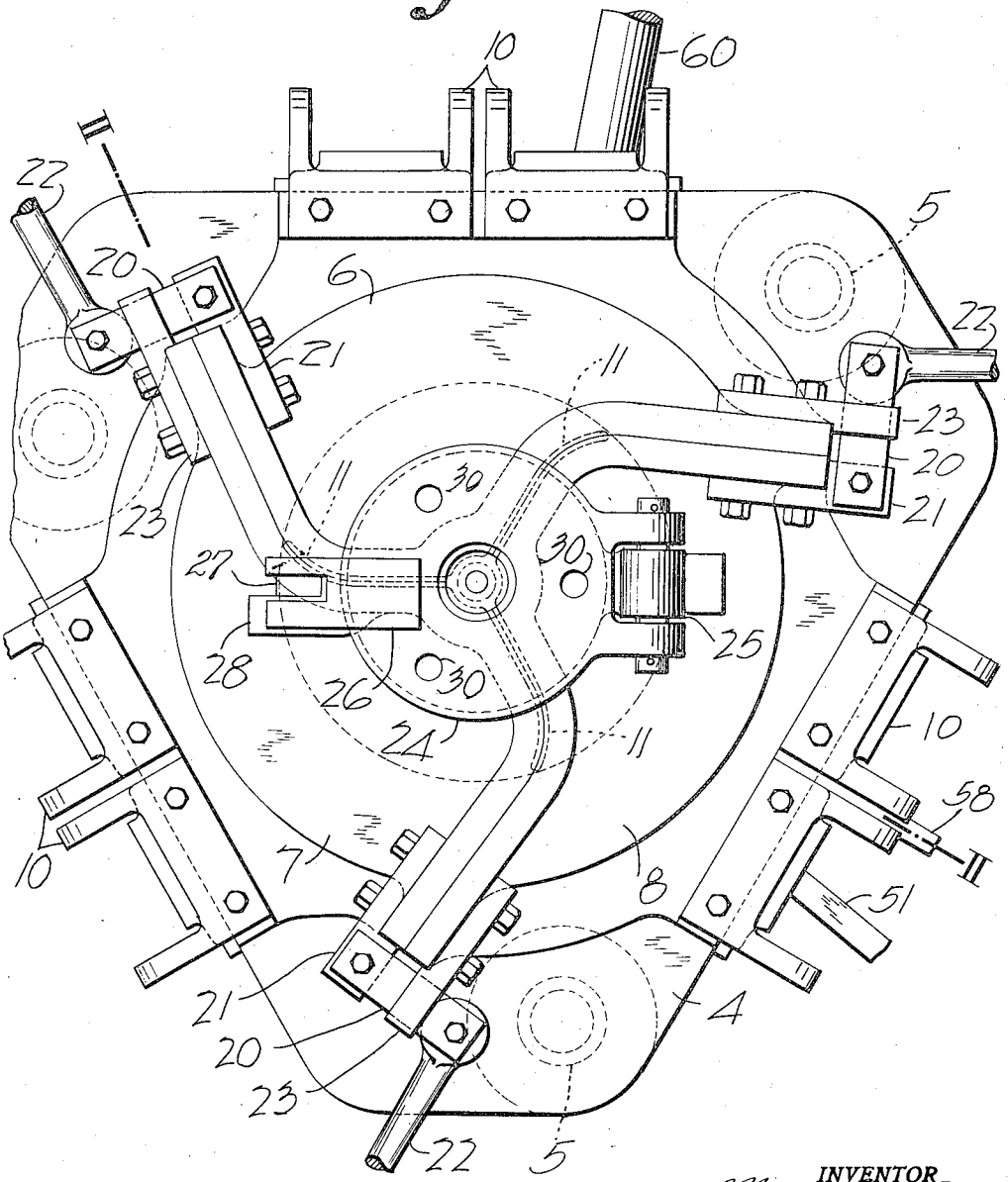
Nov. 24, 1936. M. GUYOT 2,061,765

PERMANENT MOLD

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Fig. 1.



INVENTOR
Marius Guyot

BY

ATTORNEY

Nov. 24, 1936. M. GUYOT 2,061,765

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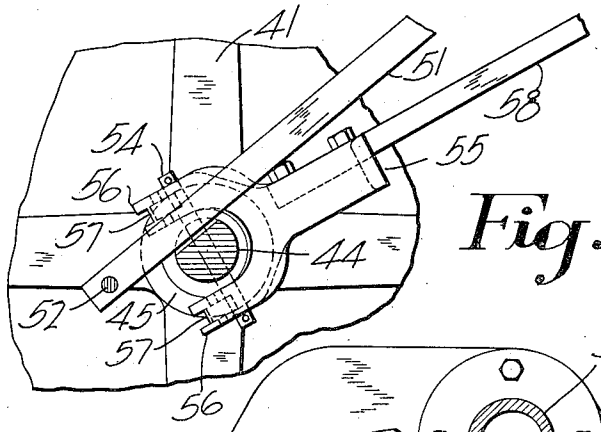


Fig. 4.

