein faced downwardly the respective recesses in the respective bodies may be aligned one with another to afford a layer of mold cavities, said bodies being mounted one over the other to provide a stack thereof containing a plurality of layers of mold cavities, the substantially centrally located openings in the mold bodies aligning one with the other when the mold bodies are stacked as aforesaid to provide a riser, each mold body having a plurality of gates of restricted width extended between the respective recesses and the opening therein, each such gate leading substantially to the vertical diameter of the recess with which it communicates to thereby open into such recess throughout the depth thereof at the part of the recess nearest the central opening, and each mold body having a plurality of riser openings therein respectively extended from the recesses to the face of the body opposite that into which the recesses open, the riser openings in the respective bodies being respectively aligned one with the other whereby when the bodies are stacked as aforesaid riser openings extended between the upper part of one mold cavity and the lower part of the mold cavity immediately thereabove are provided, said centrally located openings, the mold cavities in each layer thereof, the gates and the plurality of openings being so located in said mold bodies and said mold bodies being so constructed and arranged that, when molten metal is poured into said central opening to first flow into the cavities in the lowermost layer and thereafter into the cavities in the higher layers successively, the rate of the dissipation of heat during the pouring of molten metal into the mold cavities is substantially uniform throughout the mold.

4. A mold for casting solid spherically shaped bodies and the like that includes a body portion comprising a plurality of mold bodies of baked core sand, each of such bodies having a plurality of substantially hemispherically shaped recesses therein arranged about a substantially centrally located opening extended through the body, the recesses and openings being located in corresponding positions in each of said mold bodies whereby when a given mold body is arranged with the recesses therein faced upwardly and another mold body is arranged thereover with the recesses therein faced downwardly the respective recesses in the respective bodies may be aligned one with another to afford a layer of mold cavities, said bodies being mounted one over the other to provide a stack thereof containing a plurality of layers of mold cavities, the substantially centrally located openings in the mold bodies aligning one with the other when the mold bodies are stacked as aforesaid to provide a riser, each mold body having a plurality of gates of restricted width extended between the respective recesses and the opening therein, each such gate leading substantially to the vertical diameter of the recess with which it communicates to thereby open into such recess throughout the depth thereof at the part of the recess nearest the central opening, and each mold body having a plurality of riser openings therein respectively extended from the recesses to the face of the body opposite that into which the recesses open, the riser openings in the respective bodies being respectively aligned one with the other whereby when the bodies are stacked as aforesaid riser openings extended between the upper part of one mold cavity and the lower part of the mold cavity immediately thereabove are provided, said centrally located openings, the mold cavities in each layer thereof, the gates and the plurality of openings being so located in said mold bodies and said mold bodies being so constructed and arranged that, when molten metal is poured into said central opening to first flow into the cavities in the lowermost layer and thereafter into the cavities in the higher layers successively, the rate of the dissipation of heat during the pouring of molten metal into the mold cavities is substantially uniform throughout the mold, and complementary portions on each of said bodies adapted to be respectively interfitted one with the other to insure accurate alignment of the bodies one with the other upon stacking thereof as aforesaid.

5. The method of casting solid spherically shaped bodies and the like which consists in providing a plurality of mold cavities in a mold body about a centrally located riser opening with certain of the mold cavities positioned one above the other, providing riser openings between the upper portion of each mold cavity and the lower portion of the mold cavity immediately thereabove, forming a gate of restricted width between each mold cavity and the centrally located riser opening with each such gate leading substantially to the vertical diameter of the mold cavity with which it communicates to thereby open into such cavity throughout the vertical extent thereof, arranging the centrally located riser opening, the mold cavities, the gates, and the riser openings between the mold cavities so as to insure a substantially uniform rate of heat dissipation during the pouring of molten metal, slowly pouring molten metal into the centrally located riser opening and through the gates and riser openings into the mold cavities, permitting the molten metal to solidify, and thereafter breaking away the mold body and separating the objects from metal solidified in the central riser opening and from each other.

6. The method of casting solid spherically shaped bodies and the like which consists in providing a plurality of layers of mold cavities in a mold body about a centrally located riser opening in the body, respectively disposing the mold cavities in the respective layers in vertical alignment with each other, providing riser openings between the upper portion of each mold cavity and the lower portion of the mold cavity immediately thereabove, forming a gate of restricted width between each mold cavity and the centrally located riser opening with each such gate leading substantially to the vertical diameter of the mold cavity with which it communicates to thereby open into such cavity throughout the vertical extent thereof, arranging the centrally located riser opening, the mold cavities in each layer, the gates,

and the riser openings between the mold cavities so as to insure a substantially uniform rate of heat dissipation during the pouring of molten metal, slowly pouring molten metal into the centrally located riser opening and through the gates and riser openings first into the mold cavities in the lowermost layer and then successively into the mold cavities in the layers above said lowermost layer, permitting the molten metal to solidify, and thereafter breaking away the mold body and separating the objects from metal solidified in the central riser opening and from each other.

MILTON E. ANNICH.