

June 16, 1942.

E. C. NOCAR

2,286,994

MOLDING APPARATUS

Filed Feb. 27, 1941

3 Sheets-Sheet 1

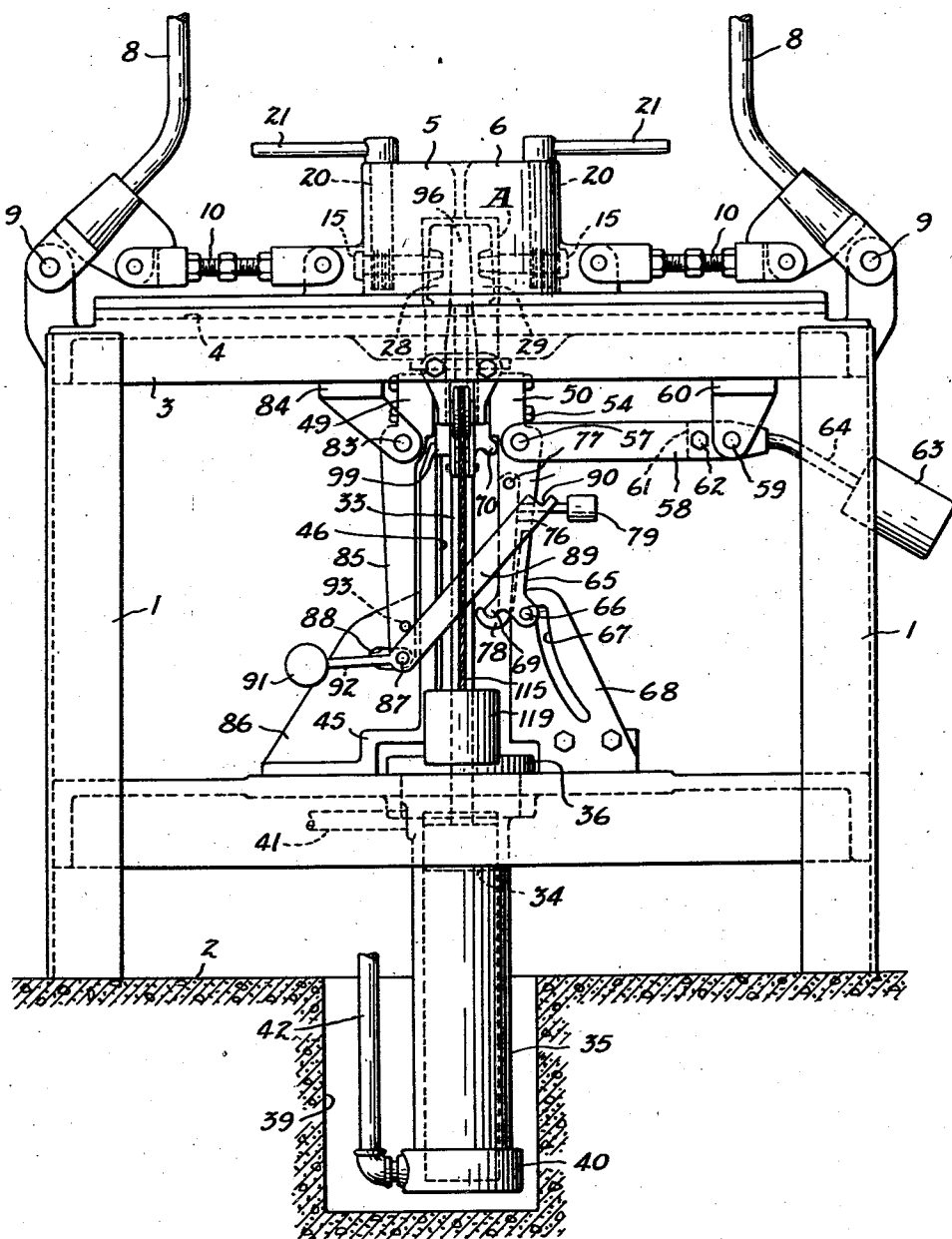


Fig. 1

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3 Sheets-Sheet 2

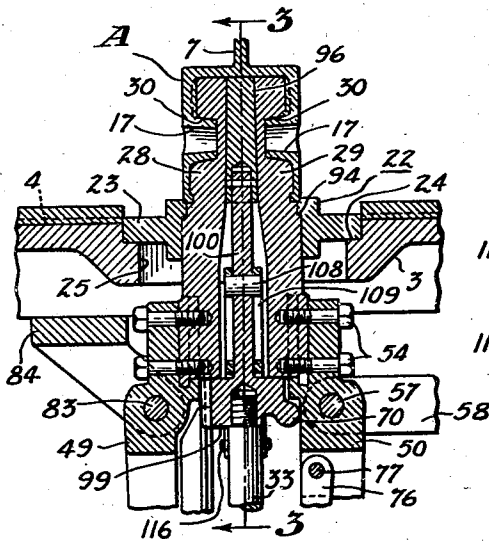


Fig. 2

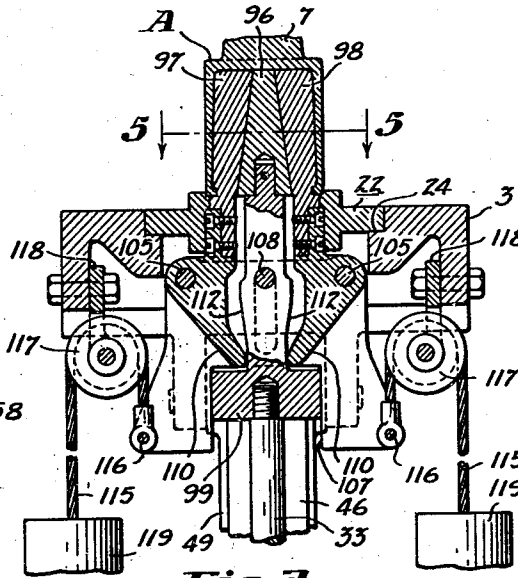


Fig. 3

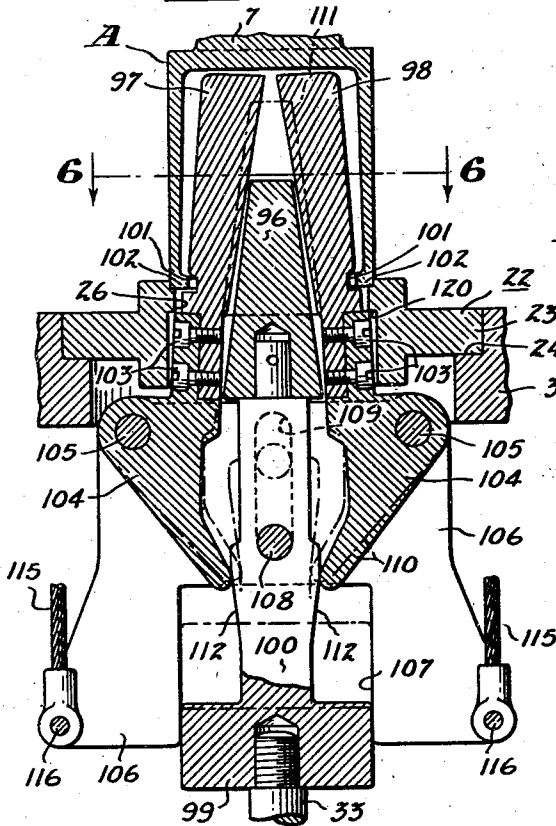


Fig. 4

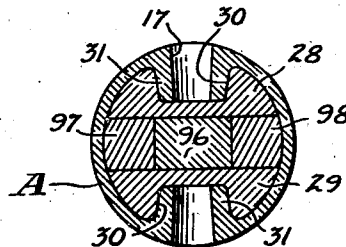


Fig. 5

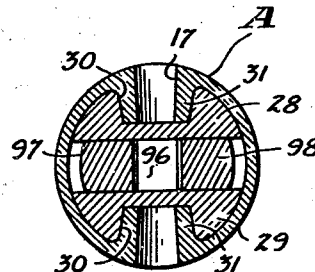


Fig. 6

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3 Sheets-Sheet 3

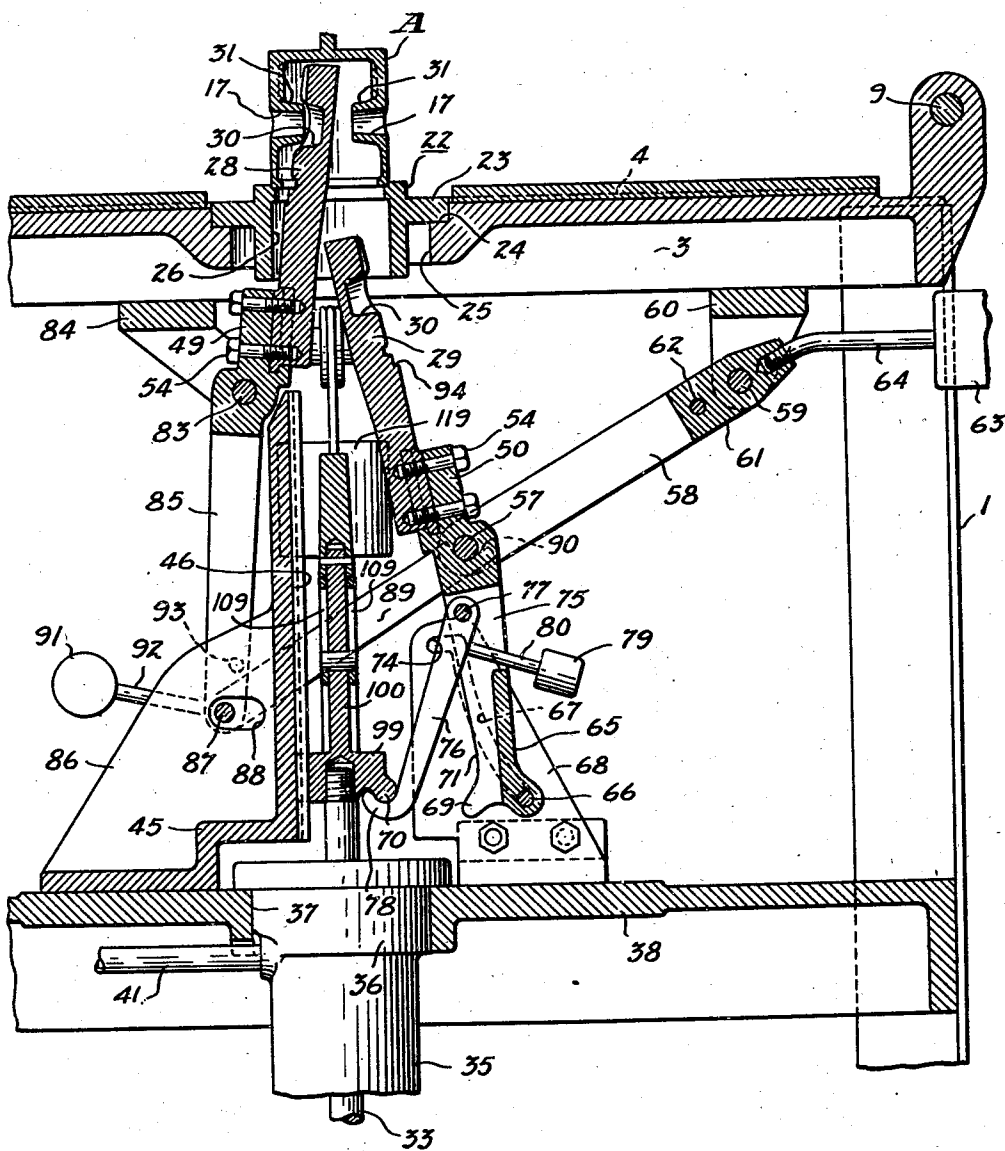


Fig. 7

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UNITED STATES PATENT OFFICE

2,286,994

MOLDING APPARATUS

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Application February 27, 1941, Serial No. 330,775

12 Claims. (Cl. 22—151)

This invention relates to molding apparatus, and more particularly to apparatus of this character for casting cup shaped articles such as pistons for internal combustion engines and the like.

Pistons are preferably made from light metals, such as aluminum alloys, and it is desirable for various reasons to cast the pistons in permanent molds. Such molds, when utilized for making a great number of pistons, are capable of producing the