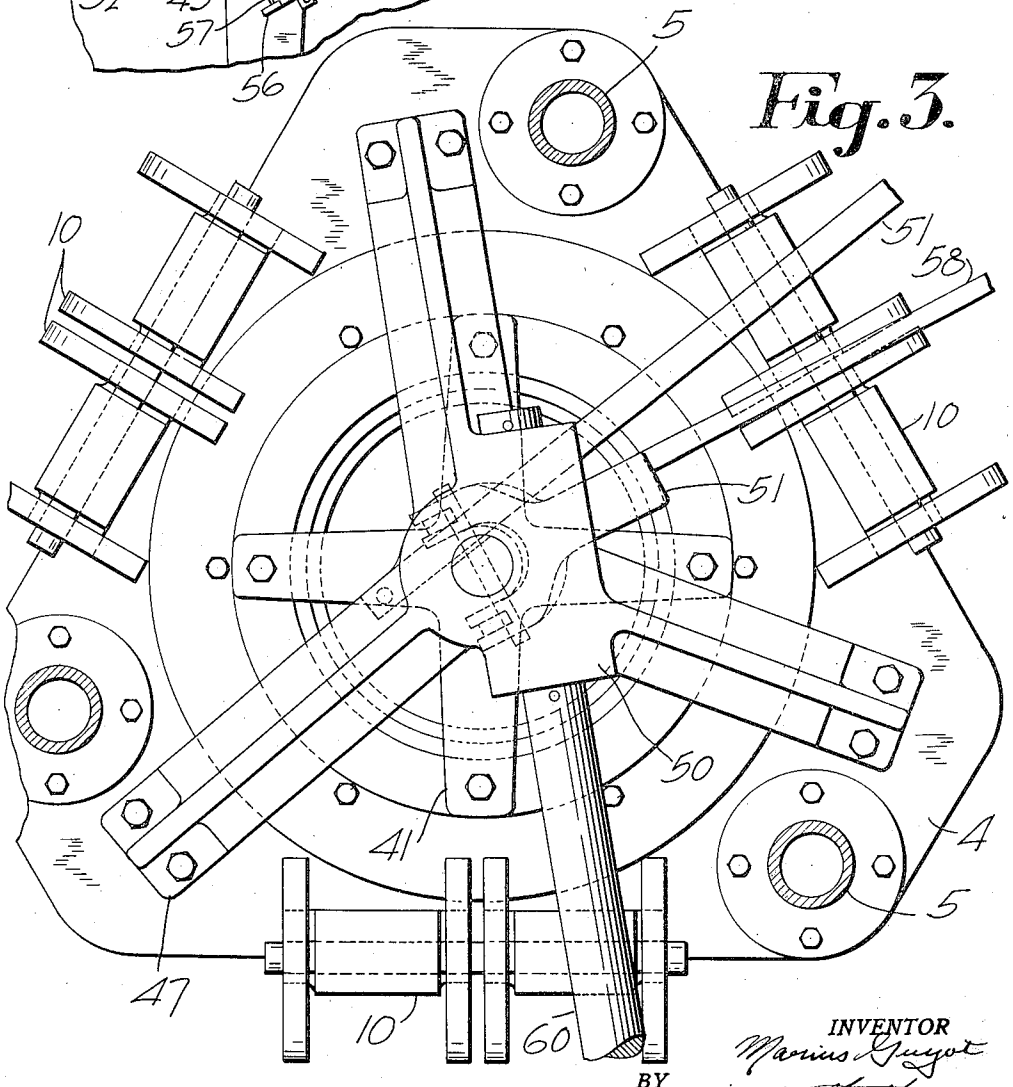


Fig. 3.

INVENTOR
Marius Guyot
BY
ATTORNEY

Nov. 24, 1936. M. GUYOT 2,061,765

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Fig.2.

