

March 5, 1935.

J. FLAMMANG ET AL

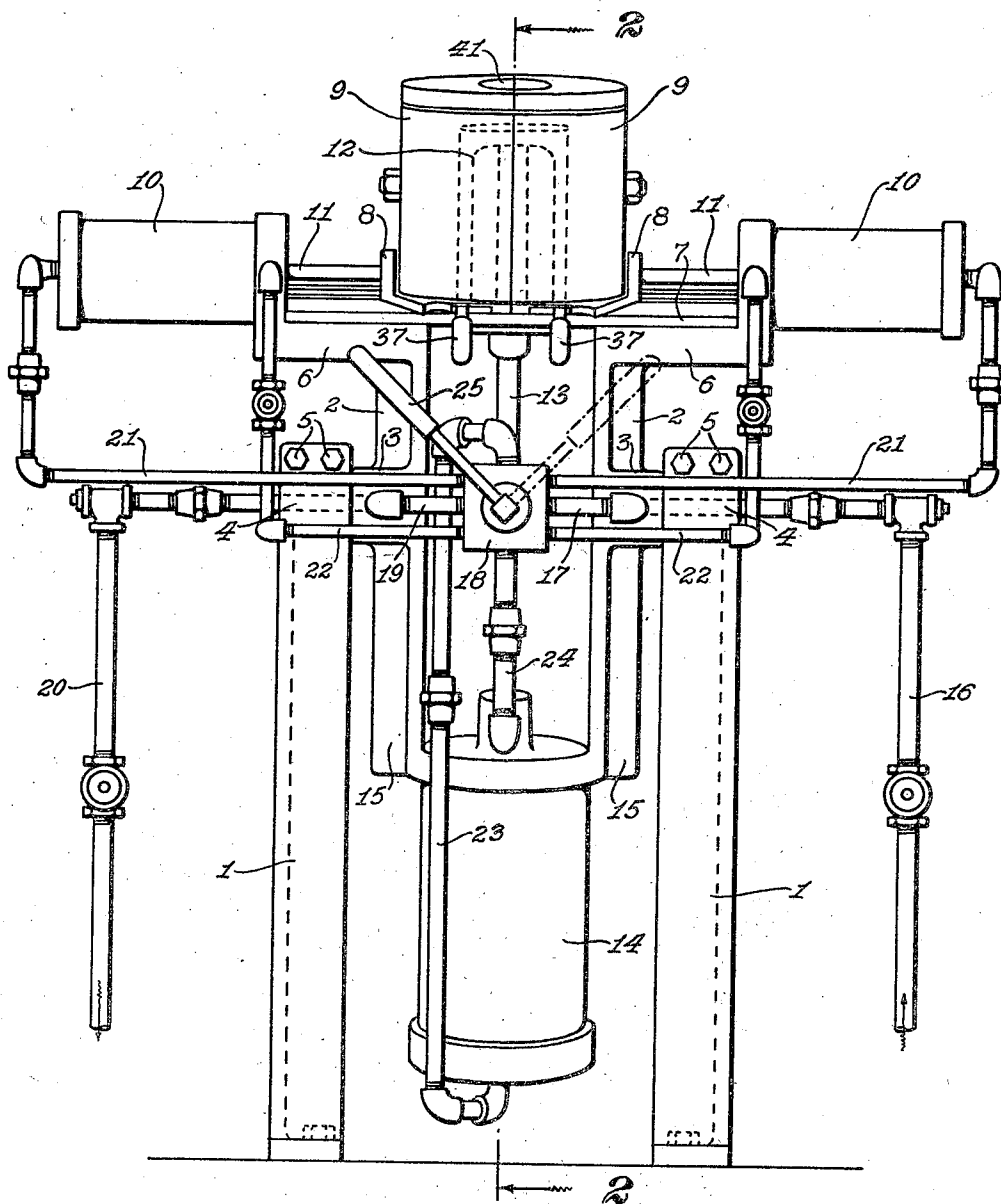
1,993,439

MOLDING MACHINE

Filed May 31, 1933

3 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

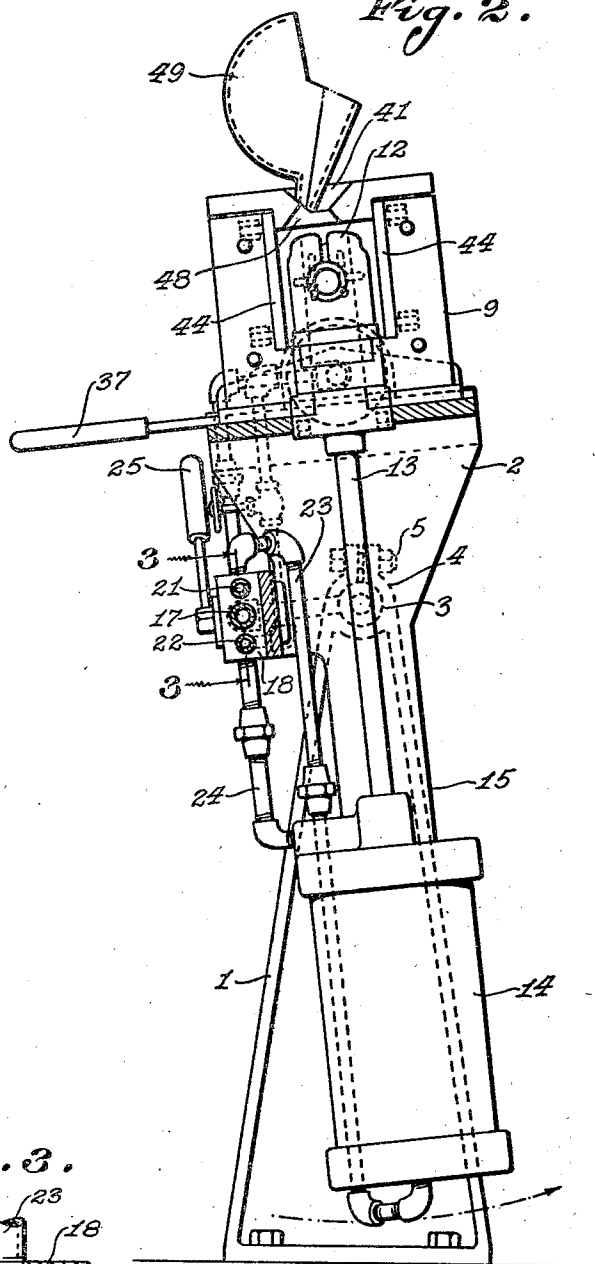
