Aug. 7, 1928. 1,679,869

A. B. NORTON ET AL

METAL MOLD

Original Filed April 13, 1925 4 Sheets-Sheet 1

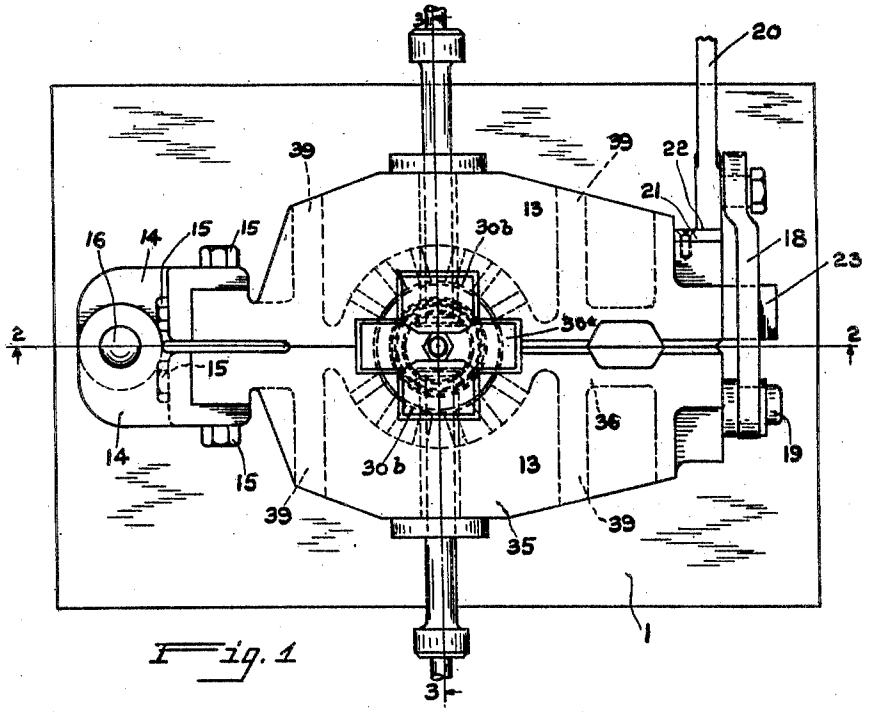


Fig. 1

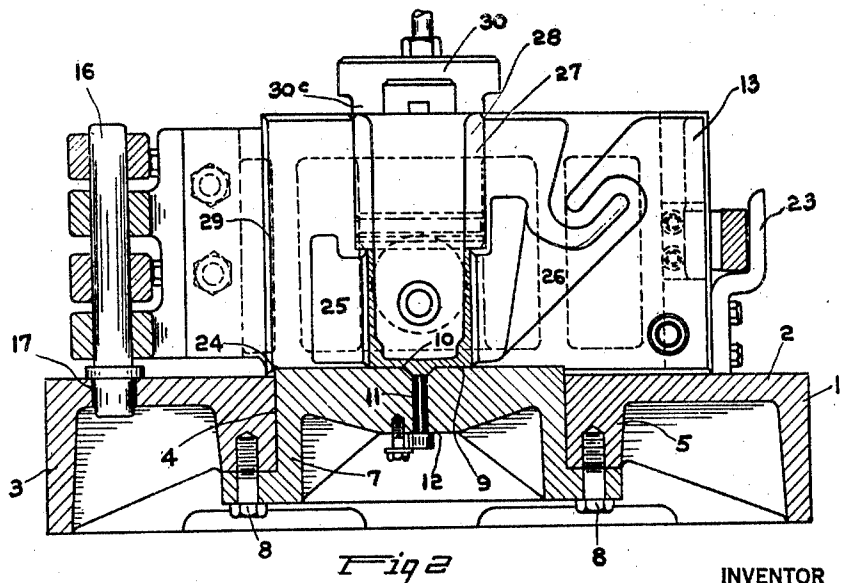


Fig 2

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Original Filed April 13, 1925 4 Sheets-Sheet 2