pistons with great uniformity and at a low unit cost. Additionally, the physical properties of the pistons are improved so that the pistons are stronger and wear better than pistons made in sand molds.

The internal structure of aluminum alloy pistons and the like and pistons formed primarily of aluminum alloy with ferrous metal inserts therein, may have widely variant internal structures. Accordingly, the cores for casting such pistons may have numerous shapes or configurations. Most light metal or aluminum alloy pistons do have lateral extensions or bosses on the inside of the skirt to receive the connecting rod pins. Frequently, the pistons have other lateral formations on the inside of the skirt, such as ribs and bosses, provided to strengthen or balance the structure. These lateral extensions interiorly of the piston, being formed by the core, require that the latter be contracted or collapsed and withdrawn in sections. Usually the composite or sectional core of a piston mold includes a central section and lateral or outer sections. The practice is to first withdraw the central sections from a casting, after which the outer or lateral sections are moved serially or simultaneously into the space vacated by the central section so as to clear the projections on the inside of the piston skirt and are then withdrawn axially from the piston casting. This withdrawal of the several core sections and the subsequent reassembling thereof to prepare the apparatus for the next casting operation requires considerable time and dexterity on the part of the operator if performed by hand. The faster the core sections can be withdrawn from a piston casting and then reassembled in preparation for the next casting operation, the more rapidly the cyclic casting operation can be performed. Consequently the production of the mold is increased by a core that can be quickly withdrawn from a casting and reassembled.

It is therefore the principal object of the invention to provide an improved molding apparatus having a sectional or multi-part core in com-

bination with a mechanism for automatically withdrawing the core sections rapidly from a piston casting and for rapidly reassembling the sections in readiness for a succeeding casting operation.

Another object is to provide a sectional core for a permanent mold and actuating mechanism therefor which withdraws the several sections of the core from a casting over predetermined paths so as to avoid engagement between the core sections and casting during the withdrawal of the core.