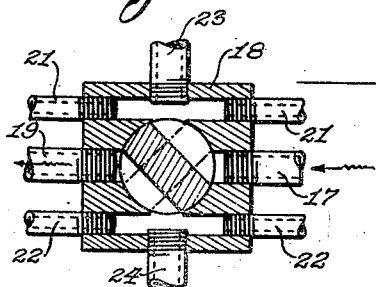


Fig. 3.



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3 Sheets-Sheet 3

Fig. 4.

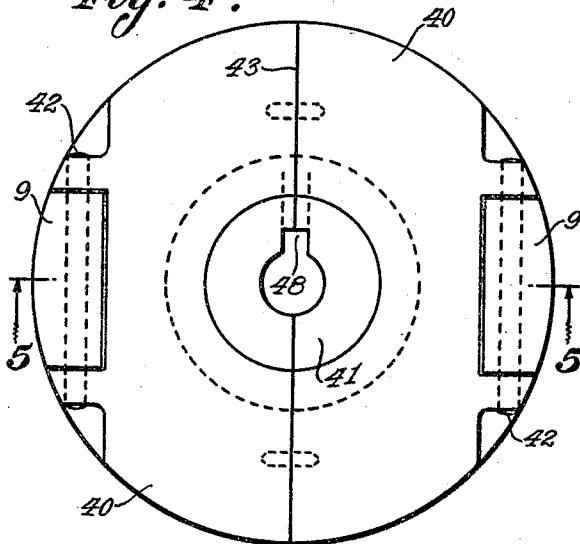


Fig. 6.

