

April 27, 1954

W. M. VENNER ET AL

2,676,372

PISTON MOLDING CORE

Filed Dec. 22, 1951

FIG. 1

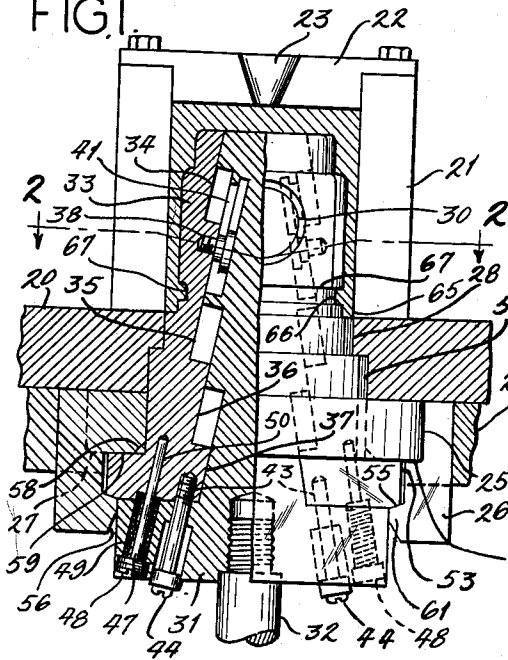


FIG. 3

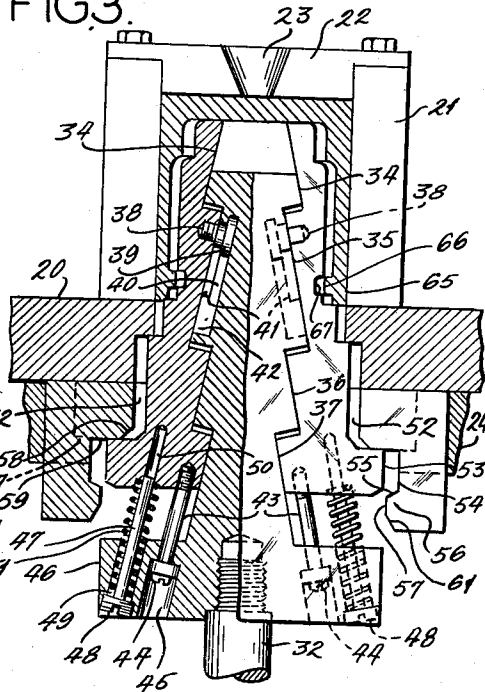


FIG. 2.

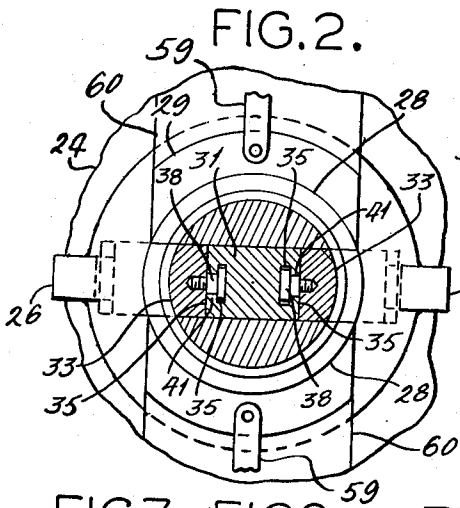


FIG. 4.

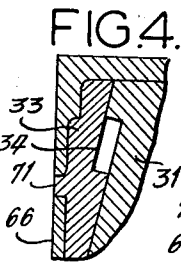


FIG. 5.

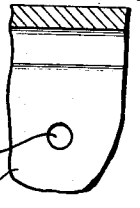


FIG. 6.

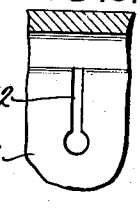


FIG. 9.

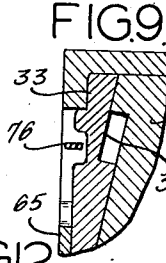


FIG. 10.

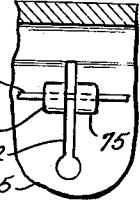


FIG. 7.

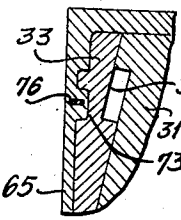


FIG. 8.