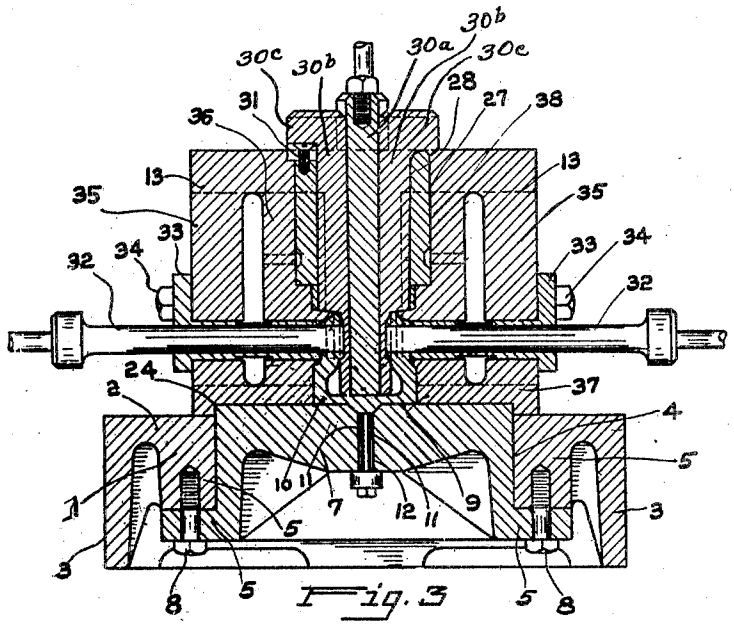


Fig. 3

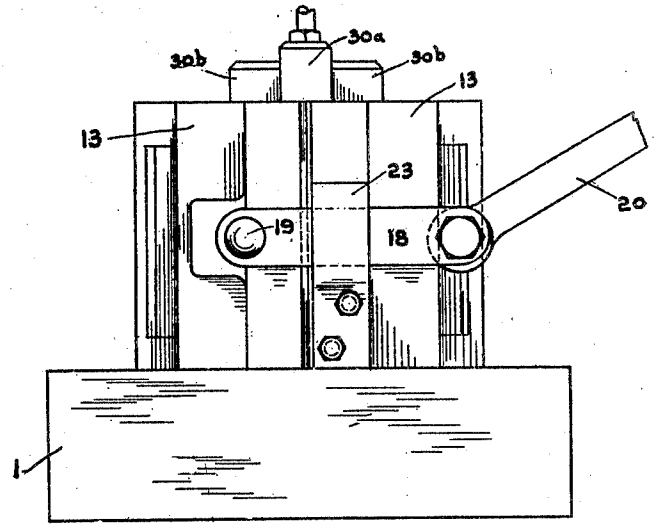


Fig. 4

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METAL MOLD

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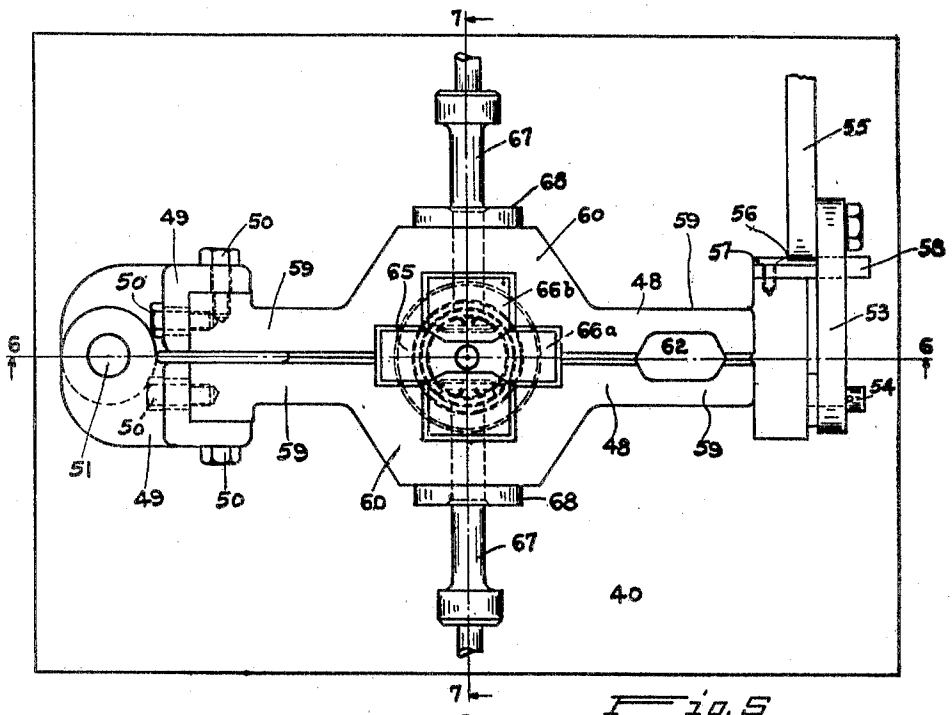