Another object is to provide actuating mechanism for a multi-part core which is so interconnected that by the movement of a single power-driven actuating means all of the core sections can be moved into and out of casting position. More specifically, the invention aims to provide a sectional core for a piston mold in which one or more of the side core sections are mounted on the central core section and arranged to move to clear the lateral projections on the inside of the piston, and in which the several core sections are so interconnected that they can be successively moved into the center of the piston by a single power means.

Certain types of pistons have inwardly extending projections completely around the skirt on the inside thereof. For casting pistons of this type a core must be provided in which all sections forming the skirt can be contracted or drawn inwardly so as to clear the lateral projections on the skirt. This invention is particularly suited to the design of such cores and one of the principal features of this development is the provision of a five part core which is adapted to form a completely circumferential ring around the inside of a piston skirt.

Numerous structural improvements are incorporated in the apparatus, including means for pivotally mounting outer sections of the core so that the core movement is guided by pivots and confined to predetermined paths; an arrangement of counterweights for balancing the core sections and for normally holding the core sections in assembled positions; the combination of pivotally mounted side core sections and a cam movable with the central core section for guiding the movement of the side core sections; and a lost motion connection for actuating certain of the core sections after a predetermined movement of a different core section. Other objects and advantages will become apparent from the following detailed description of a suitable em-

bodiment of the invention made in connection with the accompanying drawings, in which:

Figure 1 is a front elevational view of the molding apparatus, partly in section and with parts broken away, showing the mold sections and core assembled together in readiness for casting;

Fig. 2 is a fragmentary vertical sectional view on an enlarged scale through the center of the apparatus illustrated in Fig. 1, showing the relationship between the central core sections and the core forming side or outer core sections;

Fig. 3 is a vertical sectional detail taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view on an enlarged scale and similar to Fig. 3, showing the central core section partially withdrawn from the casting and the side sections which are mounted on the support means for the central section tilted toward one another so as to clear the inwardly extending or lateral projections formed interiorly of the piston;

Fig. 5 is a sectional detail taken substantially on the line 5—5 of Fig. 3;

Fig. 6 is a sectional detail taken substantially on the line 6—6 of Fig. 4; and

Fig. 7 is a vertical view with parts removed and with parts broken away, showing the final stage in the withdrawal of the core sections from the casting cavity.

In the description of the invention like parts have been indicated by the same reference numerals in the several figures. The apparatus in general is more fully described in the copending application Serial No. 380,695 filed February 26, 1941, of Sidney W. Jackson, and features described but not claimed herein are reserved and claimed in that application. Preferably, the mold comprises a supporting structure including uprights 1 which may rest on a suitable foundation 2 and are preferably formed of iron or steel. A table or bed 3, which may be an iron or steel casting, is mounted in a generally horizontal position on the upper ends of the uprights 1.

Slidably supported on ways 4 of the table or bed 3 are mold sections 5 and 6 which are movable toward and away from one another and have their meeting faces suitably formed or recessed to define the exterior of the piston or other article to be cast, indicated at A, and also suitable passages for introducing molten metal into the casting cavity.

Levers 8 pivoted at 9 to the bed 3 are connected by adjustable linkages 10 to the mold sections 5 and 6 so that the latter can be moved toward and away from one another and positioned on the ways 4 in definite relation with respect to one another and the sectional core to be later described.

Core pins 15 are slidably mounted in the mold sections 5 and 6 and have tapered ends which project into the casting cavity when the mold is assembled in pouring position to form aligned apertures 17 in the piston A. These passages are later machined to receive a connecting rod pin. The pins 15 have heads which limit the movement of the pins into the casting cavity and each of the pins is formed with rack teeth engaged by the toothed end of a vertically disposed rod 20 rotatably mounted in the corresponding mold section. Handles 21 secured on the upper ends of the rods 20 enable the latter to be rotated for movement of the pins 15 into and out of the casting cavity.

A ring-like base member 22 is formed with a circumferentially extending radial flange 23

which seats on a depressed shoulder 24 of the table 3. The base 22 extends downwardly through an opening 25 in the table and a cylindrical passage or opening 26 is formed in the base member to receive the multi-part core,

The core comprises a central section 28 and outer sections 28 and 29, the latter being disposed on opposite sides of the center section and having recesses 30 which form inwardly directed or laterally extending piston pin bosses 31 on the inside of the skirt of the piston A. These bosses have therein the openings 17 defined by the core pins 15.

The central section 28 of the core is mounted on a support 32 secured on the upper end of an actuating or power driven rod 33. This rod has a piston 34 (Fig. 1) secured on its lower end and reciprocable in a cylinder 35 secured by an upper end member 36 in an opening 37 formed in a cross member 38 supported by the uprights 1. The foundation 2 for the apparatus may be formed with a pit 39 to receive the lower end of the cylinder 35. The top end member 36 and a bottom end member 40 on the cylinder 35 are connected by conduits 41 and 42, respectively, through control valves (not shown) to a suitable source of fluid or air under pressure. Thus, air or fluid under pressure can be introduced into the cylinder 35 either above or below the piston 34 to force the same up or down as desired to either raise or lower the rod 33 and the central core section 28.

