Oct. 18, 1927. 1,645,726

C. VAUGHAN

MOLD

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FIG. 3.

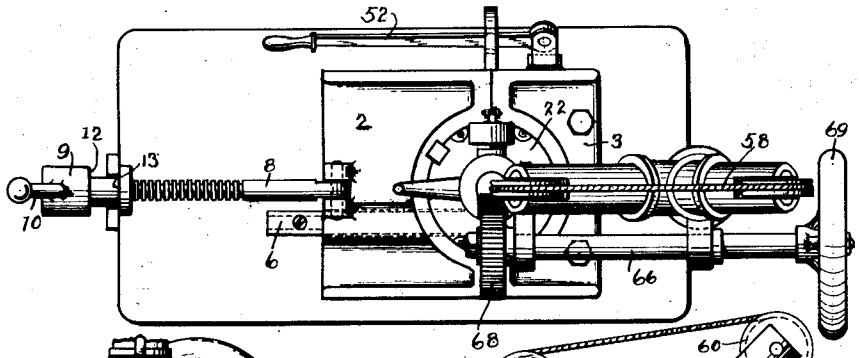



FIG. 2.

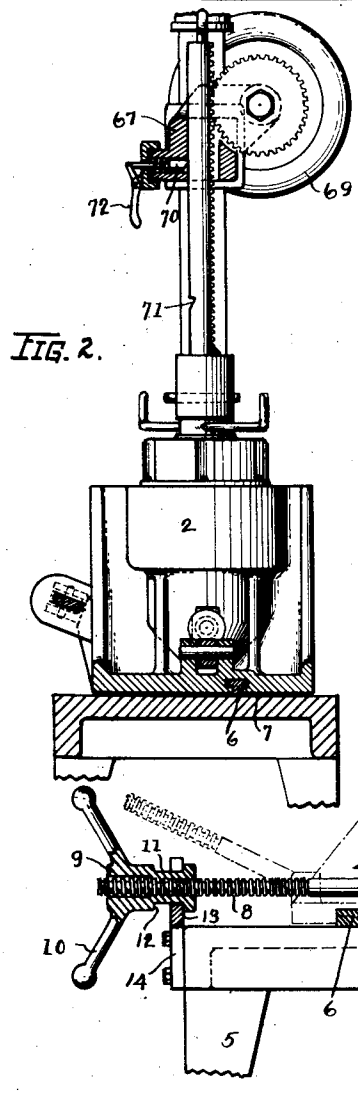
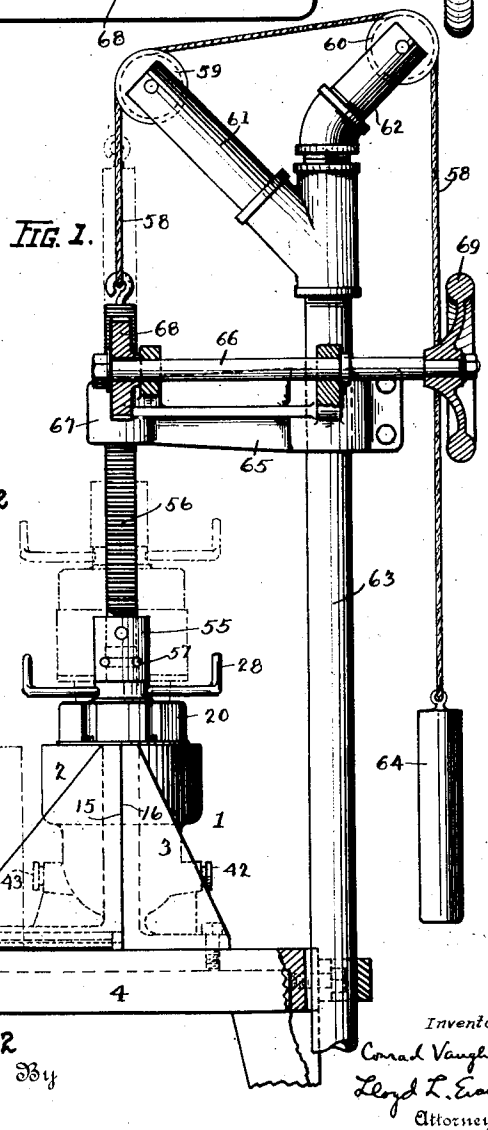



FIG. 1.




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FIG. 4.