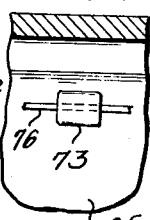


FIG. 11.

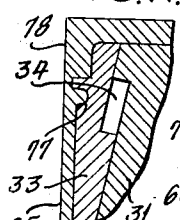
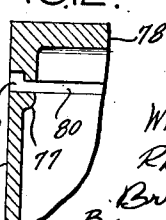


FIG. 12.



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UNITED STATES PATENT OFFICE

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PISTON MOLDING CORE

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4 Claims. (Cl. 22-170)

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This invention relates to piston molding cores for piston molding machines, and particularly of the type disclosed in United States Patents Nos. 1,551,193, issued August 25, 1925; 1,952,199, issued March 27, 1934; and 1,993,439, issued March 5, 1935. This application was copending with application Serial No. 161,203, filed May 10, 1950.

In the piston molding machine of the character described, a core is provided conforming to the inside of the piston, such as a trunk piston, particularly adapted for internal combustion engines and provided with a head and a skirt. Where there are internally projecting parts, such as wrist-pin bosses, which prevent the withdrawal of the core, this core cannot be of a single piece, but supplementary or side sections must be provided, which form with a middle section the entire core. In such a case, the withdrawal of the middle section below the side sections permits those sections to move into the space vacated by the middle section in order to clear the bosses; all as described in the patents referred to.

In some trunk pistons, there may be a part or parts thereof extending laterally of the inside face of the piston. Where such part or parts are in the regions of the wrist-pin bosses, as are the bosses themselves, no special construction other than as disclosed in the patents referred to is required, for these will be cleared by the side sections when they move into the space vacated by the middle section of the core. Where, however, the parts extending laterally of the inside face of the piston are in the regions of the thrust faces, that is, in regions at right angles to the bosses, then the middle core section cannot be withdrawn if of a single piece. It has, therefore, been the practice in such cases to make the middle core of two or more pieces, which are picked out separately. That, however, practically precludes the employment of an assembled middle core section in which the parts thereof are held in assembled relation; it also precludes the employment of such a core of separate pieces in a molding machine of the character described in the patents referred to, in which the middle core is withdrawn mechanically. While in the above Patent 1,993,439, the middle core is made of two or three parts whose engaging faces are inclined, that inclination is not abrupt but slight, in order to simply avoid dragging of the core along the inner surface of the casting to which the core has become adhered during casting at the high temperatures necessarily employed.

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Such a part or parts extending laterally of the inside face of the piston may be of various forms, viz.: an annulus or ledge extending inwardly from the inside wall of the piston to provide, for instance, for a thickened part for piston ring groove in the skirt; a perforation extending into or through the wall of the piston from the inside out which may be in the form of a plain perforation or as a vertical part of a T-slot, or the horizontal part of a T-slot or a part of a circumferential slot used in pistons; or a ledge providing a lug or lugs inside of the piston to provide for engagement by an inside fixture part when the piston is machined; or a recess on the inside of the piston to form for instance a part of the horizontal slot opposite a ring groove; or various other recesses, ledges or lugs on the inside wall of the piston.

A trunk piston which nowadays is constructed of an aluminum alloy, has a construction which renders its production by a permanent molding process difficult. Such a piston comprises a head and a skirt, the latter provided with inwardly extending wrist-pin bosses. The head is rather thick, and such thickness extends down the sides in order to provide for ring grooves. The skirt itself, however, is made thin in order to reduce the weight, there being usually ribs extending from the head to the bosses inside the piston. In casting the piston, the core as well as the mold must be kept at a temperature of 625-900° F., for otherwise a good casting will not be produced. An aluminum alloy itself has not only high crystallization shrinkage, but a high coefficient of expansion and contraction several times that of cast iron or steel of which the core is almost universally constructed. After the metal has been poured, there will be first compensation for crystallization shrinkage and thereafter solidification, both of which are indicated by a drop in the center of the gate and coloration of the gate; by these indications the molder can determine when shrinkage has been compensated for and when the metal has solidified around the core. The problem of opening the mold, that is the outside mold parts, is not of moment; for the metal will simply shrink away from the outside mold parts, which are usually in halves as shown in the patents referred to. The problem of releasing the core is, however, critical; for if the core be withdrawn too early and before the metal has set, the piston will be ruined; if, however, the release of the core be delayed too long, the metal will shrink on the core, which may result not only in the development of hairline cracks in

3 the thin skirt, but even seizure of the casting on the core. The release of the side sections of a core is again not a serious problem, provided the middle section is released in time, for if that is done, the side sections will simply move in upon further contraction of the casting. The release of the middle core is, however, a problem, because it must be done not too soon and not too late. The casting of a piston is, therefore, something very special, and it involves a special problem and a special solution.