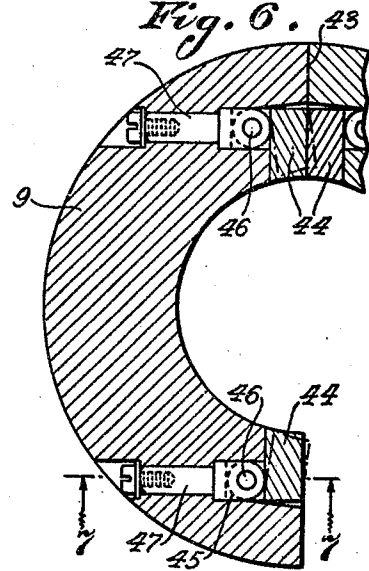


Fig. 5.

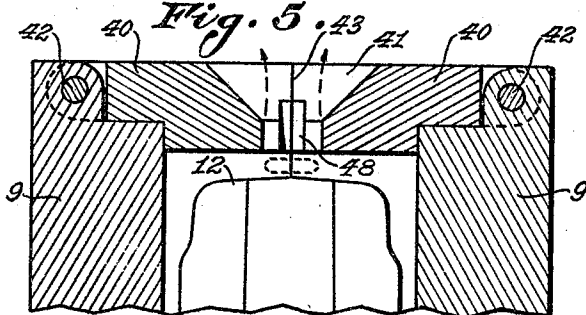


Fig. 7.

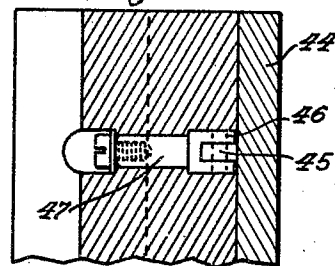


Fig. 8.

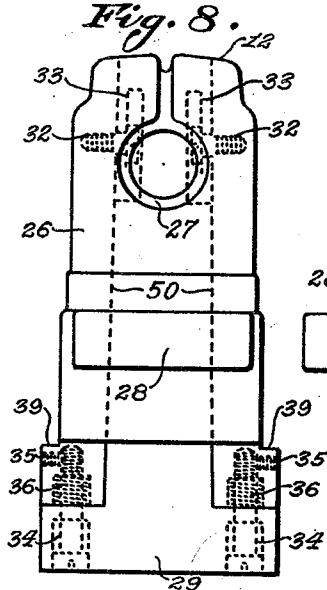


Fig. 9.

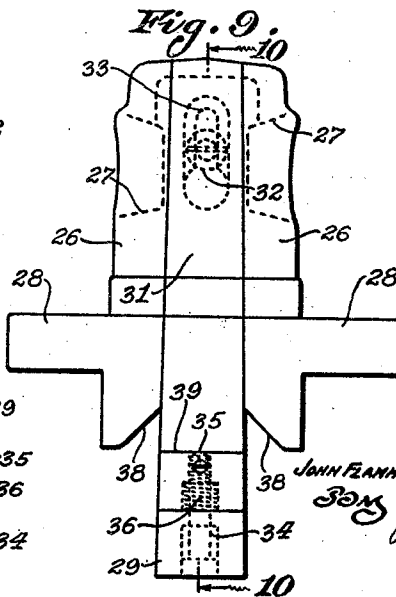
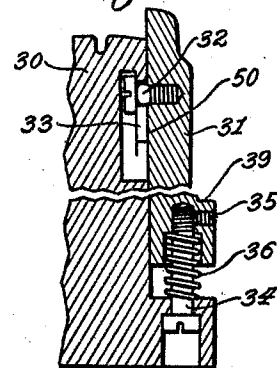


Fig. 10.



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UNITED STATES PATENT OFFICE

1,993,439

MOLDING MACHINE

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Application May 31, 1933, Serial No. 673,628

13 Claims. (Cl. 22—92)

This invention pertains to molding machines, and more particularly to a machine for casting pistons in permanent molds.

The great majority of modern trunk pistons are cast of a light metal, such as aluminum, magnesium, or the like, or their alloys. This is in order to reduce the weight of the piston as a light piston has advantages in the operation of internal combustion engines in which such pistons are most often used. A piston used in an internal combustion engine is distinct from ordinary aluminum castings in that it must meet very exacting conditions in its operation, the fact that it is subjected to very great stresses while at the same time undergoing wide changes of temperature make it necessary that piston castings be of an exceptionally high grade of perfection. In addition to this such pistons are ordinarily manufactured in large quantities and accordingly the manufacturing operations must be carried on at a rapid rate.