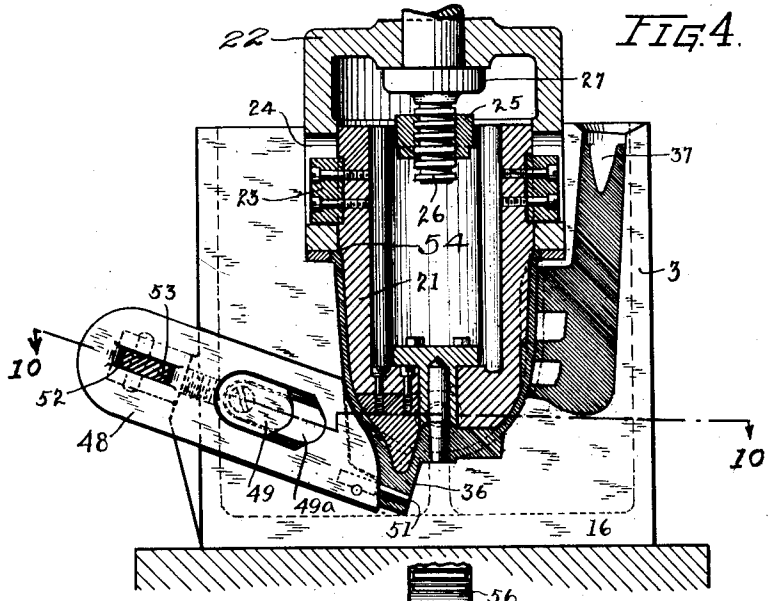



FIG. 6.

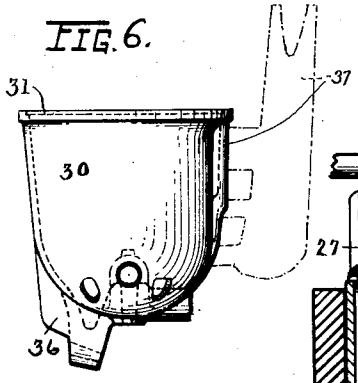
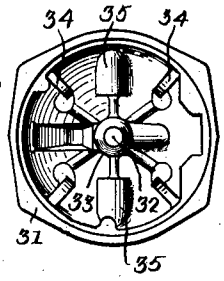



FIG. 5.




FIG. 7.




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Fig. 8

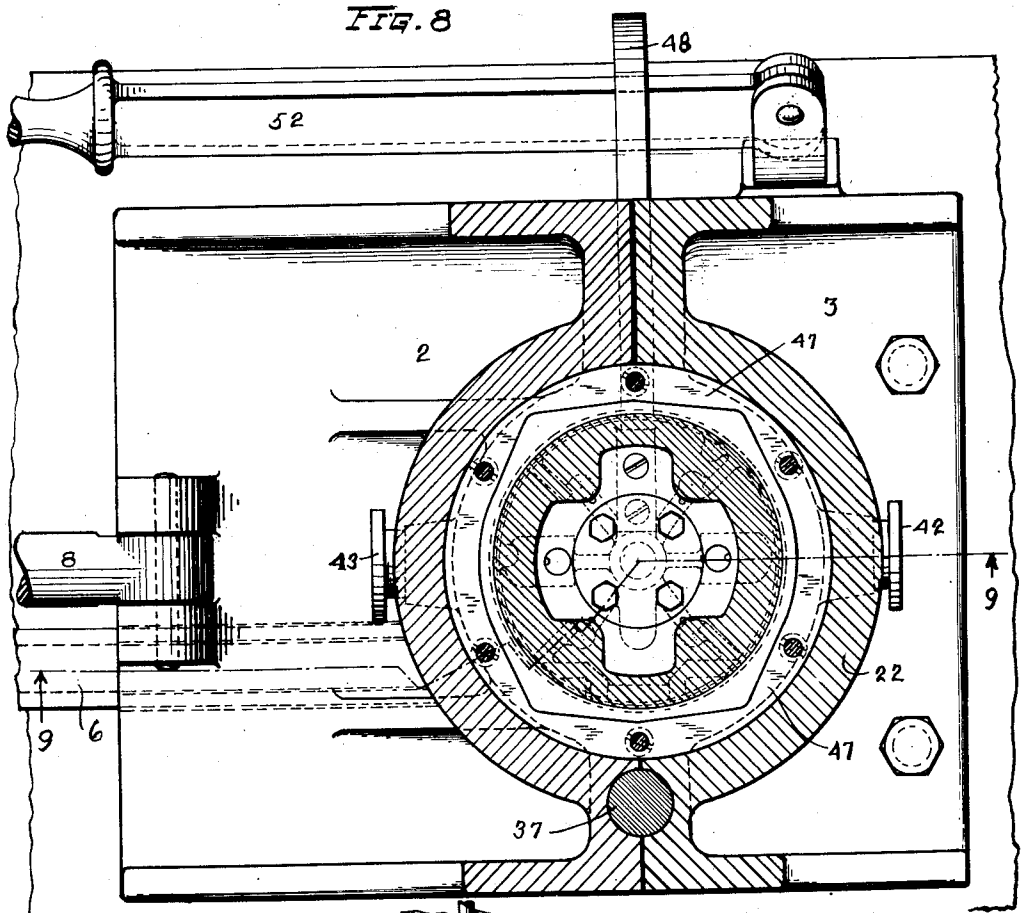
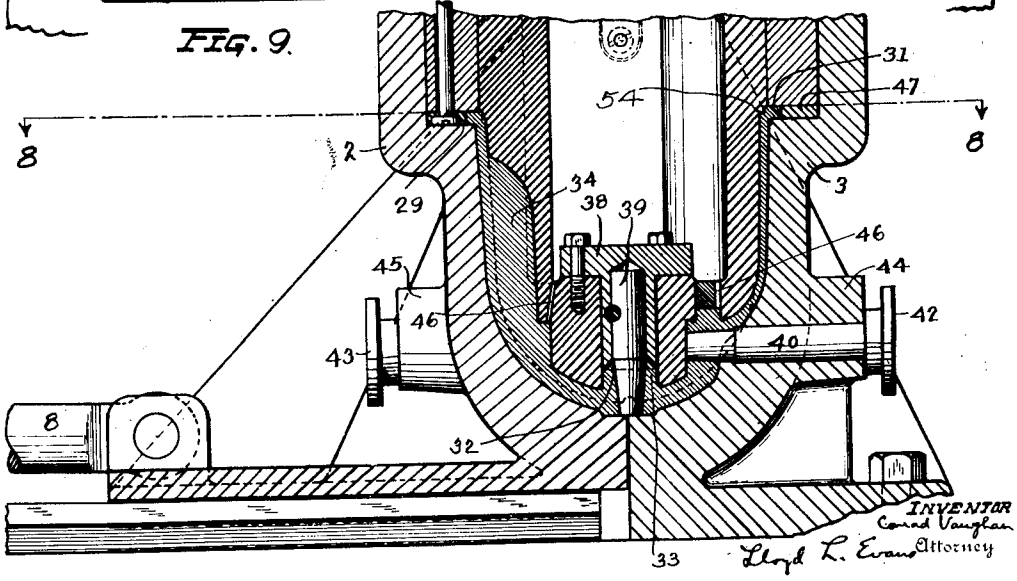