One of the objects of this invention, therefore, is to provide a piston core of the character described, which will meet the above-described requirements.

In the machines of the patents, the piston is cast with the head up and core is withdrawn from the bottom, leaving the piston casting setting on the machine.

Another object of this invention, therefore, is to provide a collapsible core capable of forming a casting of the character described, but which may be withdrawn as a whole from the casting, as distinguished from picking the core-parts out piece-meal.

Further objects will appear from the detail description taken in connection with the accompanying drawing, in which will be set forth illustrative embodiments of this invention. It is understood, however, that this invention is susceptible of various embodiments within the scope of the appended claims.

In accordance with the illustrated embodiments of this invention, an apparatus for mold casting a piston having a part extending laterally of the inside face thereof, has a core shaped to the interior of the piston. This core has an inner section and one or more lateral sections held in assembled relation to slide relatively, and the lateral section has a portion for molding the laterally extending part and that portion partially or entirely overlies that part. The inner and lateral sections are operatively connected to collapse the lateral section against the inner section upon relative sliding thereof in order to retract the overlying portion inwardly to clear the part extending laterally of the inside face of the piston casting. Where side sections are provided, these complete the core and upon retraction of the inner and lateral sections, the side sections can be moved into the space vacated by the inner and lateral sections. Holding means are positioned in the path of and for engagement by a part of a side section and outside of the casting-forming cavity, which means is adapted to hold the side section against longitudinal movement but to permit the same to move against the side section. This holding means is, however, also positioned to thereafter release the side section to permit it to move with the inner section out of the casting. Upon reverse movement of the sections, they are restored.

In the accompanying drawing:

Figure 1 is an elevation partly in section of an apparatus embodying this invention, showing the core parts in extended position;

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

Figure 3 is a view similar to Figure 1, but showing the core collapsed;

Figure 4 is a partial sectional view similar to Figure 1, but showing another embodiment of this invention, in which a perforation is formed in the skirt wall;

Figure 5 is an inside view of a part of a skirt

wall of Figure 4 showing the perforation formed therein;

Figure 6 is a view similar to Figure 5, but showing the formation of another form of perforation in the skirt wall;

Figures 7 and 8 are views similar to Figures 4 and 5, but illustrating another embodiment of this invention;

Figures 9 and 10 are views similar to Figures 4 and 5, but showing another embodiment of this invention; and,

Figures 11 and 12 are views similar to Figures 4 and 5, but showing another embodiment of this invention.

Referring to the accompanying drawing, and more particularly to Figures 1-3, 20 designates a base plate of the frame of a molding machine, providing a support for a pair of mold halves 21, each having one half of a top part 22 forming a gate 23; Figures 2 and 3 only show one half of a set of a pair of molds divided along the plane of the sheet. The mold halves 21 are arranged to slide on the support 20 (Figures 1 and 3 towards and from the observer) so as to open and close the molds, and such sliding can be accomplished by suitable mechanism (not shown). In Figure 2, base plate 20 is omitted to show a base 24 which is arranged to receive a sub-base 25 provided with laterally and downwardly extending lugs 26 which enter recesses in the base 24. The base 24 extends inwardly, as shown at 27 to support the sub-base 25, and the base 24 is flush with the top of the sub-base 25. A pair of side sections 28 of a core have extensions 29 mounted on the sub-base 25 so as to slide thereon in guides 60 (up and down, Figure 2) and they are connected by links 59 to suitable mechanism. The side sections 28 have recesses 30 to form wrist-pin bosses, and each mold half may have a core to form holes in the bosses for the wrist-pin. The structure so far described is generally as shown and described in Patent No. 1,952,199, Figures 6 and 7, which shows mechanism for moving the mold halves and for moving the side sections of the core. That patent also discloses a middle core between the side core sections to complete the core structure, this core being moved down so as to permit the side sections to move into the space vacated by the middle section. That middle core is also operated by mechanism as shown in the patent.