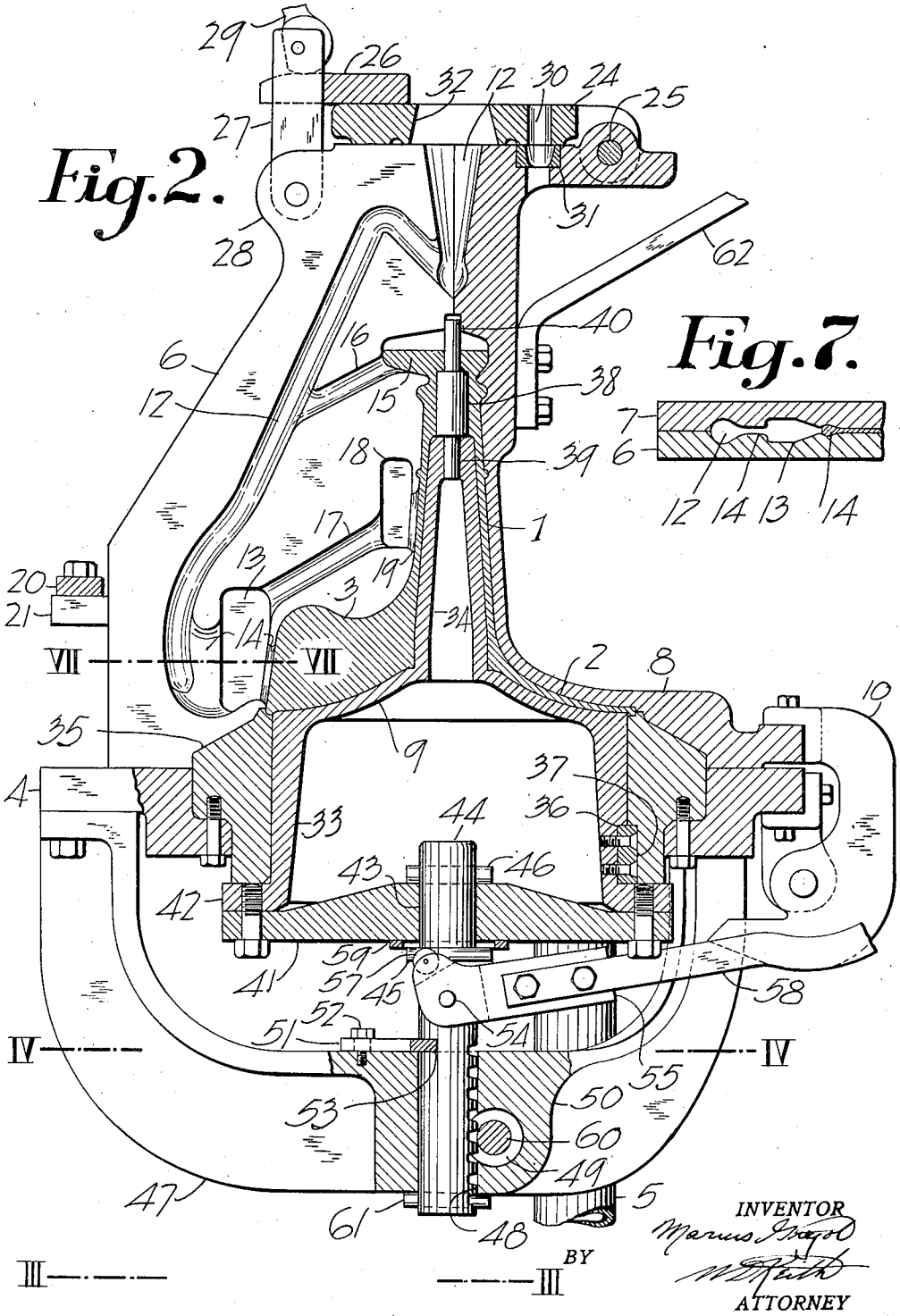


Fig.7.

INVENTOR
Marius Guyot
BY
ATTORNEY

Nov. 24, 1936. M. GUYOT 2,061,765

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Fig. 5.