Fig. 9.




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Fig. 10.

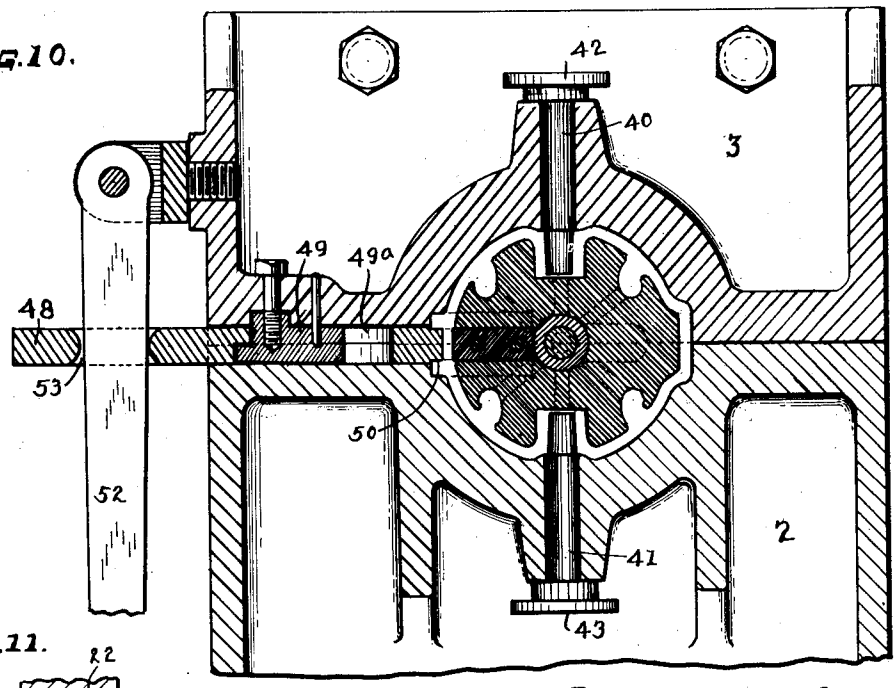



Fig. 11.