Fig. 5

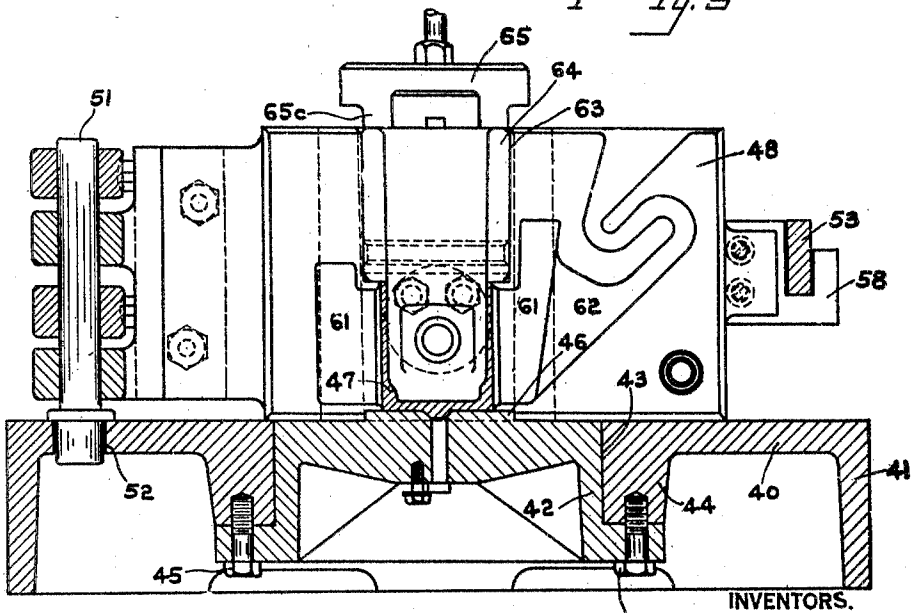


Fig. 6

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METAL MOLD

Original Filed April 13, 1925 4 Sheets-Sheet 4

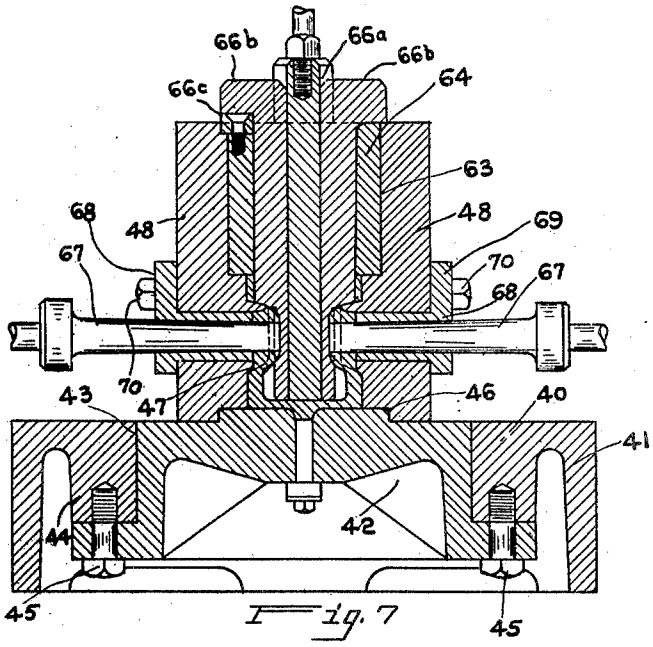


Fig. 7

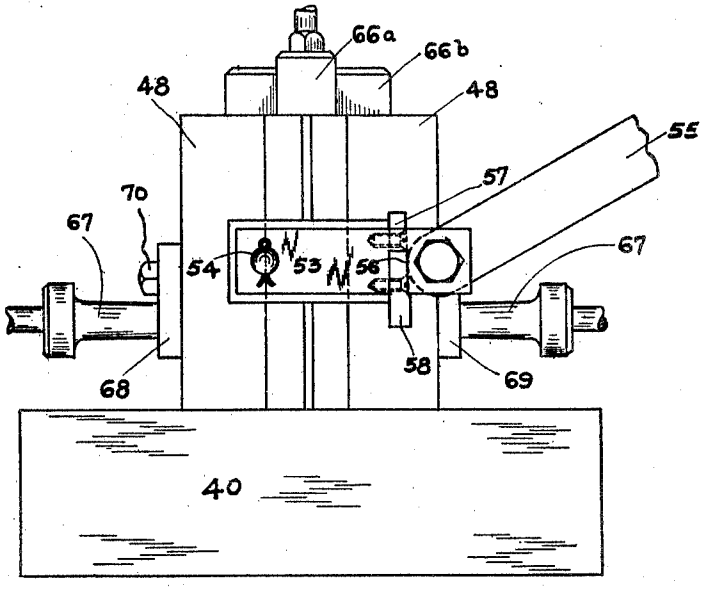


Fig. 8

INVENTOR
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Patented Aug. 7, 1928. 1,679,869

UNITED STATES PATENT OFFICE.

ALLEN B. NORTON AND MARIUS GUYOT, OF CLEVELAND, OHIO, ASSIGNORS TO ALUMINUM COMPANY OF AMERICA, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

METAL MOLD.

Application filed April 13, 1925, Serial No. 22,547. Renewed February 29, 1928.

This invention relates to a permanent mold for casting metals having melting points as high or higher than aluminum and its alloys.

It also relates to a permanent mold having hinged mold parts in which the tendency to warpage under the heat of such metals, when being cast, has been limited to an unobjectionable amount.

It further relates to a permanent mold having hinged mold parts so constructed as to compensate for distortion or warpage thereof above a negligible amount during use thereby maintaining substantially unchanged the desired size and configuration of the mold cavities.

It further relates to a permanent mold for casting pistons having substantially non-warping mold halves which are lighter, smaller and cheaper to make and easier to operate than prior art piston molds.

It also relates to mold halves for a piston mold suitably shaped to permit their being cast in permanent molds.

Permanent multipart molds for casting cup shaped articles, particularly pistons composed of high melting point metals, as constructed heretofore, have possessed a tendency to warp under operating conditions. This was evidenced in certain of the parts and particularly in the mold halves by a curvature of the straight inner or contacting surfaces of the mold halves, so that the ends of the mold halves were separated from each other when the central parts of the faces and those parts about the casting cavity were in substantial contact with each other.

When two slightly curved surfaces are contacted the gap between these surfaces increases as the distance from the point of contact increases. It is obvious therefore that when two warped mold faces are contacted, the gaps between them will be greater when they are contacted at one end than when they are contacted near the center. In permanent molds these gaps must be restricted to minimum dimensions to prevent escape of molten metal between the mold parts during the casting operation. Heretofore in many cases, it has been impossible to use hinged molds because of the difficulty of keeping the gaps, caused by warpage, within permissible limits.