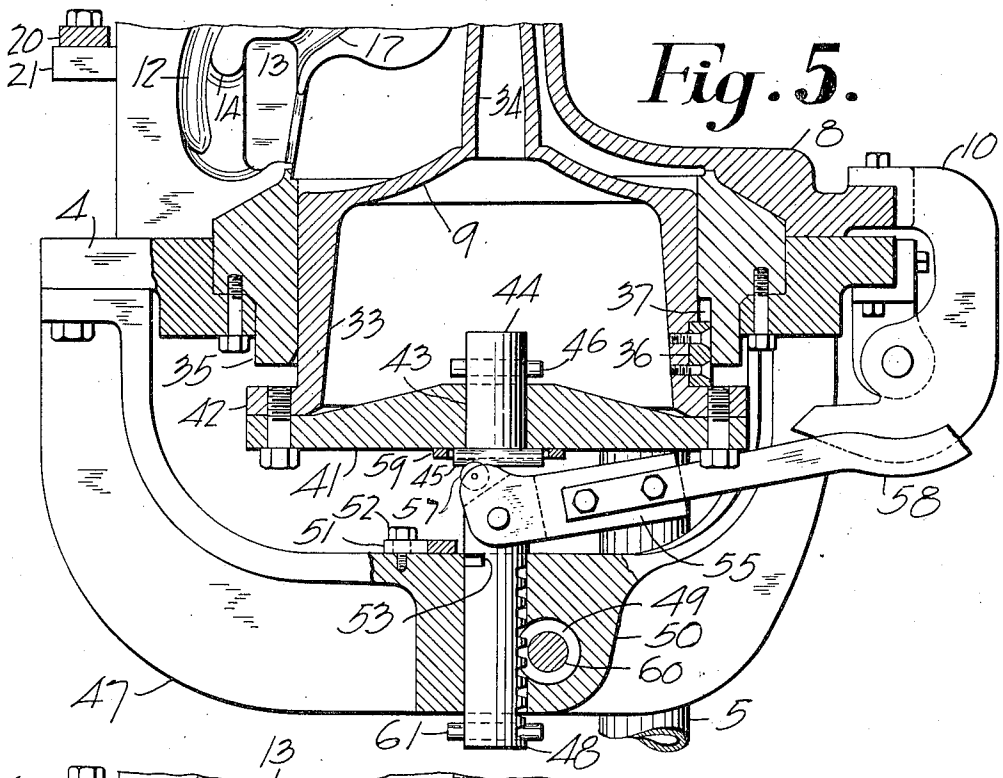
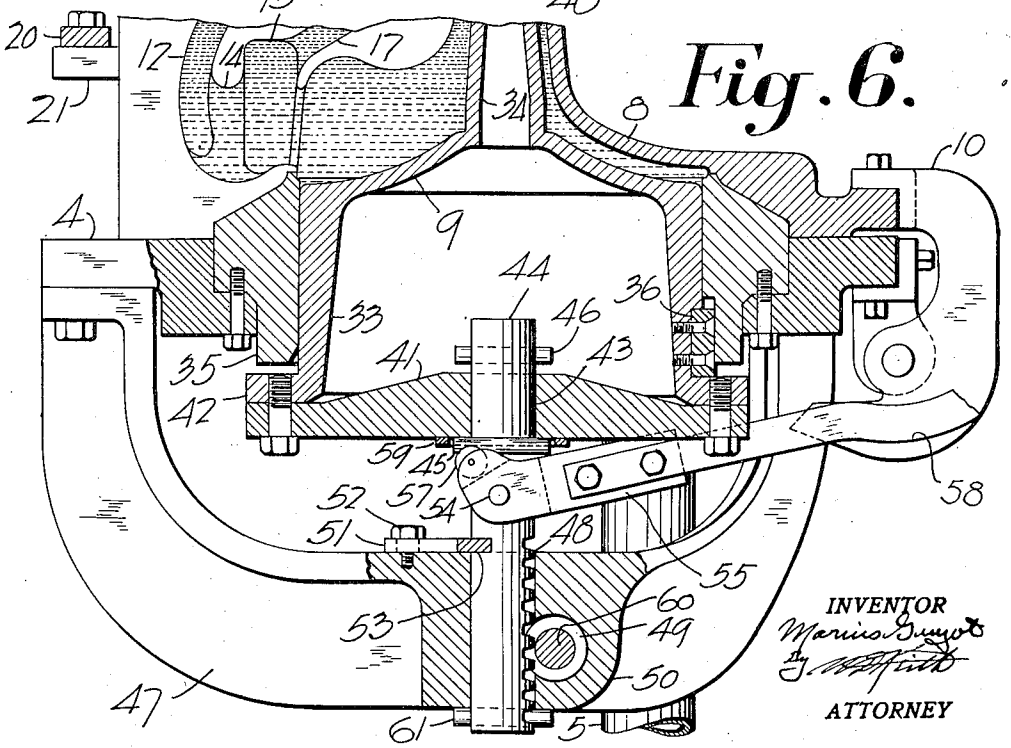


Fig. 6.



INVENTOR
Marius Guyot
By
ATTORNEY

Patented Nov. 24, 1936

2,061,765

UNITED STATES PATENT OFFICE

2,061,765

PERMANENT MOLD

Marius Guyot, Cleveland, Ohio, assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania

Application September 1, 1932, Serial No. 631,322

7 Claims. (Cl. 22—152)

This invention relates to the casting of metal articles in permanent molds. It relates more particularly to the casting, in such molds, of hollow metal articles whose walls, in whole or in part, are of relatively thin cross section.

Those skilled in the art of casting metal are familiar with the fact that an internal structure produced in a metallic article by casting the article in a permanent or metal mold, often termed a "chill" mold, is superior in many respects to the structure of the same article as cast in a sand or conglomerate mold. Comparing similar sections in the sand cast and chill cast condition, the chill cast article has a more refined grain structure in the matrix and any undissolved alloying constituent at the grain boundaries is, by the rapid freezing of the metal, not permitted sufficient time to coalesce into injurious large sized particles.