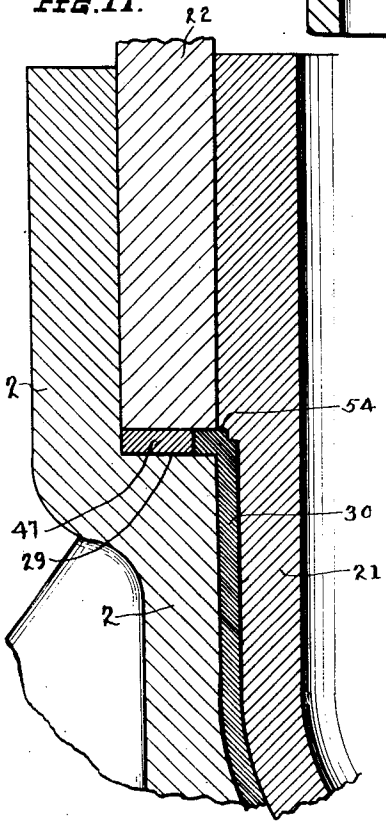
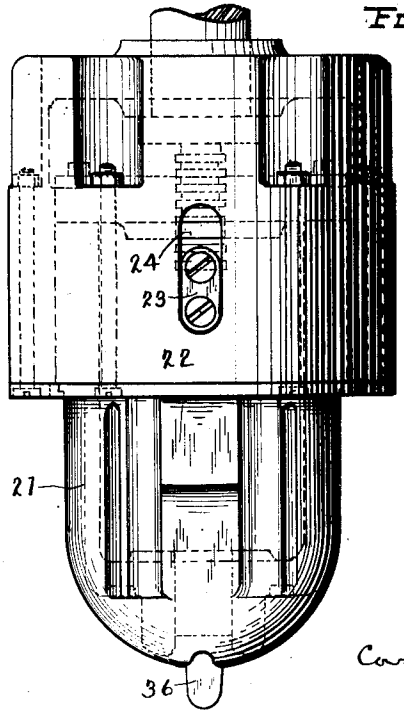



Fig. 12.




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Patented Oct. 18, 1927. 1,645,726

# UNITED STATES PATENT OFFICE.

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## MOLD.

Application filed September 1, 1923, Serial No. 660,484. Renewed July 18, 1927.

This invention relates to permanent metal molds and is particularly useful in forming castings of aluminum alloys or any alloys of relatively high crystallization shrinkage and relatively low fusing point.

An object of the present invention is to provide a permanent metal mold for casting articles of a shape requiring the use of a core and in which means are provided for easily and quickly disengaging the core from the casting before the metal of the casting has shrunk sufficiently to cause the casting to bind upon the core.

A further object of the invention is to provide a permanent mold having a sectional core in which limited movement of the core may be had to free the same from the casting before the core as a whole is removed from the casing.

Another object of the invention is to provide a mold for casting cup shaped articles in which the mold proper comprises complementary parts, one of which is fixed to and the other movable upon a common base or support.

Still another object of the invention is to so construct a mold that mold parts in contact with the metal of the casting and movable relative to other parts of the mold will not permit adhering casting metal to produce excessive wear between said mold parts.

A further object is to provide means for easily and effectively venting the recess in which the annular flange of the casting is formed to insure the shape of the flange being sharply defined throughout its periphery.

Other objects will be apparent from the following description and accompanying drawings.

The following description and accompanying drawings disclose in detail a mold designed for forming a casting of a certain form. The specific mold mechanism herein shown and described, however, constitutes but one of the various mechanical forms in which the principle of the invention may be employed.

In the drawings,

Figure 1 is an elevation partly in section showing the mold and core operating mechanism.

Fig. 2 is a sectional view on line 2—2, Fig. 1, showing the core operating mechanism in elevation.

Fig. 3 is a plan view of the mold and core operating mechanism.

Fig. 4 is a view on line 4—4, Fig. 5, showing one-half the mold in elevation.

Fig. 5 is a vertical section through the mold and core, the upper part of the core lifting mechanism being broken away.

Fig. 6 is an elevation of the casting with the sprue indicated in dotted lines.

Fig. 7 is a plan view of the casting.

Fig. 8 is a horizontal section on the line 8—8, Fig. 9.

Fig. 9 is a vertical section on the line 9—9, Fig. 8.

Fig. 10 is a horizontal section on the line 10—10, Fig. 4.

Fig. 11 is an enlarged vertical section of a portion of the core and mold wall.

Fig. 12 is a side elevation of the core.

Referring to the drawings, the mold as an entirety is indicated at 1 and comprises a plurality of members constructed to form a casting of the desired shape. The mold may be formed of cast iron or any other suitable material and comprises complementary members 2 and 3 supported on the base member 4, which in turn is supported by the legs of standards 5.

The number 3 is preferably secured to the base 4 by any suitable means, such as bolts, while the mold member 2 is mounted to slide on the base, a suitable guide track 6 being carried by the base. The guideway may be T-shaped in cross section, the base of the mold section 2 being recessed at 7 to cooperate with it. A threaded bar 8 is pivoted to the outer side of the movable mold section 2 adjacent the base and carries a nut 9 upon its outer end, the nut having handles 10 secured thereto to facilitate its operation. Formed in the body of the nut is a bearing groove 11 having side walls to form opposing shoulders 12 and 13. An open yoke 14 is suitably secured to the base member 4 and is adapted to receive the grooved portion 11 of nut 9. When the nut 9 is seated in the yoke 14 the yoke forms a thrust bearing for the nut, so that by turning the nut, the shoulder 13 bears against the yoke and forces the bar 8 to move the section 2 until it is clamped tightly against the fixed section 3. After the casting has been made, the nut 9 can be turned in the opposite direction by means of the handles so that the shoulder 12

bears against the yoke and pulls the mold section away from the section 3. The nut may then be rotated or the section 2 moved so that the nut 9 may be lifted free of the yoke in order that the movable section 2 can be quickly pulled entirely away from the fixed section 3.