In accordance with the illustrative embodiments of this invention, the middle section is of a special construction in order to enable it to be collapsed and extended laterally in order to retract the portion or portions overlying a part extending laterally of the inside face of the casting to be cleared. It will be understood, of course, that where such a laterally extending part is only at one face of the piston only the core portion forming that part need be provided and retracted. If, however, there are parts at opposite faces of the piston walls, then both sides of the piston must be provided with portions forming those parts. This middle core section can now be moved down below the side sections in order to enable them to move into the space vacated by the middle section. This middle core section may be of various forms, but a particular embodiment will now be described.

Referring again to Figures 1-3, the middle core section comprises an inner section 31 having a screw threaded connection with a piston rod 32 which can work in a cylinder as in Patent 1,952,199. Lateral sections 33 engage the middle section for relative sliding movement. The in-

ner engaging faces of the sections are inclined towards the center of the middle section, but the incline is in the form of a series of stepped inclines 34, 35, 36 and 37 which are arranged in series and in each of which the inclination is abrupt with reference to the center line of the middle section. The inner and outer sections are held in assembled relation by any suitable means constructed to permit such relative movement. As shown each lateral section is provided with a screw 38 having a head 39 moving in a slot 40 having the same inclination as the faces 35 and provided with shoulders 41 terminating below the lower end of the shoulder in order to provide an opening 42 somewhat larger than the head 39. This construction is such that when a lateral section is placed against the middle section the head 39 may be slipped into the recess part 42 and thereafter be moved under the shoulder 41. A screw 43 is threaded into each lateral section and has a head 44 in the bore 45 in the lateral part 46 of the middle section. A pin 47 has a threaded slotted head 48 threaded into a bore 49 in the extension 46. This pin extends into a bore 50 in the lateral section and there is a spring 51 between the head 48 and the lateral section. By the construction just described, the sections of the middle core will not only be held in assembled relation, but they can be adjusted relatively and held to any desired tension by adjustment of the heads 44 and 48.

The sub-base 25 has an opening 52 conforming to the middle core when extended. The lateral sections have extensions 53 arranged to enter recesses 54 in the lugs 56 on the sub-base when the core sections are extended so as to seat on shoulders 55. These lugs 56 are also provided with inclines 61 to be engaged by the extensions 53 and 46 and the latter is arranged to seat against shoulders 57. The sub-base is also provided with an inclined face 58 for engagement by the lateral sections 33 and with shoulders 59 engaged by the extensions 53.

In the embodiment shown in Figures 1, 2 and 3, the part extending laterally of the inside of the piston skirt 65 is in the form of an annular boss 66 forming an inwardly projecting ledge. Such a boss may be provided for various purposes, such for instance as providing for increasing the thickness of the skirt to permit a ring groove to be placed opposite the boss. In order to form such a boss, the side sections 28 are provided with inwardly extending annular recesses 67 which may also extend into the core side sections 23 where the boss is a complete annulus. The stepped inclines 34, 35, 36 and 37 form complementary cooperating meshing cam elements on the interengaging sections and spaced therealong. These cam elements project laterally to the extents corresponding to the projection of a lateral core section portion above the recess 67, and overlying a casting part 66. Since, however, the parts of the lateral sections above the recesses 67 overlie the boss in the piston casting, the middle core cannot be retracted unless collapsed in order to retract the overlying portion inwardly to clear the boss. That is, however, accomplished as follows:

Downward movement of the inner section 31 will cause it to slide relative to the side sections from the position shown in Figure 1 to the position shown in Figure 3. Initially, and as shown in Figure 1, the lateral sections of the middle cores are held against downward movement by

engagement of the extensions 53 with their shoulders 55 while the springs 51 are under compression. The downward movement of the middle section will, however, by engagement of the heads 39 with the inclined shoulders 41 cause the side sections to move towards the middle section until the overlying portion of the recess 67 has cleared the boss 66, at which time the extensions 53 will also have moved inwardly to clear the shoulders 55. At this time also the heads 44 will engage the bottom of the bores 45 so as to finally bring the assembled core sections to the position shown in Figure 3, where the side sections have cleared the boss 66 so that the assembled structure can be moved down and entirely out of the mold and below the side core sections 28. The side core sections can now move into the space vacated by the middle core, and because of the shortened arc on each inside face of the side core sections, the latter will also clear the boss 66. Upon opening of the mold sides 21, the piston can be picked off of the side cores.