As a result of the rapid chilling and consequent structural refinement, the physical properties of a permanent mold casting are superior to those developed in a sand casting and for this reason the bulk and weight may be reduced by cutting down section thickness while retaining adequate properties by chill casting. Other advantages accruing from chill mold castings are dimensional accuracy and ability to reproduce or duplicate a large number of castings from the same mold.

In the operation of permanent molds to produce castings having more or less extensive areas of thin section, the difficulty of obtaining acceptable castings increases as the cross sectional area decreases. Contact with the metal mold rapidly chills the inflowing metal and "misruns" or "cold shuts" frequently occur. These appear as holes in the casting caused by the failure of the molten metal to completely fill the mold cavity prior to solidification.

Certain methods are available to overcome this difficulty. The molten metal or the mold may be preheated to provide the usual operating temperature, but this detracts from the chilling effect which is efficacious in producing grain refinement and improved properties. In the narrow sections of the casting cavity the mold or core may be given an exceptionally heavy coating of mold wash, but the usual result of this procedure is a roughened casting surface which detracts from the appearance of the article. As another alternative, also familiar to the art, a method may be used which depends for its success on pressure applied to the metal during or after its entry into the mold. This pressure method requires cumbersome, complicated and expensive equipment for the development and application of the mechanical, hydraulic or pneumatic pressure, and the castings thus made frequently suffer from porosity occasioned by entrapped air or other gases. As a further alternative, the difficulty may be somewhat alleviated by supplying an increased number of risers, feeders, shrinkage pads, or similar devices which decrease the chilling effect, increase scrap loss, complicate the mold design, and must subsequently be separated from the casting, the latter requiring grinding or other finishing operations at the points of contact with casting and feeding devices.

It is an object of my invention to provide a mold which is simple, easy to operate, and economical in construction, and which, when operated according to the method hereinafter disclosed, produces commercially uniform and acceptable castings.

Another object of my invention is to provide a mold whereby I can produce permanent castings of unusually low section thickness with little or no scrap loss, without the addition of any feeding devices beyond those ordinarily used, without undue metal or mold preheating, and without the application of undue pressure, either mechanical or otherwise, to the metal.

The mold hereinafter described is especially adaptable to the production of hollow cup-shaped castings, horn or substantially cone-shaped castings or in fact any type of casting in which a sectional or unitary core is inserted within a mold cavity to define the interior of the casting. I have used it with particular success in making washing machine agitator castings.

In order to produce such castings of a section thickness most suitable for their commercial adaptation, the old and well-known gating methods were first tried, but in cases where unusually thin sections were provided they proved unsuccessful. By the use of the mold and method disclosed hereinafter, I have been enabled to utilize a simple gating method and notwithstanding this to produce castings of thinner cross sectional area and sounder structure than have heretofore been successfully made.

As a preferred embodiment of my invention I have selected for purposes of illustration the casting of a washing machine agitator. The invention will be more clearly understood when explained in conjunction with the following description and appended drawings in which:

Fig. 1 represents a top plan view of a mold assembly embodying the invention;

Fig. 2 represents a vertical sectional elevation taken on the line II—II of Fig. 1;

Fig. 3 represents a bottom plan view of the mold assembly taken on the line III—III of Fig. 2;

Fig. 4 represents a fragmentary bottom plan view taken on the line IV—IV of Fig. 2;

Fig. 5 represents a fragmentary vertical sectional elevation showing the core in its lowest position;

Fig. 6 represents a fragmentary vertical sectional elevation showing the core in intermediate position;

Fig. 7 represents a fragmentary section taken on the line VII—VII of Fig. 2.

Referring to the drawings, a casting assembly is shown which is adapted to the formation of a washing machine agitator having an upwardly extending, substantially cylindrical, central hollow portion 1 and an outwardly flared base portion 2. Fins or flanges 3 are provided integral with the upper surface of the flared base and cylindrical central portion. Preferably the agitator is composed of a suitable metal having a low specific gravity, as compared with iron, such as include aluminum, magnesium, their alloys, or any other similar light metals and their alloys.

The mold for casting the article comprises a suitable main base member 4 supported upon legs 5 or the like. Mounted upon the upper surface of the base member are relatively movable mold sections 6, 7 and 8, which sections are adapted to cooperate with each other and with a suitable core member 9 to constitute a metal-receiving cavity therebetween.