The permanent mold sections 2 and 3 have a face to face engagement, the face 15 of the mold section 2 engaging the face 16 of the mold section 3, and the sections are hollowed out so that they form the outer wall of a cup-shaped casting, the inner wall of the casting being formed by a suitable permanent core structure indicated generally at 20.

The permanent core 20 comprises a cup-shaped lower section 21 and an upper section 22, both preferably hollow, the upper section 22 being inverted over the open upper end of the lower section and telescopically connected thereto. The open upper end of the lower plunger or core section 21 fits within the open lower end of the upper section 22 and has lugs 23 engaging in slots 24 in the upper section by means of which the sections are held against relative turning movement and by means of which the two sections are accurately positioned with respect to each other as will be hereinafter explained. Bridging the open top of the hollow section 21 of the core is a bar 25 rigidly secured to the section 21 and having a central threaded aperture therein to receive the threaded end of a jack screw 26. The jack screw 26 has a cylindrical portion above the lower threaded end thereof which extends through a central aperture in the top of the upper core section 22 and carries a flange 27 which engages the under side of the top of the core section 22. The jack screw 26 has a handle 28 rigidly secured thereto immediately above the top of the upper core section 22 by means of which the screw may be turned to slide the lower core section up or down in the upper core section. When the lower section is forced downwardly by the jack screw 26 until the lugs 23 engage the lower ends of the slots 24, the core sections are in proper molding position. The retraction of the lower mold section into the upper mold section by means of the jack screw serves to free the core from the casting prior to the removal of the core from the mold, as will be hereinafter more fully explained.

While the present invention is, in its broader aspects, applicable generally to the formation of cup-shaped castings, the mold herein shown is designed particularly for forming a cap or casing for motors, such as used upon vacuum cleaners, in which it is desirable to provide certain internal ribs and positioning lugs, external ribs and flanges and apertures through the wall of the casting and through certain of the ribs. The present invention embodies certain special features of construction in the mold and core to facilitate the formation of these lugs, apertures and flanges in a satisfactory manner by means of metal mold and core members capable of repeated use.

The mold 1 is formed to slidably receive the upper core section 22 as well as the lower section 21, and consequently the upper portion of the mold is enlarged to a greater diameter than the lower portion and has an internal shoulder 29 between the two portions thereof. The mold sections and the core are shaped and correlated to form the bottom and the outer and inner walls of the cup-shaped casting. The casting 30, which the mold herein shown is designed to form, is shown in Figs. 6 and 7 and consists of a cup-shaped body having an upper annular edge, which in the present case is flange 31. In the present invention the flange 31 of the casting is formed between the shoulder 29 of the mold and portions of the core comprising the lower edges of the upper core section 22, the shoulder 54 of the core section 21 and a separate ring 47, the inner edge of which conforms to the outer configuration of the flange 31 of the casting. The ring is bolted to the lower edge of the core section 22 and rests upon the shoulder 29 when the core is in place in the mold. The fit between the ring 47 and the shoulder 29 and between the ring 47 and edge of core section 22 is tight enough to prevent any overflow of metal which would form a rough edge on the flange but by reason of the fact that the ring 47 is a separate piece attached to the core section, there is sufficient space between them to permit the air within the flange forming space to be completely displaced by the inflowing metal, so that the flange forming space is entirely filled with metal and a smooth uniform flange is formed.

The lower core section 21 has its upper portion within the upper core section 22 offset to a slightly greater diameter than the portion thereof within the casting, a circumferential shoulder 54 being formed between these portions, which, when the core is positioned for casting, is flush with the lower edge of the core section 22 and forms part of the mold for the flange 31 of the casting. By reason of this construction, the casting forming portion of the lower core section 21 never contacts with the inner surface of the upper core section 22 and there is no wear or tendency for the parts to stick due to adhesion of some of the metal of the casting to the core. Moreover, by reason of the cooperative relation between the upper portion of the core section 21 and the inner portion of the core section 22, it will be seen that the core section 21 is prevented from transverse movement with respect to the core section 22 during the vertical movement of said core section 21. After the core has been loosened

by drawing the lower core section 21 a short distance into the upper core section 22, the core can be lifted bodily out of the mold and after the core is removed the sections 2 and 3 can be separated to discharge the casting, the slide 48 being withdrawn from engagement with the casting prior to the separation of the mold sections.