These requirements that perfect castings be formed and that this be done at a rapid rate are antagonistic to each other and render the piston casting art a correspondingly difficult one.

It is an object of this invention, therefore, to provide a piston casting machine capable of forming high grade castings at a rapid rate.

Another object is to provide such a machine capable of adjustment to control the manner of flow of the molten metal into the mold matrix.

Another object is to provide a molding device so constructed that the finished casting may be freed therefrom without injuring or marring the casting.

Another object is to provide such a molding machine with means for operating it automatically at a high rate of speed.

Further objects will appear from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a front view of a molding machine embodying this invention;

Figure 2 is a section on line 2—2 of Figure 1;

Figure 3 is a section of the control valve taken on line 3—3 of Figure 2;

Figure 4 is a plan view of the mold itself;

Figure 5 is a partial vertical section taken on line 5—5 of Figure 4;

Figure 6 is a partial horizontal section through the mold shown in Figures 4 and 5;

Figure 7 is a detail section on line 7—7 of Figure 6;

Figure 8 is a side view of the sectional core;

Figure 9 is an end view of the same; and

Figure 10 is a detail section on line 10—10 of Figure 9.

Referring to the drawings 1 designates a base or frame upon which the machine is mounted. A support 2 is provided with trunnions 3 journaled in bearings 4 in the base 1. The frame 2 is thus pivoted on the base so that it may be tilted at any desired inclination to the vertical. The trunnions 4 may be provided with any suitable clamping device, such as the studs 5 whereby the trunnions 3 may be clamped so as to fix the position of the support 2 and secure it against displacement.

The support 2 has a pair of oppositely extending arms or extensions 6 adapted to support a bed or plate 7. Guided for sliding movement on the plate 7 is a pair of brackets 8 having mounted thereon a pair of cooperating mold sections 9. The sections 9 are provided with cooperating matrices adapted to form the outside surfaces of the piston casting. Fluid pressure cylinders 10 are mounted on extensions 6 and provided with the usual pistons, not shown, having piston rods 11 connected to the brackets 8 so that these brackets may be slid along the bed plate 7 by operation of the fluid pressure in the cylinder 10.

Arranged to cooperate with the mold sections 9 is a sectional core indicated generally at 12 in Figure 1. This core is composed of middle and side sections as will be more fully explained hereinafter, the middle section being mounted on the piston rod 13 of a fluid pressure cylinder 14 mounted on a downward extension 15 of the support 2 so that fluid pressure may be applied to the cylinder to extract or insert this middle core section.

In order to operate the cylinders fluid pressure is provided from any suitable source of supply, not shown, by a pipe 16. Connections from the pipe 16 pass through one of the trunnions 3 to a pipe 17 by which the pressure is supplied to a control valve 18 shown in detail in Figure 3. A pipe 19 provides an exhaust for the valve 18 and passing through the other trunnion connects with an exhaust pipe 20. The valve 18 is connected by pipe 21 with the outer ends of the cylinders 10 and by pipe 22 with the inner ends of said cylinders. Similarly the valve 18 is connected by a pipe 23 with the lower end of the cylinder 14 and by a pipe 24 with the upper end of said cylinder. The valve 18 may be provided with a manipulative handle 25 for manually operating the same. It will be seen that by throwing the handle 25 to the left, Figure 1, the valve 18 will take the position in full lines in Figure 3 so that

the outer ends of the cylinders 10 will be connected to the pressure supply and accordingly the brackets 8 will be moved inwardly to close the mold sections 9. At the same time the supply 5 will be connected to the lower end of the cylinder 14 so as to force the core section inwardly into its position in the mold. By throwing the handle 25 to the right, Figure 1, to the dotted line position, the position shown in dotted lines in 10 Figure 3 will be obtained wherein the outer ends of the cylinders 10 and the lower end of the cylinder 14 will be connected to the exhaust while the inner ends of the cylinders 10 and the upper end of the cylinder 14 will be connected to the 15 pressure. This will operate the cylinders to draw the middle core section downwardly and to move the mold sections 9 outwardly so as to separate the same and free the casting therefrom.