The mold sections 6, 7 and 8 are generally wedge-shaped and each section is provided with two working faces in engagement and flush with one another. Each of the mold sections is hingedly connected to the base member 4 by means of suitable hinges 10 which construction permits them to be pivotally displaced outwardly relative to each other and their common central vertical axis. The adjacent contacting mold faces are suitably recessed to form the casting cavities 11, in which the aforementioned fins or flanges 3 are formed, and as shown in Fig. 2, gates 12 are provided which open into the risers 13, communicating with fins 3 through the restricted passages 14, by means of which molten metal is introduced into the casting cavity. An auxiliary riser cavity 15 is also preferably provided in the form of co-operating recesses in the mold sections adjacent the upper portion of the casting, which may also be connected with the inlet gates 12 by communicating passages 16, and in practice it is preferable to provide a metal feeding and gating communication with all of the fins or flanges incorporated in such a casting although this is not necessary. Additional inlet passages 17 may also be provided to permit molten metal to enter the casting cavity at an intermediate position along the vertical extension 1. The metal in this case enters the casting through enlarged riser or feeder cavities 18 and restricted communicating passages 19.

In order to restrain the mold sections in operative position, adjacent sections are equipped with suitable links 20, pivotally secured to brackets 21 extending outwardly from one of each pair of adjacent engaging mold faces. Each link 20 is provided with a suitable cam lever 22 pivotally secured thereto and adaped to bear behind brackets 23 projecting or extending outwardly from the other engaging mold faces. The upper portions of the mold sections are also clamped together by means of a suitable clamping ring 24, which is hingedly connected at 25 to the mold section 8. The clamping ring 24 is provided with a slotted or bifurcated plate 26 welded or otherwise attached thereto and extending beyond the periphery thereof. A link 27, pivoted at one end to a suitable lug 28 formed integral with mold section 7 is adapted to be positioned within the slot in the bifurcated plate 26 and is provided at is opposite end with a pivotally attached cam lever 29 which may be manipulated to bear upon the upper surface of the plate 26 in clamping relationship therewith. Dowel pins 30, or the like, secured in the ring 24 and projecting downwardly therefrom into suitable hardened bushings 31 located in the mold sections 6, 7 and 8 serve to register the clamping ring with the cam lever 29 and also position the aperture 32 in the ring in alignment with the single entrance aperture to gates 12.

Referring particularly to Fig. 2, the core 9 comprises an annular base portion 33 having a central, elongated cylindrical portion 34 projecting vertically therefrom and preferably formed integral therewith. The core 9 is centralized relative to the recessed mold sections or casting cavity by means of a centering ring 35 secured as by cap screws within an aperture in the base 4, the ring 35 also cooperating with the lower extremities of the recessed mold sections 6, 7 and 8 thereby insuring axial alignment of the core and casting cavity. Secured in the base 33 of the core is a key 36 which cooperates with a complementary keyway 37 in the ring 35, which construction prevents rotational movement of the core with respect to the casting cavity or mold sections and also acts as a guide as will be hereinafter seen. The upper end of the core 9 is centrally positioned against lateral play or displacement relative to the mold cavity by means of a shouldered pin 38 one end of which is positioned within an aperture or bore 39 in the upper end of the core and the opposite end is adapted to enter the aperture or bore 40 in the complementary mold sections.

Means for supporting the core 9 and imparting vertical axial movement thereto is provided as follows. A core-supporting member or base 41, shown herein in the form of a cross, is suitably secured to a flange 42 extending outwardly from the portion 33 of the core 9. Extending through an aperture or bore 43 in the member 41 is a reciprocatory member in the form of a shaft 44. Shaft 44 is equipped with a fixed collar or flange 45 adapted to bear upon the under face of the member 41 (Figs. 5 and 6) and a pin 46 extending through the upper end of the shaft is adapted to bear upon the upper surface of the member 41 (Fig. 2). The distance between the upper surface of the collar 45 and the lower contacting surface of the pin 46 is greater than the thickness of the member 41 which constitues a movable connection between the base member 41 and shaft 44, the purpose of which will be hereinafter described. The lower end of shaft 44 is guided within a bracket 47 supported by the base 4 and is provided with suitable rack teeth 48 which are adapted to be engaged by a pinion 49, mounted within the housing 50 formed integral with the bracket 47, through the medium of which longitudinal movement may be imparted to the core 9. A locking device in the form of a lever 51 pivotally mounted upon the upper flat surface or flange

of the bracket 47 by means of a suitable shouldered bolt 52 or the like, is adapted to be rotated into a slot 53 formed in the shaft 44 and thereby provides means for locking the shaft against vertical axial movement.

Fulcrumed on the shaft 44 adjacent the collar 45, as by means of a through pin 54, is a yoke member 55, the oppositely disposed legs or arms 56 of which are bifurcated and have rotatably mounted therein suitable rollers 57. An operating lever 58 secured to the yoke and extending beyond the base 4 provides means for pivoting the yoke in a manner to bring the rollers 57 into or out of contact with a bearing surface 59 which may be provided in the form of a washer or the like suitably attached to the under surface of the member 41. By this means the core may be raised or lowered relative to the shaft 44 an amount equal to the difference in the distance between the upper surface of the collar 45 and the under bearing surface of the pin 46, and the thickness of member 41. That is, the core 9 may be raised from the position shown in Fig. 6 to the position shown in Fig. 2.