The casting 30 has a rounded bottom through which is an axial aperture 32 surrounded by an inwardly projecting boss 33. Adjacent the bottom of the casting 30 are internal ribs and lugs 34 and 35 upon the inside and also a channel shaped projection 36 upon the outside. The lower core section 21 is formed with grooves and depressions to form the ribs and lugs upon the inner side of the casting and the complementary mold sections 2 and 3 have recesses formed in their abutting faces to receive the metal which forms the external projection 36 of the casting and also to provide the sprue cavity 37 open to the top of the mold and to one side of the casting cavity through which the molten metal flows into the mold to form the casting.

The lower end of the core section 21 has a plug 38 removably secured in a central aperture in the bottom thereof and secured in the plug 38 is a tapered pin 39 which when the core is in place engages the bottom of the mold to center the core with respect to the mold and to properly space the bottom of the core from the bottom of the mold. The pin 39 serves to form the axial aperture 32 in the end of the casting and the boss 33 of the casting its formed in the recess of the core section below the lower end of the plug 38. As a further means of properly positioning and securing the core, diametrically opposite horizontally disposed pins 40 and 41 pass through the mold sections 3 and 2, respectively, into engagement with recessed portions of the core adjacent its lower edge. The pins 40 and 41 have tapered inner ends to facilitate the removal thereof and have heads 42 and 43 which engage with bosses 44 and 45 on the mold sections 2 and 3 to limit the inward movement of the pins and to provide means by means of which the pins can be readily knocked out after the casting has been formed. The pins 40 and 41 form oppositely disposed apertures in the wall of the casting 30.

The recessed portions of the lower portion of the hollow core are provided with suitable vents 46 to permit air displaced by the inflowing metal to escape to the interior of the core, so that the recesses are completely filled with metal in the pouring operation and the ribs and lugs upon the interior of the casting are properly formed. Heretofore edge flanges of hollow castings formed in molds in which the gate opens to the interior of the casting cavity below the top have been rough and uneven due to the trapping of air in the grooves in which the flange is formed or to overflow of molten metal.

The projection 36 of the casting is formed with a channel on one side and with an aperture below the channeled portion thereof. In order to form the channel and aperture in the projection 36, a slide 48 is disposed in a slideway formed by inclined grooves in the meeting faces of the mold sections 2 and 3 and is attached to the fixed mold section 3 by means of an undercut block 49 bolted to the mold section 3 and engaging in a slot $49^a$ extending lengthwise of the slide 48. The inner end portion 50 of the slide 48 is cut to conform to the outer surface of the casting 30 and carries projecting tapered pin 51 which extends into the recess of the mold to form the aperture in the projection 36. In knockdown permanent molds as heretofore constructed one great drawback has been the excessive wear between sliding parts and the tendency of such parts to stick due to the metal of the casting adhering to one of the parts and interfering with the sliding movement. As shown in Fig. 10, the inner end portion 50 of the slide 48 which projects into the mold cavity to form the channel in the projection 36 is of less thickness than the body of the slide, so that when the slide is retracted the portion thereof which has been in contact with the casting does not touch either side of the slideway formed in the mold. This prevents wear upon the slideway due to abrasion by particles of the metal of the casting adhering to the portion of the slide which contacts with the casting and permits close fit to be maintained between the relatively sliding parts so that molten metal will not enter between them.

For withdrawing the slide 48 a lever 52 is pivoted to the fixed mold section 3 and extends through an aperture 53 in the outer end of the slide 48. After the molten metal has been poured into the mold and the casting has partially cooled, the pins 40 and 41 are knocked out, releasing the bottom portion of the core, and the lower section 22 of the core is partially withdrawn by rotating the jack screw 26 by means of the handle 28, the core section 21 being held against rotation by the lugs 23 thereof engaging in the slots 24 of the upper section 22 and the casting being held against movement with the core section 21 by the engagement of the lower edge of the section 22 with the flange 31 of the casting.

Inasmuch as the mold core is quite heavy, it is desirable, in order to increase the speed of operation, that convenient hoisting mechanism be provided for lifting the core out of the mold and for returning the core into the mold. To this end the upper end of the jack screw 26 is rotatably mounted and sus-

pended from a bushing or collar 55 attached to the lower end of a vertical rack bar 56. The jack screw is connected to the collar 55 by means of pins 57 which fit within complementary grooves formed upon the upper cylindrical end of the jack screw 26 and the inner surface of the cylindrical collar 55, the pins 57 supporting the jack screw 26 in the collar 55 but permitting the jack screw to be rotated in the collar to adjust the core sections 21 and 22. A cable 58 is attached to the upper end of the vertical rack bar 56, passes over sheaves 59 and 60 upon forks 61 and 62 at the upper end of a fixed vertical standard 63 suitably secured to the base 4 and carries at its opposite end a counterweight 64 which partially counterbalances the weight of the core. A horizontally disposed bracket 65 is fixed to the standard 63 and carries bearings for a horizontal shaft 66. The bracket 65 is formed at its outer end with a guide portion 67 through which the rack bar 56 passes and the shaft 66 has a pinion 68 meshing with the teeth of the rack bar, the inner end of the shaft 66 having a hand wheel 69 by means of which it may be turned to raise or lower the core. The guide portion 67 of the bracket carries a spring latch 70 which is engageable with a notch 71 in the rack bar to hold the core in an elevated position, the latch 70 being provided with an actuating handle 72 by means of which the rack bar can be released when it is desired to again lower the core into the mold.