Supported on the cross member 38 is a bracket 45 which has a vertically disposed guide portion 46 engageable with one side of the support 39 which slides therealong.

The mechanism for supporting and actuating the outer core sections 28 and 29 includes members 49 and 50 formed with T-slots, into which correspondingly shaped portions of the base of the core sections are interfitted. Bolts 54, which extend through the supports 49 and 50, are threaded into the bottoms of the core pieces to secure the latter in the T-slots of the supports.

The support 50 for the core section 29 is tiltably carried by a pivot pin 57 and is disposed between the ends of a pair of spaced parallel pivoted members or arms 58, which receive the pivot pin 57 to support the same. The arms 58 are pivotally supported on a pin 59 carried by a bracket 60 secured to the underside of the table or bed 3 at a point remote from the opening 26 in the mold base. Desirably, a separator 61 is received on the pivot pin 59 between the arm members 58 and is secured to the latter by means of a bolt 62, so that the separator rotates with the arms. A counterweight 63 is mounted on the end of an arm 64 threaded into the separator 61 and balances the weight of the core section 29 and the mechanism for supporting the latter, so that the core is normally held thereby in its uppermost position and the raising and lowering of the core section is facilitated.

A depending extension 65 of the core support 50 has secured in its lower end or foot a transverse guide pin 66 which extends into a slot 67 formed in a cam member 68 secured to the cross member 38. The foot of the extension 65 has a toe portion 69 which is directed toward the path of the support 39 for the central core section. The support 39 has a knob-like portion 70 which bears against one side 71 of the extension 65 as the central core section 28 is lowered by the downward movement of the piston 34. As the central core section approaches its lower limit

of movement, the knob 70 of the support 99 bears against the curved toe portion 69 of the extension 65 on the support 50 and forces the toe to the right, as viewed in Figs. 1 and 7. This movement tilts the support 50 and the mold section 29 in a counter-clockwise direction on the pivot 67, thus freeing the core section from one of the wrist pin bosses 31 of the piston A, and moving the core section into the space vacated by the lowered central core section 96.

The upper end of the cam slot 67 has a horizontal portion 74 which receives the cam pin 66 when the core sections are in assembled position (Fig. 1). Accordingly, while the central core section 96 is being withdrawn from a casting, as will be later described, by the power device 35, the outer core section 29 is positively held in its uppermost position within the casting by the engagement of the cam pin 66 in the horizontal portion 74 of the cam slot. When the support mechanism for the core section 29 is tilted, the cam pin 66 is in line with the downwardly extending portion of the cam groove 67, which controls the movement of the core section 29 cooperatively with the support members or arms 89 and restricts the downward movement of the core section to a predetermined path.

The extension 65 of the support 50 is centrally slotted or cut away, as indicated at 75, and receives a hook member or arm 76 which is mounted on a pivot pin 77 extending through the upper end of the cutaway portion of the extension and secured in the sides of the extension. The member 76 hangs downwardly in the slot or groove 75 and lower end or hook portion 73 thereof is disposed slightly below the toe 69 and in the path of the knob-like portion 70 on the support 99. A weight 79 mounted on the end of an arm 80 threaded into the upper portion of the member 76 holds the latter against the knob 70 on the support 99 during the lowering of the latter, so that when the support 50 and outer core section 29 are tilted by the interengagement of the toe 69 and knob 70, the hook 73 is retained in the path of the knob to be engaged by the latter. Since the hook 73 is below the end of the toe 69, the knob 70 does not engage the hook until after the guide pin 66 has been shifted into alignment with the downwardly extending portion of the cam slot 67. As the central core support 99 is drawn downwardly from the casting, the tilted core section 29 is lowered simultaneously therewith by the interengagement of the hook 73 with the knob 70. During this movement the outer core section 29 is guided over a predetermined path by the cam slot 67 in cooperation with the pivoted arms 89. Thus, objectionable contact between the core section and the lateral or inwardly extending projections on the skirt of the fresh casting is avoided.