In the operation of my improved mold, to secure the benefits of my improved method of casting, the mold is assembled as shown in plan view in Fig. 1 and the core 9 is brought into the intermediate position shown in Fig. 6. The movement of the core into this intermediate position is accomplished by means of rotating the pinion 49, by any suitable crank arrangement, not shown, mounted on the shaft 60, until vertical movement of the shaft 44 is restrained by the contacting of the extending pin 61 with the under surface of bracket 47. In this position the shaft 44 is locked by means of rotating the lever 51 into the slot 53 in the shaft, in which position the core is restrained from lowering or running down because of its weight. Thereafter the molten metal is introduced through the gates 12, communicating passages 16 and 17 and riser cavities 13, 15 and 18, in an amount which will not completely fill the casting cavities 11. The operating lever or handle 58 is now lowered to raise the core into its final position (Fig. 2), which action raises the molten metal in the casting cavities and accomplishes the desirable advantages of my invention. A sufficient amount of molten metal is then added to completely fill the mold and the lever 58 is held down or depressed sufficiently long to permit the casting to solidify, which is a relatively short interval of time in the casting of thin-walled articles of the nature herein described.

Alternative methods of practicing my invention include introducing sufficient molten metal in the casting cavity when the core 9 is in its intermediate position (Fig. 6) to completely fill the same when the core is raised to its final position (Fig. 2) and thereafter raising the core by means of the operating lever 58; or feeding molten metal to the casting cavity and simultaneously advancing or raising the core from its intermediate to its final position within the casting cavity.

In all three methods described above the molten metal is unconfined and is raised into the recessed mold by the raising or advancing movement of the core, the only pressure exerted on the molten metal being that necessary to overcome the dead weight of the molten metal, the frictional resistance of the mold parts against flow of the molten metal and atmospheric pressure acting on the exposed metal in the gate passage. Furthermore the guiding of the core 9 by means of the key 36, within its complementary keyway 37, and the shouldered pin 38, within its cooperating apertures 39 and 40 insures acceptable uniform castings.

On completion of the casting operation the cam lever 29 is manipulated to release the clamping ring 24 which can then be rotated about its hinge 25, and thereafter the cam levers 22 are actuated to release the adjacent mold sections in order that they may be pivoted outwardly on their hinges 10 by handles 62 or other suitable means secured to each mold section. The cast article, together with its attached gate metal, risers and runners, is then exposed upon the core 9. The core is thereafter lowered to the position shown in Fig. 5 by means of releasing the locking device 51 and rotating the pinion 49, which procedure strips the cast article from the core. The casting may then be readily removed from its mold and core, after which the gates, risers, etc. can be removed by any suitable cutting means. The simplicity with which the excess metal may be removed leaves the casting with clean, smooth working surfaces which for many uses may not require any further polishing or grinding operation, hence the cost of production is decreased while an improved article is obtained.

From the foregoing description it is evident that the invention resides in changing the spaced relationship of mold and core while the metal is being poured, or during a momentary pause in the metal pouring operation. No undue pressure is applied to the metal, since it is not restrained on all sides but is free to flow into those portions of the mold cavity not yet filled with molten metal. Some portions of the casting cavity which ultimately define the thin sections of the casting fill quickly since the metal flows into them while the cavities are in an enlarged condition and the sections are thereafter smoothly and progressively narrowed. In these portions of the casting cavity which, when the core is in its final position, define the thinnest casting sections, there is no restriction of metal flow during preliminary pouring since these sections are filled before being narrowed. For the same reason there is no premature freezing or entrapment of gases. Since no pressure of any kind is applied to the metal, the disadvantages accruing from pressure type casting are not encountered. The mold may be manually operated with ease and simplicity and all operations, including metal pouring, may be performed by one operator.

In order to be most advantageously susceptible to the application of my method a certain directional relationship should exist between the direction of core motion and the position and inclination of the thin sections of the casting cavity. It is apparent that if, for instance, a thin wall of a hollow casting lies in a plane parallel to the line of motion of the core, no section reduction can be effected by longitudinal motion of the core. If, however, as in the agitator casting illustrated, the thin section of the casting lies in any of the possible planes which are not parallel to the line of motion of the core, then the motion herein described becomes effective and an improved result is obtained.

By the practice of the invention as herein outlined, I have succeeded in making commercially acceptable castings of washing machine agitators or the like without resorting to special gating methods heretofore believed necessary for this type of casting, and with a section considerably

reduced below that formerly obtainable even by the use of these special gating methods. As a result, castings of this nature can be reduced substantially in weight, although their physical properties are ample to fulfill the requirements of service.