In operation the movable mold section 2 is first brought into engagement with the fixed mold section 3 and clamped against the section 3 by means of the screw 8. The sectional core is then lowered into the mold cavity until the lower edge of the upper core section 22 seats upon the shoulder 29 and the lower core section is extended by turning the jack screw 26 until the lugs 23 thereof engage the bottoms of the slots 24 in the upper section 22 and the pin 39 engages the bottom of the mold cavity. The pins 40 and 41 are then inserted through the apertures in the mold section into engagement with the core and the slide 48 is moved inwardly until the pin 51 engages the wall of the recess in the mold. Molten metal is then poured into the sprue cavity 37 until the casting cavity and sprue cavity are filled. After the metal of the casting is slightly cooled, the core is loosened from the casting by operating the jack screw 46, the temperature of the casting being determined by the depth of the shrink holes in the sprue. The pins 40 and 41 and slide 48 are then withdrawn, the core lifted bodily out of the mold by means of the rack and pinion mechanism and the section 2 of the mold withdrawn from the section 3 to free the casting. After the removal of the casting the operation may be repeated.

It will be noted that with mold and core portions of relatively thin section, such as herein shown, much smaller sprues may be employed than in previous permanent molds for casting aluminum alloys, since with such relatively thin mold and core portions the chilling of the casting is reduced sufficiently that the feeding of molten metal to compensate for shrinkage may be readily accomplished, thereby substantially eliminating shrinkage porosity.

It will be seen that in the mechanism above described I have provided a mold which can be quickly assembled to receive the molten metal and which can be quickly and easily opened to free the casting from the mold, and that the relatively movable mold parts have no interengaging surfaces subjected to excessive wear or liable to stick together by reason of the entry of the metal of the castings between them.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. The combination with a permanent mold having a cavity, of a permanent core adapted to be positioned within the cavity, said core comprising telescopic upper and lower sections held against relative rotative movement therebetween, and means for telescoping the sections to free the core from the casting.

2. The combination with a permanent mold having a cavity, the upper portion of which is enlarged, of a permanent core comprising an upper section adapted to slidably fit in the enlarged upper portion of the cavity and a lower section telescoping within the upper section and adapted to be positioned within the lower portion of the cavity, and means carried by the upper section for moving the lower section into the upper section, without relative transverse movement therebetween, to free the core from the casting.

3. In a permanent mold for casting cup-shaped articles from metal of relatively high crystallization shrinkage and relatively low melting point, in combination, a core adapted to be positioned within the mold, comprising telescopically connected sections having relatively large cooperative surfaces to prevent relative transverse movement of said sections during vertical movement of the core, means for telescoping the sections of the core to free the core from the casting, and means for lifting the core out of the mold.

4. The combination with a permanent

mold having a cup-shaped cavity, of a core adapted to be positioned within the cavity, said core having a part closing the open upper end of the mold cavity, said core comprising telescopically connected sections adapted only for relative vertical movement therebetween, and means for telescoping the sections to free the core from the casting.

5. The combination with a mold for casting cup-shaped articles, of permanent mold parts shaped to form a cup-shaped cavity, the upper portion of which is enlarged, and a permanent core comprising an upper section slidably fitting in the enlarged upper portion of the mold cavity, and a lower portion adapted to move within the upper core section and adapted to be projected into the lower portion of the mold cavity, and means carried by the upper section for moving the lower section of the core into the upper section to free the core from the casting.

6. The combination with a mold having a cup-shaped cavity, of a core comprising upper and lower sections, said core and mold having cooperative surfaces to form the mold cavity for the inner and outer walls of the casting, the lower face of the upper section of the core being shaped to form at least a portion of the upper annular edge of the casting, and means for moving the lower section of the core vertically relative to the upper section without relative transverse movement between said sections, whereby the lower portion of the core is freed from the inside of the casting while the casting is held in the mold by the upper section of the core.

7. In a mold for casting cup-shaped articles the combination of a plurality of permanent mold sections shaped and correlated to form the walls against which the bottoms and sides of the cup-shaped articles are cast, and a permanent core consisting of upper and lower sections movable only longitudinally relative to each other, the upper section being shaped to form a portion of the annular top edge of the cup-shaped article, and means for first freeing the lower section of the core from the casting and then bodily removing the core sections together.