The support 49 for the outer core section 28 is pivotally mounted on a pin 83 carried by a bracket 84 secured to the underside of the table or bed 3 adjacent the cylindrical opening 26 in the mold base. A depending extension portion 85 on the pivoted support member 49 has a lower end which is bifurcated and straddles web 86 of the bracket 45. A pin 87 journaled in the lower ends of the bifurcated portion of the extension 85 is received in a slot 88 formed in the web 86 and limits the oscillating movement of the support member 49 on the pivot 83. On the ends of the pin 87 beyond the sides of the extension portion 85 of the core support are struts or arms 89 which extend upwardly in

an oblique direction and across the path of the pivot pin 57 which carries the support for the core section 29. The upper ends of the strut arms 89 are formed with seats 90 engageable with the ends of the pivot pin 57 as the latter is lowered by the interconnection of the parts with the piston 34. Weights 91 mounted on the ends of levers 92 secured to the arms 89 adjacent the pivot 87 normally hold the arms 89 against pins 93 carried by the extension portion 85 of the support 49. By this arrangement the arms 89 are retained in correct position for engagement of the pivot pin 57 in the seats 90 upon lowering of the outer core section 29. After the pin 57 has engaged the arms 89, the latter are thereby forced downwardly and to the left, which causes a shifting of the pin 87 in the slot 88 from the right to the left, so that the support member 49 and the outer core section 28 are tilted in a clockwise direction to substantially the position illustrated in Fig. 7. In this position the core piece 28 has been freed from the casting so that it clears the lateral or inwardly extending wrist pin boss 31 and is positioned in the space previously vacated by the central core section 96 and the other outer core section 29.

This invention is particularly directed to the arrangement for supporting a pair of lateral or side core sections 97 and 98 on the same prime mover or actuator 99 as the central core section 96. The support 99 is formed with an upwardly extending portion 100 which carries and is surmounted by the middle or central core section 96; the latter preferably being of tapered form.

The side core sections 97 and 98 have recesses 101 on their outer surfaces which form inwardly extending ribs 102 adjacent the bottom of the skirt of the piston A. Similar grooves may be formed in the core sections 28 and 29, if desired, so that the rib 102 may be circumferentially continuous around the inside of the piston skirt. Bolts 103 secure the side core sections 97 and 98 to a pair of tiltable supports 104 which are disposed on opposite sides of the upwardly extending support portion 100 and are pivotally mounted on spaced parallel pins 105 which are carried by guide plates or members 106. These guide members are disposed in spaced parallel relation to one another on opposite sides of the upright portion 100 of the support 99, and are cut away or slotted, as indicated at 107, to straddle the support 99 to be guided by the latter. The slots 107 are of sufficient vertical extent to permit vertical movement of the guide members 106 with respect to the support 99 while being restrained against lateral movement by engagement with the support.

A pin 108 is secured in the portion 100 of the support 99 and extends into vertically elongated slots 109 formed in the guide plates 106. Thus, the side core sections 97 and 98 may be simultaneously moved vertically with respect to the central core section 96 while pivotally supported for movement toward and away from one another by the guide members or plates 106, which in turn are guided by the support 99.

The tiltable supports 104 are formed with extension fingers 110 which are biased or inclined toward one another and slidably engage opposite sides of a narrow part of the extension 100 of the support 99.

Upon lowering of the rod 33 by the piston 34, as previously described, and when the core is in assembled position, the tapered middle or central core section 96 is withdrawn from between the

side core sections 97 and 98, the guide plates 106 remaining stationary and the pin 108 moving downwardly in the slots 109. When the central core section is freed from the side core sections by movement to approximately the position illustrated by broken lines III of Fig. 4, a thickened or tapering cam part of the extension portion 100 of the support 99 moves downwardly between the fingers 110 so that cam surfaces 112 of such thickened portion of the support forces the fingers 110 apart to tilt the supports 104 on the pins 105. By this action the side core sections 97 and 98 are drawn or tilted inwardly or toward one another to the full line position illustrated in Fig. 4, thus freeing the same from the inside of the casting and withdrawing the slots or recesses 101 from the ribs 102.

As downward movement of the support 99 is continued under the influence of the power actuated piston rod 33, the pin 108 seats in the bottoms of the slots 109 to thereby establish a positive connection between the parts to draw the guide plates 106 carrying the side core sections 97 and 98 downwardly, thus lowering the central core section and side core sections simultaneously. It is to be noted that the tapered character of the central core section 96 provides sufficient clearance so that the side core sections 97 and 98 can be tilted inwardly toward one another when the central core section has been only partially withdrawn from the piston casting.

In order to support the side core sections 97 and 98 to insure that they are lowered only when positively drawn downwardly by the engagement of the pin 108 in the bottoms of the slots 109, flexible elements or ropes 115 are secured to the guide plates or members 106 at 116 and are carried thence upwardly over pulleys or sheaves 117 rotatably mounted in brackets 118 secured to the bed or table 3. Weights 119 are supported on the ropes or elements 115 and operate to exert a continuous upward force on the members 106 so that the pin 108 seats in the bottoms of the slots 109 except when the core is in assembled condition.

