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W. M. VENNER ET AL
PISTON MOLDING CORE

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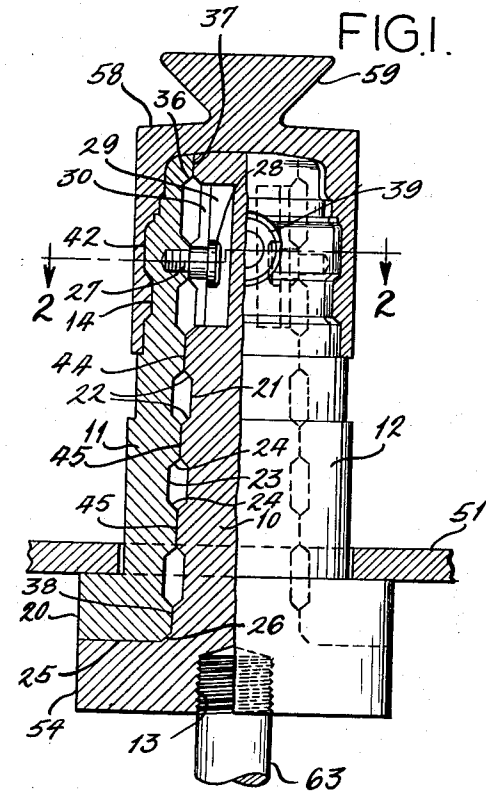


FIG. 1.

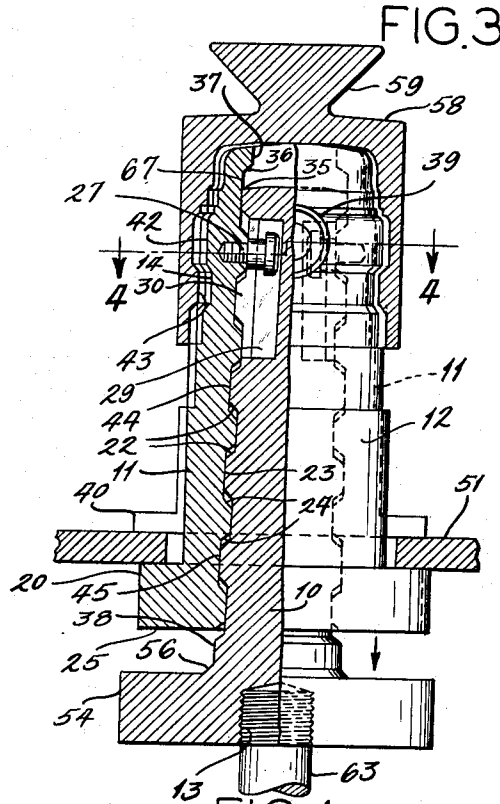


FIG. 3.

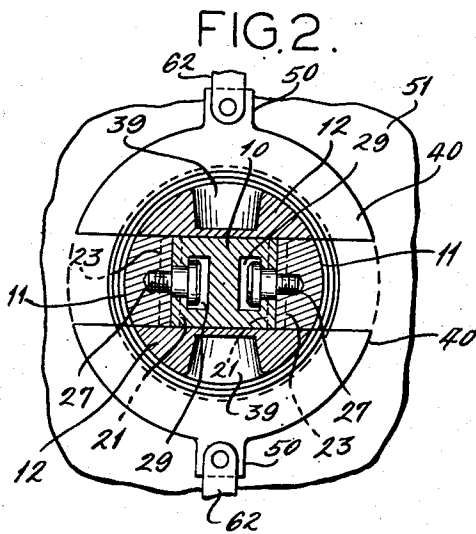


FIG. 2.

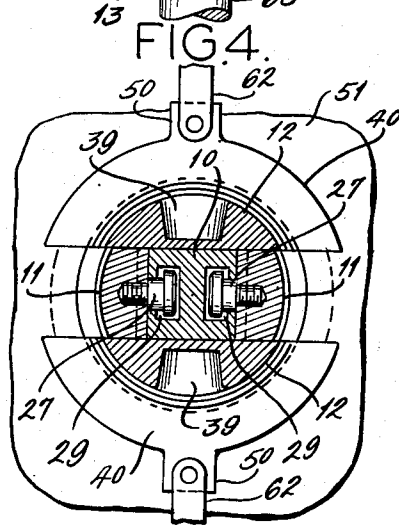


FIG. 4.