The core 12 is composed of a pair of side sections 26 adapted to form the inner side surface 20 of the piston including the portion 27 for forming the wrist pin bosses. These sections 26 are provided with lateral wings or supports 28 mounted for sliding movement on the plate 7. These 25 sections are guided on said plate in any suitable manner so as to slide in a rectilinear path toward and from each other. Arranged to fit between the sections 26 is a composite middle core section 29 which when assembled with the side sections 26 30 forms the complete inner surface of the casting. The section 29 is mounted on the piston rod 13 of the cylinder 14, as above described, so that it may be withdrawn by operation of said cylinder.

As above mentioned the middle core section 29 35 is a composite one comprising a center part 30 and end parts 31, only one of which is shown in Figure 10. The parts 31 are mounted upon the center part 30 for sliding movement longitudinally thereof. They are guided in such movement 40 by any suitable means such as screws 32 having heads slidable in keyhole slots 33 in the center part 30. The lower end of each of the end parts 31 is guided by a screw 34 slidable in the part 30 and secured by a set screw 35 or the like in the part 31. A spring 36 may be mounted 45 on the screw 34 so as to provide means which are continually active to lift the end parts 31. The interengaging faces 50 of the parts 30 and 31 are slightly inclined to the vertical so that 50 as the parts 31 slide upwardly on the part 30 they are retracted radially inwardly.

It will be seen that upon completion of the casting when the cylinder 14 operates to withdraw the middle core section, the center part 30 55 is withdrawn downwardly thereby. The end parts 31 of this middle section, however, tend to remain in their original position. This tendency is due both to a certain amount of adhesion between these parts and the casting and also to the action of the spring 36. Accordingly as the center part 30 moves downwardly the end parts 31 do not follow immediately but are first retracted radially inwardly. This movement operates 60 to free these end parts from the casting by a movement substantially normal to the cast surface. This arrangement, therefore, avoids dragging the core surface along the cast surface in effecting this separation. Such a dragging operation has been found to have a tendency to 70 mar the casting as particles of the cast metal tend to adhere to the core surface.

After the middle core section has been withdrawn the two side sections 26 may be moved inwardly toward each other into the space vacated 75 by the middle section, handles 37 attached to the

sections 26 being provided for that purpose. When the core sections are returned to their positions for molding the casting the side sections are first moved outwardly and thereafter the operation of the piston 14 moves the middle section 39 5 into place between the two side sections. Said side sections may be provided with bevelled inner faces 38 adapted for engagement by the upper end of the middle section 29 so that in case the side sections have not been separated sufficiently the 10 middle section will act on these cam surfaces to move them apart. As the middle core section moves into its final position shoulders 39 on the end parts 31 engage corresponding shoulders (not shown) on the plate 7, or the mold sections 9, so 15 as to arrest the end parts 31 in their proper positions after which the center part 30 moves on to its final position, compressing the springs 36.

As already pointed out when a mold part is separated from the casting by a movement along 20 the casting surface there is a tendency to drag the metal of the casting with it and accordingly there is liability of marring the casting. In order to avoid this effect the mold sections have been provided in this machine with means whereby this 25 dragging effect may be avoided and these parts separated from the casting surface by a movement substantially normal to that surface.

The mold sections 9 are provided as shown in 30 Figures 4 and 5 with top portions 40 adapted to form the outer surface of the piston and usually provided with a gate 41. In the ordinary construction wherein these top portions 40 are fixedly secured to the sections 9 the separating movement of these sections tends to drag the parts 40 35 along the top of the casting. In accordance with the present invention, however, these parts 40 are hinged at 42 to the sections 9. It will be noted that the hinges 42 are placed laterally outside of the matrix and above the top of the piston head. 40 By thus positioning the hinge the movement of the top portion 40 in rotation on said hinge is in a direction substantially normally to the surface of the casting. Furthermore the drag of the casting on the part 40 is in such a direction with relation to 45 the hinge 42 as to induce such a movement of the part 40 in a direction outwardly from the casting and normal thereto. It will be seen, therefore, that this construction avoids any dragging of the top portion along the casting surface and in fact 50 accomplishes the breaking of the mold from the casting in a direction normal to the surface. When the mold sections 9 are again brought together for a new casting the meeting surfaces 43 engage each other in such a manner as to force 55 the parts 40 back into their proper positions.