In operating a mold of the character described, the molten metal is poured into the casting cavity of the assembled mold shown in Fig. 1, the cavity being formed above the base 22 by the mold sections 5 and 6 around the core sections 96, 97, 98, 28 and 29. After solidification of the metal and when it is desired to withdraw the multi-part core from the casting, the operator introduces fluid or air under pressure into the upper end of the cylinder 35 to force the piston 34 downwardly. In this manner the support 99 carrying the central core section 96 is lowered. The movement of the support 99 and the extension 100 thereof operates to first tilt the lateral core sections 97 and 98 toward one another to clear the rib 102 and to then withdraw the central and lateral core sections simultaneously and as a unit. The withdrawal of the lateral core sections 97 and 98 is delayed by the lost motion of the pin 108 in the slots 109 of the guide plates 106 until the tapered central core section 96 has been partially withdrawn. Thus a space or clearance is provided into which the lateral core sections can be tilted. After the central core section 96 and the lateral core sections 97 and 98 have been withdrawn from the casting, the pressure of the knob 70 against the toes 69 of the extension 65 pivots the supports 50 on the pin 57, freeing the outer core section 29 from the interior of the casting and moving the same

into the space vacated by the descending central and lateral core sections. As lateral pressure is exerted against the extension 65 of the outer core support by the knob 70, the support 32 bears laterally against the guide portion 46 of the bracket 45, thus preventing side movement or displacement of the central and lateral cores or of the actuating rod 33. After the initial lost motion travel of the support 99 and the tilting of the core section 29, the hook 78 engages the knob 70 to be drawn downwardly by the continued movement of the support 99. In this manner the core section 29 is withdrawn from the casting A through the space previously occupied by the central and lateral core sections 96, 97 and 98, the pin 66 being guided in the cam slot 67 to hold the core section 29 and the support 50 therefor to a predetermined path of movement. After a second period of lost motion during which the outer core section 29 is withdrawn from the casting and the central and lateral core sections 96, 97 and 98 are further withdrawn, the pin 57 is engaged in the seats 90 of the arms 89, forcing the latter to the left to the position shown by the full lines of Fig. 7. In this manner the outer core section 28 is tilted to the position illustrated in Fig. 7, so that it clears the lateral extensions on the inside of the casting.

To reassemble the core for the next casting operation the operator introduces air or fluid under pressure into the lower end of the cylinder 35, thereby forcing the piston and rod 33 upwardly. The weights 119 serve to raise the guide plates or members 106 and the side core sections 97 and 98 supported thereby. The upper limit of movement of the side or lateral core sections 97 and 98 is determined by a shoulder 120 formed by a reduced diameter portion of the cylindrical passage 26. This shoulder engages the upper ends of the tiltable supports 104 when the side core sections 97 and 98 have been moved to their uppermost positions illustrated in Fig. 4. The knob 70, moving upwardly, permits the support 50 to be raised by the weight 63 to elevate the outer core section 29 to its correct position with respect to the mold base 22. As the arms 89 are released by the pin 57, the weights 91 tilt the arms against the pins 93 and also tilt the support 49 on the pivot pin 83 so as to move the outer core section 29 substantially to its correct position with respect to the mold base 22. The upward movement of the core section 29 is guided by the movable or pivoted members 58 and the pin 66 in the cam slot 67. A circumferential shoulder 94 on the outer core section 29 engages the bottom of the mold base 22 to limit the upward movement of the core section and the tapered central core section 96 bears against the sides of the outer or lateral core sections 97 and 98 to spread and support the latter in correct relation with respect to one another, and to move the same to their correct positions with respect to the mold base. At the upper limit of movement of the central core section 96, the top of the support 99 engages the bottoms of the outer core sections 28 and 29.

The present invention provides a generally improved multi-part core for casting cup shaped articles such as pistons and the like in permanent molds. The apparatus includes novel mechanism for automatically tilting several core sections in succession into the central region of the cast articles and withdrawing the tilted sections in succession. First the side core sections

97 and 98 are withdrawn through the space previously occupied by the central core section 96, and then the outer core sections 28 and 29 are successively tilted into such space. The successive tilting and withdrawal movements of the several core sections take place automatically under the influence of a single power actuated member and the retracted core sections can be automatically reassembled into molding positions by a simple reverse movement of the one prime mover or power member. Hence, the core may be efficiently manipulated by a single operator without an extended period of training or instruction. Furthermore, the apparatus can be quickly and economically operated, thereby lowering the cost of production of the articles being cast, while increasing the number of articles that can be made in a given period of time.

The principles of the present invention may be utilized in various ways, numerous modifications and alterations being contemplated, substitution of parts and changes in construction being resorted to as desired, it being understood that the embodiment shown in the drawings and described above is given merely for purposes of explanation and illustration without intending to limit the scope of the claims to the specific details disclosed.

What I claim is:

1. A piston mold core comprising a central section, a first pair of outer sections, a second pair of outer sections, means supporting the central section and actuable to withdraw the same from a piston casting, means mounting the first pair of sections on the support for the central section, and means mounting the second pair of sections for tilting movement, said last means having lost motion connection with the supporting means to tilt the sections of the second pair into the space formerly occupied by the central section after a predetermined withdrawal of the latter.