We have discovered that the warpage of the mold parts is due, among other causes, to their configuration and particularly to the presence of flanges, webs and similar projections extending outwardly therefrom. By applying the principle of our discovery to the parts of certain prior art piston molds which, when clamped together at their ends possessed considerable warpage, we are enabled to reduce the warpage of these parts to an unobjectionable amount, even when the parts are hinged together at one end. The warpage was directly due to unequal expansion of the portions of a given part and more remotely to unequal distribution of heat in these parts. The inner surfaces in contact with the molten metal were highly heated and tended to expand considerably while the flanges, webs and other parts projecting outwardly therefrom were less highly heated and tended to expand to a lesser amount. The stresses induced by this differential expansion produced the warpage. By eliminating these projections, wholly or in part, and particularly along the longitudinal top and bottom edges, the heat distribution was made more nearly uniform and the warpage of these parts correspondingly reduced.

In the drawings attached hereto and forming a part of this specification:

Fig. 1 is a top plan view of a permanent multipart mold for casting pistons embodying our invention and resembling, in certain respects, the mold shown in the patent to Bamberg, No. 1,296,588, issued March 4, 1919.

Fig. 2 is a vertical elevation partly in section taken on line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken substantially on line 3—3 of Fig. 1.

Fig. 4 is a view in end elevation of the mold shown in Fig. 1.

Fig. 5 is a top plan view of a modified form of piston mold embodying the invention.

Fig. 6 is a view in side elevation and partly in section taken on line 6—6 of Fig. 5.

Fig. 7 is a vertical sectional view taken on line 7—7 of Fig. 5, and

Fig. 8 is an end elevation of the mold shown in Fig. 5.

The mold shown in Figs. 1 to 4, inclusive, consists of a mold base 1 having a flat top 2 and depending peripheral flanges or legs 3. The top 2 has a circular aperture 4 and a depending flange 5 adjacent thereto. A pilot 7 is fitted into the aperture 4 and secured

to the flange as by cap screws 8. Preferably the pilot 7 is sufficiently long to extend slightly above the upper surface of top part 2 to serve as a means for positioning the mold halves on the base 1. The top surface 9 of the pilot 7 is suitably machined or otherwise formed to serve as the bottom wall of a casting cavity 10. The pilot 7 is perforated, as at 11, and fitted with a serrated plug 12 to avoid means of escape of gas or air from the casting cavity when the molten metal enters and, if desired, this perforation 11 and the plug 12 may be disposed substantially as shown in Figs. 2 and 3 to provide on the casting a boss to serve as a centering or holding boss when the casting is being machined. The mold base 1 may obviously be formed integrally with the pilot 7 but when the parts are formed separately they may be used interchangedly and the same base 1 employed for the casting of pistons of various sizes and shapes by merely using therewith a pilot 7 of suitable shape and size. Furthermore, the base 1 may be made of a standard size and the pilot 7, which is a much smaller casting, can be made to fit various pistons at a relatively small cost, as compared with a full sized base.

Furthermore this construction permits the use of a pilot of hard material, such as hardened steel, and a base of softer, cheaper material such as cast iron. The pilot which takes the major part of the wear in the base part of the mold can thus be made more wear resistant with slight added cost and can be replaced when it wears out without scrapping the whole base.

Seated upon the top surface of part 2 of the base, are two mold halves 13 which are alike in substantially all respects. These mold halves 13 are hinged together at one end by hinge members 14 secured each to a mold half as by cap screw 15 and a hinge pin 16 which extends through a perforation 17 in the base 1 which is somewhat larger than the pin to permit relative movement of the pin and the mold halves 13 with respect to the base 1. The free ends of the mold halves 13 are provided with means for clamping the same together in operative position consisting of a locking bar 18 loosely mounted on a stud 19 on one of the mold halves and carrying at its opposite end a lever arm 20 loosely connected thereto. A wear plate 21 secured to one mold half 13 engages with the cam shaped end surface 22 on the lever arm 20 whereby the parts may be locked together. A guide 23, attached to one mold half 13, serves to guide locking arm 18.