A similar situation exists at that portion of the body where the two mold sections meet along the cylindrical surface of the piston. At this point 60 also the separating movement of the sections 9 is along the casting surface. In order to avoid this drag the structure shown in Figures 6 and 7 has been applied. Each mold section 9 is provided at each of these diametrically opposite points with a loose portion 44 extending in an axial direction 65 along the piston surface. This loose section is provided with one or more ears 45 at 46 on a stud 47 secured in any suitable manner in the section 9. Here again the position of the hinge is such that the movement of the portion 44 in rotation on that hinge is in a direction 70 away from the casting surface as indicated in dotted lines in Figure 6. In this case also it will be seen that when the mold sections are closed the portions 44 of the different mold sections en- 75

gage each other and force each other back into normal casting position.

It has been found that the manner in which the metal is flowed into the mold matrices affects the manner of formation of the casting. Molten aluminum when poured into a mold matrix has a tendency to assume a sort of skin over the free surface thereof. Accordingly the metal advancing in the mold passages is covered with such skin.

When portions of the metal advancing along different passages of the mold meet, this skin may tend to prevent a thorough union between the two portions. Accordingly a flow may be formed in the casting at the point of union. In order to avoid such effects it is very desirable to control the flow of the metal into the mold matrices. In accordance with this invention, therefore, the entire machine is arranged to be tilted and fixed at a desired angle and the gate 41 by which the metal is poured into the mold is provided with a lateral extension or extra passage 48 extending directly toward that portion of the mold matrix which leads most directly to the bottom of said matrix. In other words when the mold is tilted this passage is on the lower side. Thus when the operator pours the metal into the mold with a ladle 49 its flow may be directed through this passage to the lowermost portion of the mold matrix. If the mold has previously been adjusted to the proper angle of inclination the rise of the metal in the mold may be controlled so that its movement from passage to passage in the mold takes place in a desired manner.

It will be seen, therefore, that this invention provides a machine whereby piston castings may be made at a rapid rate and which is safe-guarded against defects ordinarily resulting from the continued operation of such a machine. The mold is tilted at a predetermined angle and the metal poured in in such a manner as to control the flow thereof. When the mold has been filled and the cast metal has set the operator swings the valve handle 25 to the right, Figure 5, whereupon the middle core section 29 is drawn downwardly by the cylinder 14 and the mold sections 9 are separated laterally by the cylinders 10. As the middle core section is drawn downwardly the center part 30 moves at once, while the end parts 31 are first retracted inwardly to break them from the casting after which they follow the part 30. As the mold sections 9 are separated the drag of the mold on the parts 40 and 44 tends to rotate said parts on hinges and such rotary movement breaks these parts from the casting in a direction normal to the surface thereof, in this way dragging of the metal is avoided. When the core has been completely withdrawn and the mold sections completely separated the casting is free except for the side core sections 26. The operator now moves the handles 37 which moves the sections 26 toward each other in a rectilinear path into the cavity vacated by the section 29. This guided movement of the sections 26 breaks them from the casting in a clean manner and without danger of chipping or marring the casting. The casting is now entirely free and may be lifted from the machine. Reverse movement of the handle 25 operates to restore the parts. The mold sections 9 are moved together by which movement the parts 40 and 44 are restored to their proper positions. The operator usually separates the handles 37 to place the sections 26 in their proper positions. If he should neglect this, however, the middle section 29, being raised by the cylinder 14, will engage the cam surfaces

38 and separate the side sections. The middle section then moves to its final position thereby restoring the end parts 31 to their normal position. The machine is now ready for a repetition of the casting operation.

While this invention has been described as a unitary device, it will be understood that individual features and subcombinations thereof may be useful by themselves without reference to the other features or the complete combination. It is understood that the employment of such individual features and subcombinations is contemplated by this invention and within the scope of the appended claims. It is understood, however, that various changes may be made, within the scope of the appended claims, in the details of construction without departing from the spirit of this invention; it is to be understood, therefore, that this invention is not limited to the specific details shown and described.