The machine is now ready to repeat the operation. The middle core section is moved up from position Figure 3 to position Figure 1 after the side cores have been moved out. During such movement the side sections 33 will engage the inclined faces 58 and the extensions 53 and 46 will engage the inclined faces 55 and 61 on the lugs 56 and then abut against the shoulders 59 so that upon further upward movement of the inner section 31 the lateral core sections will be moved out with the extensions 53 moving into the recess 54 and above the shoulders 55. Finally, the extensions 46 of the middle section will move against the extensions 53. By now moving the mold sides 21 in, the molding machine is again in condition for another pouring.

Figures 4 and 5 show another embodiment of this invention in which the part extending laterally of the inside face of the piston casting is in the form of a hole or recess 70 in a piston wall forming a ledge above the hole, and formed by a portion 71 on one or both of the lateral core sections. The operation of casting such a piston will be apparent because the same type of middle and lateral core sections may be used as in Figures 1-3, the lateral core section being indicated at 33. In Figure 6, the recess or hole in the skirt wall may be in the form of a slot 72 in order to provide for the casting of a vertical slot in the piston.

Figures 7 and 8 disclose another embodiment of this invention. In this case the piston skirt is provided with an inwardly extending lug or lugs 73 which are formed on one or both sides of the piston casting and the lateral core sections may be provided with corresponding recesses to form those lugs. The retraction of the lateral core sections 33 may be performed in the same manner as shown in Figures 1-3. In Figures 9 and 10, there are a pair of lugs 74 and 75 which may be on opposite sides of a slot 72 as in Figure 6. Again the lugs, as well as the slot may be formed by the lateral sections 33 as shown in Figures 1-4.

These lugs 73, 74, 75, Figures 7-10 may be used for various purposes, such as providing locating stops for a fixture or mandrel placed inside the piston when it is to be machined. The hole or perforation 70, Figures 4 and 5, may be for the same purpose. In Figures 7-10, the lugs may be traversed by a steel ring 76 which is anchored in the lugs and which ring is used for main-

taining the piston skirt against expansion when the piston is made of aluminum having a much higher expansion than steel. The core has a recess to receive the ring, when the core is collapsed.

In the embodiment shown in Figures 11 and 12, an annulus or part annulus 77 is provided inside a piston as a part of or below the thickened head 78. The core is provided with a recess or recesses to form the annulus 77 and also with an annular projection or projections 81 to form a slot or slots 80. When now a ring groove 79 is cut into such a piston, it will form a circumferential slot 80 in one or both regions of the thrust faces as employed in many aluminum pistons to partially separate the head from the skirt. The lug 77 and skirt 65 may also have formed therein a slot like 72, Figures 6, 9, and 10, so as to connect the circumferential slot 80 with the vertical slot.

In all embodiments, of Figs. 1-3, as well as of Figs. 4-12, the side sections 28 are constructed to clear the casting, irrespective of the form of the casting part extending circumferentially and radially of the inside of the piston skirt, and irrespective of whether the core portion or portions forming such part or parts extend into the side cores. That is because not only will the side cores move away from the casting into the space vacated by the inner and lateral core sections, but the chords on the inside of the side cores are shorter than the diameter of the casting, even inside of a boss ring or ledge. Likewise where there is a slot formed in the piston, as at 80, Fig. 12, the slot-forming parts on the side cores will also move away from the inside wall of the piston, radially and chordally.

This invention enables a casting to be produced having a part thereof extending laterally of the inside face thereof and in an expeditious manner. It is not necessary to provide an inner core assembly of pieces which must be picked out separately after the casting has solidified. The sections of the inner core are always maintained in assembled relation, so that by simply moving the inner core assembly out of the casting, and moving the side sections into the space vacated by that assembly, the casting can be picked off. Again after the side sections have been separated, the middle core assembly can be moved therebetween and extended. This enables the casting operations to be performed in a machine as in the patents referred to. Moreover, as noted above aluminum castings have a high crystallization shrinkage and a high expansion and contraction. If the core be withdrawn too early, the crystallization is not compensated for and a sound and clean casting will not be secured. On the other hand, if the withdrawal of the core be delayed, the casting will seize the core and will crack and be ruined. That is avoided by this invention. While after the withdrawal of the middle core assembly the side core sections are left standing for subsequent movement into space left by the middle core, even if these side sections should not be moved in shrinkage will simply move them in to the extent that the casting contracts; for as shown in Patent No. 1,952,199, these side sections simply rest on the base and inward movement is not impeded by such contraction.