The bottom of the surfaces of the mold halves 13 are suitably recessed, as at 24, to engage with the top and side surfaces of the pilot 7 above the top surface of base 1. The adjacent or inner side faces of the mold halves 13 are suitably recessed to form casting cavity 10, riser cavities 25 and gate cavity 26. Each mold half is also provided, above the casting cavity 10, with a semi-circular opening 27 in which is fitted a bushing 28 which extends from the top of the casting cavity to the top of the mold half and which bushings cooperate with each other when the mold halves are in assembled position to grip the main sectional core and hold the parts in assembled relation and properly positioned with respect to the casting cavity. It will be noted that the adjacent or inner faces of the mold halves 13 are cut away from the hinge end thereof to a point 29 close to the riser cavity 25 and that they contact with each other between the casting cavity and the hinged ends over an area sufficiently large to prevent escape of molten metal from the casting cavity but not sufficiently large to cause separation of the free ends of the halves under operating conditions.

A main core 30, consisting of a central section 30^a and opposite side sections 30^b has outstanding flanges 30^c to seat on the top of the mold halves 13 and projects into the casting cavity 10 to form the inner walls of the casting cavity. A key 31 carried by one of the mold halves and engaging with a corresponding key way, positions the core 30 with respect to the mold halves. Horizontally disposed core pins 32 extend through each mold half and project into the casting cavity to form cored out wrist pin bushings on the casting. Each core pin 32 is preferably carried by a flanged bushing 33 secured to the outside of mold halves 13, as by cap screws 34. It will be noted that the mold halves 13 have struts 35 spaced apart from the inner wall thereof and connected to the base and top portions of the mold halves and carry the outer ends of the bushings 33.

The mold halves themselves consist of an inner vertical wall 36 to which is integrally united horizontal bottom and top walls 37 and 38, respectively, and outwardly extending webs 39 integrally connecting the walls 36, 37 and 38. It will be noted that the walls 37, 38 and 39 are small as contrasted with the corresponding walls of the above mentioned Bamberg patent and furthermore that they engage with each other over an area only slightly wider, in a horizontal direction, than that occupied by the gate, riser and casting cavities. Due to a restriction of the sides of walls 37, 38 and 39 and to decreasing the contact area of the mold halves with each other, we are enabled to connect the mold parts by a hinged joint without encountering an objectionable amount of warpage under operating conditions. By reason of the enlarged aperture 17 for the pin 16 in the base 1, the mold halves may expand lengthwise thereof away from the

casting cavity to an extent greater than the expansion of the mold base without setting up stresses or being otherwise restrained.

The preferred form of a mold embodying our invention is illustrated in Figs. 5 to 8, inclusive, in which 40 indicates a mold base comprising a flanged member 41 to rest on a support and a centrally disposed pilot 42 fitting into a central aperture 43 in the member 41 and secured to a depending flange 44 integral with the member 41 and surrounding the aperture 43, cap screws 45 or similar securing means serving to removably connect the base member and pilot. The top surface of pilot 42 may be substantially flush with the top surface of base member 1 but, as shown, is flush with the top surface of member 1 except near the center thereof where it is provided with an upstanding projection 46, the top surface of which is suitably machined or otherwise formed to serve as the bottom wall of casting cavity 47.

Two mold halves 48, alike in substantially all respects, are seated upon the top of the mold base and hinged together at one end, as by means of hinge members 49 secured to the mold halves, by cap screws 50 and a hinge pin 51 fitting loosely in an enlarged aperture 52 in base member 41. By reason of this loose connection of the pin 51 with the base member 41, limited movement of the mold halves, with respect to the base member 1, is permitted. The free ends of the mold halves 48 are provided with means for clamping the same together, this means consisting of a locking arm 53 rotatably mounted on a stud 54 secured to one of the mold halves and carrying at its other end a rotatably mounted lever arm 55, the inner end 56 of which is adapted to engage with a wear plate 57 carried on the mold half. Preferably the outer face of this wear plate 57 is inclined substantially as shown in Fig. 8 to facilitate locking and unlocking of the mold halves. A guide 58 locates the locking arm 53 when in locked position.