2. In a multi-section core for a permanent mold, a central section and a support therefor actuable to withdraw the section from a casting, side sections and means mounting the same on the support for movement with the latter, said mounting means having lost motion connection with the support to provide for limited movement of the support in withdrawing the central section prior to movement of the side sections with the support, and means for actuating the support over a generally rectilinear path to withdraw the central section and the side sections sequentially from a casting.

3. In a multi-section core for a permanent mold, a central section and a support therefor actuable to withdraw the section from a casting, side sections and means mounting the same on the support for movement with the latter, said mounting means having lost motion connection with the support to provide for limited movement of the support in withdrawing the central section prior to movement of the side sections with the support and also including means actuable by relative movement between the central section and the side sections to tilt the latter toward one another during said limited movement of the support, and means for actuating the support over a generally rectilinear path to withdraw the central section and the side sections sequentially from a casting.

4. In a multi-section core for a permanent mold, a central section and a support therefor actuable to withdraw the section from a casting,

side sections mounted on the support for limited movement relative thereto in the direction of withdrawal of the central section and also for tilting movement to and from one another, means for actuating the support to withdraw the sections from a casting, and means secured to the side sections and engageable with the support during said limited relative movement to tilt the side sections.

5. In a multi-section core for a permanent mold, a central section and a movable support therefor actuable to withdraw the section from a casting, a guide slidable on the support and means limiting the sliding thereof, a side section pivotally mounted on the slide for tilting movement, and means operable during sliding of the guide to tilt the side section.

6. In a multi-section core for a permanent mold, a central section and a movable support therefor actuable to withdraw the section from a casting, a guide slidable on the support and means limiting the sliding thereof, a side section pivotally mounted on the slide for tilting movement, and co-acting cam parts on the support and side section which bear against one another during sliding of the guide to tilt the side section.

7. In a multi-section core for a permanent mold, a central section and a vertically movable support therefor, a guide slidable vertically on the support and means limiting the movement of the guide on the slide, a side section and means mounting the same on the guide for tilting movement, and means having connection with the guide and normally urging the same to its upper limit of movement on the support to retain the side section above the center section during raising of the support in assembling the sections.

8. In a multi-section core for a permanent mold, a central section and a vertically movable support therefor, a guide slidable vertically on the support and means limiting the movement of the guide on the slide, a pair of side sections and means mounting the same on the guide for tilting movement toward and away from one another, means connected to the side sections and upon movement of the guide to its upper limit of movement to tilt the side sections together, and means having connection with the guide and normally urging the same to its upper limit of movement on the support to retain the side sections tilted together during raising of the support in assembling the sections.

9. In a multi-section core for a permanent mold, a central section and a support therefor actuable to withdraw the section from a casting, a guide slidable on the support in the direction of withdrawal of the central section, side sections disposed on opposite sides of the central section and pivotally connected to the guide for tilting movement, and co-acting cam parts on the support and side sections which bear against one another during sliding of the guide on the support to tilt the side sections toward one another as the central section is withdrawn.

10. In a multi-section core for a permanent mold, a central section and a support therefor actuable to withdraw the section from a casting, a guide slidable on the support in the direction of withdrawal of the central section, side sections disposed on opposite sides of the central section and pivotally connected to the guide for tilting movement, co-acting cam parts on the support and side sections which bear

against one another during sliding of the guide on the support to tilt the side sections toward one another as the central section is withdrawn, and pin and slot means interconnecting the guide and the support to limit the relative sliding movement of the guide on the support.

11. In a permanent mold having a generally horizontal apertured base, a multi-section core comprising a central section and a support therefor actuatable for substantially vertical movement to raise and lower said section through the base aperture, a guide and means mounting the same for movement in substantial parallelism with the movement of the support, a side section pivotally mounted on the guide, means having connection with the guide and normally urging the same upwardly against the underside of the mold base to support the side section in raised position in the base aperture, and means providing a limited sliding connection between the support and the guide to permit limited vertical movement of one independently of the other during assembly and disassembly of the core, whereby lowering the support withdraws the central section prior to the side section, said upward urging means being yieldable downwardly to permit movement of the sections in unison below said limited independent vertical movement.

12. In a permanent mold having a generally horizontal apertured base, a multi-section core comprising a central section and a support therefor actuatable for substantially vertical movement to raise and lower said section through the base aperture, a guide and means mounting the same for movement in substantial parallelism with the movement of the support, a side section pivotally mounted on the guide, means having connection with the guide and normally urging the same upwardly against the underside of the mold base to support the side section in raised position in the base aperture, means providing a limited sliding connection between the support and the guide to permit limited vertical movement of one independently of the other during assembly and disassembly of the core, whereby lowering the support withdraws the central section prior to the side section, said upward urging means being yieldable downwardly to permit movement of the sections in unison below said limited independent vertical movement, and means having connection with the side section and arranged to automatically tilt the latter into space vacated by the central section prior to the movement of the sections in unison.

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