Having thus described the invention, what is claimed is:

1. A molding machine of the character described, comprising a mold including a pair of separable mold sections adapted to provide a mold cavity, a sectional core having a middle section movable upwardly into the mold cavity, said middle section for said core including center and end parts, said end parts being mounted on said center part and guided for movement longitudinally thereof and inwardly toward each other, mechanism continually active to lift said end parts relatively to said center part, and means cooperating with said mold to depress said end parts.

2. A molding machine of the character described, comprising a mold including a pair of separable mold sections adapted to provide a mold cavity, a sectional core having a middle section movable upwardly into the mold cavity, said middle section for said core including center and end parts, said end parts being mounted on said center part for movement longitudinally thereof and inwardly toward each other, headed studs on said end parts cooperating with key hole dovetail slots in said center part to guide said end parts, springs continually active to lift said end parts relatively to said center part, and means cooperating with said mold to depress said end parts.

3. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, a sectional core having a middle section movable upwardly into the mold cavity, said middle section for said core including center and end parts, said end parts being mounted on said center part and guided for movement longitudinally thereof and inwardly toward each other, mechanism continually active to lift said end parts relatively to said center part, means cooperating with said mold to depress said end parts, and means for adjusting the extent of movement of said end parts.

4. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, a sectional core having a middle section movable upwardly into the mold cavity, said middle section for said core including center and end parts, said end parts being mounted on said center part for movement longitudinally thereof and inwardly toward each other, headed studs on said end parts cooperating with keyhole, dovetail slots in the upper portion of said center part to

guide said end parts, adjustable guide studs connecting the lower ends of said end parts with said center part, springs continually active to lift said end parts relatively to said center part, and means cooperating with said mold to depress said end parts.

5. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, one of said sections having a portion positioned to mold a surface of the casting substantially parallel to the direction of the separating movement of said section loosely mounted thereon for movement transverse to the direction of the separating movement.

6. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, one of said sections having a portion positioned to mold a surface of the casting substantially parallel to the direction of the separating movement of said section hinged thereon for swinging movement transverse to the direction of the separating movement.

7. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, one of said sections having a portion positioned to mold a surface of the casting substantially parallel to the direction of the separating movement, said mounting being such that the drag of the casting on said loose portion is adapted to induce transverse movement thereof.

8. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, one of said sections having a portion positioned to mold a surface of the casting substantially parallel to the direction of the separating movement of said section pivoted therein outside of and in the direction of the separating movement from its engagement with the casting.

9. Apparatus for molding trunk pistons, comprising, a mold including a plurality of separable mold sections adapted to provide a mold cavity, a cover for said mold having a portion forming an inner surface of the mold cavity adapted to mold the piston head, and means for guiding said cover for independent movement away from

the casting during the separating movement of said sections.

10. Apparatus for molding trunk pistons, comprising, a mold including a plurality of separable mold sections adapted to provide a mold cavity, a cover for said mold having a portion forming an inner surface of the mold cavity adapted to mold the piston head, and means for guiding said cover for pivotal movement relative to the casting and so as to swing away from the casting under the drag of the latter thereon.

11. Apparatus for molding trunk pistons, comprising, a mold including a plurality of separable mold sections adapted to provide a mold cavity, one of said sections having a part adapted to mold a surface of the piston body substantially parallel to the direction of separating movement supported thereon for swinging movement away from the casting under the drag of the latter thereon.

12. A molding machine of the character described, comprising, a mold including a pair of separable mold sections adapted to provide a mold cavity, a sectional core having a middle section movable upwardly into the mold cavity, said middle section for said core including center and end parts, said end parts being mounted on said center part and guided for movement longitudinally thereof and inwardly toward each other, mechanism continually active to lift said end parts relatively to said center part, means cooperating with said mold to depress said end parts, one of said mold sections having a portion positioned to mold a surface of the casting substantially parallel to the direction of the separating movement of said section loosely mounted thereon for movement transverse to the direction of the separating movement.

13. In a molding machine of the character described, a mold mounted at an inclination and having a gate in its top portion, said gate having an open lateral extension extending away from the axis of the lower gate in a direction radially downward toward the lower portion of the mold cavity.

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