The mold halves 48 are thin, flat and substantially rectangular with narrow edges and substantially parallel inner and outer side surfaces, the portions 59 thereof being only slightly thicker than the riser and gate recesses formed therein, and have raised portions 60 on the outer side extending from edge to edge intermediate the ends thereof of sufficient size to permit the formation therein of casting cavities of various diameters. The outer surfaces of the mold halves 48 are made up of plane surfaces substantially free from outwardly projecting flanges or webs of substantial size and heat radiating surfaces except at the hinged ends where the wall 59 may be slightly thickened to furnish ample seating for cap screws 50. The bottom surfaces of mold halves 48 are recessed to engage with the projection 46 substantially as shown. The inner sides or faces of the walls 59 and 60 are recessed to form casting cavity 47, riser cavities 61 and gate cavity 62. These faces are also relieved above the casting cavity 47 to form an enlarged circular recess 63 in which semicircular bushings 64 are secured to clamp around the main core and hold the parts thereof in assembled relation and in proper position in the casting cavities.

The main core 65 consists of a central section 66^a and two side sections 66^b, the sections being provided with outstanding flanges 66^c to engage with the top surface of the bushings 64 and the core extends into the casting cavity 47 where it forms the inner walls thereof. Horizontal oppositely disposed core pins 67 project through the mold halves 48 into the casting cavity 47 and are preferably supported by hardened steel bushings 68 which may have flange portions 69 through which cap screws 70 extend to secure the same to the mold halves 48. These core pins 67 serve to form cored out wrist pin bosses on the casting.

By referring to Figs. 5 and 6, it will be seen that the mold halves 48 contact with each other only over an area of slightly greater horizontal dimensions or length than the corresponding dimensions of the combined gate, riser and casting cavities, and furthermore that the inner faces of the mold halves are cut away or relieved so that they do not contact between the hinge pin and closely adjacent to riser cavity 61. Any warpage of the mold halves 48, due to the high heat of the metal being cast, will thus become effective as from the point of contact of the mold halves on the side next to the hinge and will be effective from that point toward the free ends of the mold halves.

When the mold halves are extended and hinged together some distance beyond the edge of the contacting surface, the mold halves move on a large radius of curvature and hence can be withdrawn from castings having outer projections or certain other configurations more easily than when a shorter radius of curvature is used.

We have found that mold halves constructed substantially in accordance with the showing of Figs. 5 to 8, inclusive possess a tendency to warp, if at all, only to a negligible degree and amount.

It will be observed that the outer surfaces of the mold halves 48 are substantially plane surfaces without any outstanding webs or flanges. Such mold halves are thus adapted to be cast in molds of permanent composition which is a point of considerable importance because of the decreased cost and improved properties traceable to this form of manufacture. It is desirable to use mold parts free from porosity and fine

grained. When mold part castings are porous, partly machined castings are often scrapped due to the uncovering of a pore or hole in the casting cavity wall. Permanent mold castings are exceptionally free from porosity as contrasted with sand mold castings and also are finer grained which gives a smoother surface on the aluminum or other casting formed against their surface.

It will be observed that the central parts 60 of the mold halves 48 are somewhat thicker than the parts 59. We have found that these portions of the mold halves may be of greater thickness than the parts 59 without noticeable effect on the warping of the mold halves. With the added wall thickness in the parts 60, casting cavities of different diameters may be formed in mold half castings of substantially the same sizes. It thus is possible to utilize mold halves of a few standard sizes for pistons of many various sizes.

The base member 40 with its removable pilot 42 may likewise be made in standard sizes and employed with pilots 42 shaped for the particular pistons to be cast.

Having thus described our invention, what we desire to secure by Letters Patent is defined in what is claimed, it being understood, the described apparatus was merely selected for purposes of illustration and that variations in the form of the arrangement of parts shown and described herein may be made without departing from our invention.