It is evident to those skilled in the art that the core or other movable mold part may be inserted from the bottom as illustrated in the drawings or from any other suitable angle best calculated to effect the change of space relationship of core and mold with reference to the usual sections of the casting cavity. Pouring of the metal may take place through gates connecting at the top or lower portion of the casting cavity as well as at the side as illustrated. The translation of metal caused by the core motion is not turbulent or violent, nor is gas churned in or entrapped, as experienced in some methods employed in introducing metal into a metal cavity. In the case of a mold already equipped for the introduction of cores by mechanical means, very little if any additional changes need be made to permit carrying out my improved method of casting.

In this specification and the appended claims the term "final position", as applied to the position of the core, signifies that position which the core occupies in my invention when the casting metal is freezing and corresponds to the position shown herein in Fig. 2 which the core occupies in an ordinary mold when the mold is closed and the casting is ready to be poured.

The term "intermediate position" as used in this specification and the appended claims in referring to the movable core, signifies such a position as is illustrated in Fig. 6 of the drawings, namely, a position which the core occupies at the commencement of the metal pouring operation and from which position the core is subsequently moved to attain the final position described immediately hereinabove.

Having thus described and explained my invention and its mode of operation, it is to be understood that the apparatus and type of casting described herein were selected merely for purposes of illustration and that numerous variations in the form and arrangement of parts shown and described may be made without departing from the nature and scope of my invention, except as defined in the appended claims.

What I claim is:

1. A casting apparatus comprising a recessed mold and a core associated therewith, means for moving said core into said recessed mold to an intermediate position therein, and further means independent of the first-mentioned means for advancing said core into final position within said recessed mold.

2. A casting apparatus comprising a recessed mold and a core associated therewith, means for advancing said core into said recessed mold to an intermediate position therein, means for locking said core-advancing means to position the core in said intermediate position, and separately operated means independent of said first-mentioned means for advancing said core into final position within said recessed mold.

3. A casting apparatus comprising a recessed mold and a core movably associated therewith, means for moving said core into said recessed mold to an intermediate position therein, means for guiding said core and restraining it from rotation with respect to said recessed mold, and further means independent of the first-mentioned means for advancing said core into final position within said recessed mold.

4. A casting apparatus which comprises a recessed mold and a core movably associated therewith, means for advancing said core into said recessed mold to an intermediate position, means for locking said core-advancing means to position the core in said intermediate position, means for guiding said core and restraining it from rotation with respect to said recessed mold, and separately operated means independent of said first-mentioned means for advancing said core into final position within said recessed mold.

5. A permanent mold comprising a base member, complementary mold sections movably mounted on said base member, said mold sections being recessed to constitute a casting cavity, a core cooperating with said mold sections and adapted to be advanced into and out of said casting cavity, means for moving said core into said casting cavity to an intermediate position, further means independent of the first-mentioned means for advancing said core into final position within said casting cavity, and gate means for introducing molten metal into said casting cavity.

6. A permanent mold comprising a base member, an aperture in said base member, a centering ring secured within said aperture, complementary mold sections movably mounted on said base member, said mold sections being recessed on their cooperating faces to constitute a casting cavity the lower portion of which engages the centering ring, a movable core supported below said base member and adapted to project into said casting cavity, a shaft movably attached to said core, rack teeth formed in said shaft, a pinion adapted to mesh with said rack teeth, means for rotating said pinion to move said core into or out of said casting cavity, a slot in said shaft, a locking member adapted to enter said slot to lock the shaft and core in an intermediate position with respect to said casting cavity, means for moving said core relative to said shaft from its intermediate position to a final position within said casting cavity, and means for limiting the movement of the core to its final position.

7. A permanent mold comprising a base member, an aperture in said base member, a centering ring secured within said aperture, complementary mold sections rotatably hinged to said base member, said mold sections being recessed on their adjacent cooperating faces to constitute a casting cavity, said mold sections engaging the centering ring at their lower extremities, means for clamping said mold sections in rigid relationship, gating means for introducing molten metal into the casting cavity, a core movably supported below said base member and extending through said centering ring into the casting cavity, a shaft movably attached to said core, means for imparting movement to said shaft to move the core into an intermediate position in said casting cavity, a keyway in said centering ring, a key secured to said core in registry with said keyway, said key and keyway providing means for restraining the core from rotating relative to the mold sections, means for locking said core in its intermediate position, a yoke fulcrumed on said shaft, said yoke being provided with bearing rollers in contact with the base of said core, and means for pivoting said yoke whereby the bearing rollers advance the core relative to said shaft.

MARIUS GUYOT.