8. In a mold for casting cup-shaped articles the combination of a plurality of permanent mold sections which cooperate to form the outer walls of the mold cavity, and a permanent core slidably received within said mold sections, said core comprising an enlarged section, and a section slidably mounted within said enlarged section having a relatively large cooperative area of contact with said enlarged section during said slidable movement, said slidable section being shaped to form the inner wall of the mold cavity, and a portion of said slidable section engaging the casting being smaller and offset from the portion engaging the enlarged core section.

9. A mold for casting an article having a depression therein and comprising permanent mold members to form the body of the casting and a core slidable in the mold to form the depression, said portion of the core forming the wall of the depression being offset and reduced in size from that portion slidably engaging the mold, said mold engaging core portion being adapted to engage the mold during the bodily removal of the core until said reduced core portion is substantially removed from the casting cavity, whereby the portion of the core forming the wall of the casting when freed from the casting upon withdrawal of the core is spaced from the mold.

10. A permanent mold core having a hollow section with an open end, and a second section having a portion slidably fitting within the open end of the first section and a portion projecting beyond the end of the first section adapted to form the inner wall of a casting cavity, the portion thereof fitting within the first section being of greater dimensions than the casting forming portion.

11. The combination with a mold having a cup-shaped cavity, the upper portion of which is enlarged, whereby an internal ledge or shoulder is formed between the enlarged upper portion and the lower portion, of a mold core comprising a hollow upper section having an open lower end slidably fitting within the enlarged upper portion of the mold cavity and a lower section slidably fitting within the open end of the upper section and projecting into the lower portion of the mold cavity, means for holding the lower section against rotation in the upper section, and means carried by the upper section and connected to the lower section for adjusting the lower section in the upper section.

12. The combination with a mold having a cavity which is offset to a larger size, forming an internal shoulder, of a core having a top portion fitting within the enlarged upper portion of the cavity and formed with an external shoulder corresponding to the shoulder of the cavity, and a lower portion of reduced size projecting into the lower portion of the cavity, and a ring secured to the shoulder of the core and adapted to engage the shoulder of the cavity when the core is lowered into the cavity, said ring being of less width than the shoulder, whereby a flange forming space is provided between the shoulders of the mold and core.

13. A mold comprising laterally separable mold sections formed to provide a cup-shaped cavity between them, a core having a portion closing the top of the cavity and a portion for forming the inner wall of a

hollow casting, said core being removable vertically from the mold without simultaneous transverse movement after a casting is formed in said mold, and means carried by the mold sections for retaining the casting while the core is being withdrawn.

14. The combination with a mold formed of complemental sections, of a sectional core within the cavity of the mold, means for freeing the core from a casting and for subsequently withdrawing the core longitudinally from the mold without simultaneous relative rotative movement between the sections of said core, and independent means for separating the sections of the mold to free the casting therefrom.

15. The combination with a metal casting mold formed with a cavity open at the top, of a core insertable into the open top of the cavity, means for shifting the core and for maintaining the same in axial alinement with the cavity, and means for counterbalancing the core.

16. The combination with a mold formed with a cavity open at the top, of a core insertable into the open top of the cavity, a rack bar connected to said core, a pinion engaging said rack bar, whereby said core may be lifted out of the mold or lowered into the mold, and a counterweight connected to said rack bar.

17. In a mold having a cavity open at the top, in combination, a telescoping sectional core adapted to be lowered into said cavity, means for telescoping said core sections to free said core from a casting deposited in said cavity, means for preventing relative rotative movement between said core sections, and means for hoisting the core out of the mold.

18. The combination with a mold having a cup-shaped cavity open at the top of the mold, of a core comprising upper and lower telescopically connected sections, the upper section slidably fitting in the upper portion of the cavity and the lower section forming the inner wall of the casting cavity, a jack screw rotatably mounted in the upper section and engaging a threaded bore in the lower section, means for rotating said screw to adjust the lower section with respect to the upper section, a rack bar connected to the upper end of the jack screw, and a pinion carried by a shaft on a fixed support engaging said rack bar, whereby said core may be hoisted out of the mold.

19. A mold comprising two sections with abutting faces recessed to provide a casting cavity, a sprue cavity, and an enlarged portion at the open end forming a slideway, and a slidable member in the slideway having an inner portion of reduced size adapted to form the interior wall of the casting cavity.

20. The combination with a mold formed of laterally separable sections, the abutting faces of which are recessed to form a mold cavity, of a telescopic core adapted to be inserted into the cavity, means for telescoping the core to free the same from a casting, mechanism for hoisting the core out of the mold, and mechanism for separating the mold sections to free the casting.

In testimony whereof, I hereunto affix my signature.

CONRAD VAUGHAN.