What is claimed is:

1. A permanent mold for casting high melting point metals comprising a mold base, and hinged cooperating mold halves movable thereon having adjacent faces recessed to form cavities for molten metal, the said faces being out of contact with each other from the hinged ends of the mold halves to points close to the said cavities, the outer side surface of the mold halves being substantially free from flanges.

2. A substantially non-warping mold half for a piston mold comprising a rectangular casting having narrow edges and substantially parallel inner and outer side surfaces, and a hinge member secured to one edge.

3. A substantially non-warping mold half for a piston mold comprising a rectangular casting having narrow edges and substantially parallel inner and outer side surfaces, and a hinge member secured to one edge, the inner surface being cut away adjacent to an end edge and recessed to provide walls for cavities for molten metal being cast.

4. A substantially non-warping mold half for a piston mold comprising a thin flat casting having a recessed projection portion extending beyond the outer surface of the remainder of the casting from edge to edge and intermediate the ends of the casting, and a hinge member secured to one end of the casting.

5. A permanent mold for casting high melting point metals comprising a base upon which the mold halves may slide, and mold halves hingedly connected together at one end and having adjacent faces contacting with each other remote from the hinged ends thereof, the contacting faces of the mold halves being recessed to form cavities for metal to be cast.

6. A permanent mold for casting pistons comprising a mold base and cooperating hinged mold parts having their adjacent faces recessed to form gate, riser and casting cavities, the adjacent faces of the said hinged mold parts operatively cooperating with each other, when in closed position, over an area slightly wider when measured in a horizontal direction than the horizontal length of the combined cavities and considerably less than the horizontal length of the mold parts.

7. A permanent mold for casting pistons comprising a mold base and cooperating hinged mold parts having their adjacent faces recessed to form gate, riser and casting cavities, the adjacent faces of the said hinged mold parts operatively cooperating with each other, when in closed position, over an area slightly wider when measured in a horizontal direction than the horizontal length of the combined cavities and considerably less than the horizontal length of the mold parts, the mold halves being free from substantial outwardly projecting flanges.

8. A permanent mold for casting pistons comprising a base having a pilot opening, a removable pilot therein, a hinge pin loosely mounted in the base and projecting upwardly therefrom, two mold halves hinged to the pin and having their meeting faces recessed to engage the pilot and to form a casting cavity with riser cavities disposed on opposite sides of the casting cavity and a gate communicating with one riser cavity, and a main core and core pins projecting into the casting cavity, the mold halves being of substantially uniform thickness and free from exterior projections, and contacting with each other when in enclosed position only between points closely adjacent to the outside of the oppositely disposed gate and riser cavities.

9. A permanent mold for casting aluminum alloy pistons comprising a mold base, a hinge pin carried thereby, two mold halves hinged to the said pin and supported on the mold base, the meeting faces of the mold halves being recessed to form gate, riser and casting cavities, and a core projecting into the casting cavity, the mold halves contacting with each other from the casting cavity to points slightly beyond the gate and riser cavities, respectively, and being of substan-

tially uniform thickness and free from outwardly extending projections.

10. A permanent mold for casting pistons composed of high melting point metal comprising a mold base, two mold halves on the base having surface contact with each other, a hinge pin connecting the mold halves and carried by the base, the adjacent surfaces of the mold halves being recessed to form gate, riser and casting cavities therebetween, and a core extending into the casting cavity, the adjacent surfaces of the mold halves being out of contact with each other from the hinge pin to a point close to the adjacent riser cavity.

11. A mold for casting pistons composed of high melting point metals comprising a mold base, two mold halves suitably recessed to form walls of a casting cavity, the mold halves being of substantially uniform thickness and free from outwardly extending projections, a main core, a core pin relatively long as compared with the thickness of a mold half extending through the mold half into the casting cavity, and a core pin bushing secured to the exterior of the mold half and affording bearing area for the core pin outside the mold half.

In testimony whereof we hereunto affix our signatures this first day of April, 1925.

A. B. NORTON.
MARIUS GUYOT.