The above operations cannot be accomplished by the piston core shown in Patent 1,993,439; for while the engaging face of the inner and lateral sections are inclined, this incline is not

abrupt, but slight in order to simply avoid dragging of the core along the inner surface of the casting, due to adhesion between the core and the inside face of the casting, because of the high temperatures employed during the casting operation. In accordance with this invention, while the engaging faces of the inner and side sections are inclined, they are specifically constructed and designed to actually collapse the lateral section against the inner section upon relative sliding thereof in order to retract the overlying portion in the core inwardly to clear the part extending laterally of the inside face of the casting.

Having thus described this invention what is claimed and desired to be secured by Letters Patent is:

1. In an apparatus for mold-casting a piston having an inwardly projecting ledge, a core shaped to the interior of such a piston and comprising, an inner section and a lateral section permanently held in assembled relation to slide relatively while so held but to remain parallel, said lateral section having an inwardly extending recess for molding said ledge and having a projection extending outwardly above the recess, a series of sets of cooperating meshing cam elements on the interengaging sections and spaced therealong, said elements projecting laterally to extents corresponding to said projection and cooperating when said sections are relatively extended to hold said lateral section extended laterally, holding means engaging said lateral section outside of the casting-forming cavity, and means operatively connecting said sections and cooperating with said cam elements, adapted upon sliding of said inner section with respect to said lateral section and while the lateral section is held against longitudinal movement, to positively pull said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge.

2. In an apparatus for mold-casting a piston having an inwardly projecting ledge, a core shaped to the interior of such a piston and comprising, an inner section and a lateral section permanently held in assembled relation to slide relatively while so held but to remain parallel, said lateral section having an inwardly extending recess for molding said ledge and having a projection extending outwardly above the recess, a series of sets of cooperating meshing cam elements on the interengaging sections and spaced therealong, said elements projecting laterally to extents corresponding to said projection and cooperating when said sections are relatively extended to hold said lateral section extended laterally, holding means engaging said lateral section outside of the casting-forming cavity, and means operatively connecting said sections and cooperating with said cam elements, adapted upon sliding of said inner section with respect to said lateral section and while the lateral section is held against longitudinal movement, to positively pull said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge, said connecting means cooperating with said cam elements upon movement of said inner section in the opposite direction to positively push said lateral section outwardly away from said inner section.

3. In an apparatus for mold-casting a piston having an inwardly projecting ledge, a core shaped to the interior of such a piston and com-

prising, an inner section and a lateral section permanently held in assembled relation to slide relatively while so held but to remain parallel, said lateral section having an inwardly extending recess for molding said ledge and having a projection extending outwardly above the recess, a series of sets of cooperating meshing cam elements on the interengaging sections and spaced therealong, said elements projecting laterally to extents corresponding to said projection and cooperating when said sections are relatively extended to hold said lateral section extended laterally, but adapted upon sliding of said inner section with respect to said lateral section and while the lateral section is held against longitudinal movement, to move said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge, and holding means positioned for engagement by a part of said side section and outside of the casting-forming cavity, adapted to hold the same against longitudinal movement but to permit the same to move laterally against said inner section.

4. In an apparatus for mold-casting a piston having an inwardly projecting ledge, a core shaped to the interior of such a piston and comprising, an inner section and a lateral section permanently held in assembled relation to slide relatively while so held but to remain parallel, said lateral section having an inwardly extending recess for molding said ledge and having a projection extending outwardly above the recess,

a series of sets of cooperating meshing cam elements on the interengaging sections and spaced therealong, said elements projecting laterally to extents corresponding to said projection and cooperating when said sections are relatively extended to hold said lateral section extended laterally, but adapted upon sliding of said inner section with respect to said lateral section and while the lateral section is held against longitudinal movement, to move said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge, and holding means positioned in the path of and for engagement by a part of said side section outside of the casting, adapted to hold the same against longitudinal movement but permit the same to move against said inner section, said holding means being also positioned to thereafter release said side section to permit it to move with said inner section out of the casting.

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