INVENTOR:
WILLIAM M. VENNER
PERCY L. BOWSER JR.
By *Bruning & Sutherland*
ATTORNEYS.

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PISTON MOLDING CORE

William M. Venner, Clayton, and Percy L.
Bowser, Jr., University City, Mo.

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7 Claims. (Cl. 22-170)

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This invention relates to piston mold cores, 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 is a continuation of application Ser. No. 719,844, filed January 2, 1947, now abandoned.

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, all as described in the patents referred to. In some cases there may be internal projections or ledges which may be in regions at right angles to the bosses, such as balancing lugs or re-enforcements in those regions, or there may be an annulus inside the piston for a ringland. In such a case it is difficult and in some cases impossible to withdraw the center core section.

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 which 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

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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 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 and which will have distinct advantages.

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 an illustrative embodiment 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 an illustrative embodiment of this invention as in the piston holding machine of the character described in the above patents, the core comprises a middle section and a pair or pairs of side sections movable into the space occupied by the middle section when the latter is withdrawn. The middle section is composed of an inner section and one or more lateral sections slidably engaging the inner section and means is provided adapted to collapse the lateral section or sections against the inner section upon relative sliding thereof. In the piston core of Patent 1,993,493, while the engaging faces of the inner and lateral sections are inclined, this inclination is not abrupt but slight in order to

simply avoid dragging of the core along the cast inner surface of the casting.

In accordance with an illustrative embodiment of this invention, the piston core assembly is designed to provide for the formation of an inwardly projecting ledge on the inside of the casting. In order to effectuate that purpose the core exterior has a recess for molding that ledge with a projection above, i. e. toward the end of the core, and the core assembly has means between the inner and lateral sections adapted upon relative sliding thereof to permit retraction of that projection inwardly to clear the ledge. Where the ledge is in the region of a side section or sections, then the movement of the latter into the space occupied by the former will retract the recess from the ledge. In the embodiment described, the inner and lateral sections are permanently held in assembled relation to slide relatively while so held but to remain parallel, and a series of sets of cooperating elements on the inter-engaging sections and spaced therealong are adapted upon sliding of the inner section with respect to the lateral section, and while the lateral section is held by the casting to move the lateral section parallel to and against the inner section. It is, however, important in the molding of pistons to avoid dubbing or rounding of the head-forming ends of the sections; for otherwise an objectionable fin will be formed. Means is provided to avoid such dubbing or rounding. It is understood that the expressions "above," "below," "inner," "side" and "lateral" are used for convenience in connection with the drawing showing the core with the top up.

In the accompanying drawing:

Figure 1 is an elevation, partly in section, of a piston core illustrating an embodiment of this invention, one of the side cores being shown in elevation, the parts being shown assembled ready for pouring of the metal and the casting being shown in sections;

Figure 2 is a top view of the entire core but with the casting and core parts in sections on line 2—2, Figure 1;

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

Figure 4 is a view similar to Figure 2, but showing the middle core collapsed, partly in section on line 4—4, Figure 3.

Referring to the accompanying drawing, 10 designates the inner section of the middle section of the core assembly, while 11 designates lateral sections which, together with the side sections 12 form the inside of the piston. The side sections have recesses 30 which form the wrist-pin bosses and the outside mold halves (not shown) may have cores to form holes in the bosses as in Patent 1,952,199. These side sections have lugs 40 provided with extensions 50 and guided on a base 51 on the molding machine and connected by rods 62 to handles (not shown) whereby these side sections may be moved into the space left by the center core when the latter is withdrawn, all as shown in Patent 1,952,199.

The core section 10 is provided with a threaded recess 13 for attachment to the withdrawing piston rod 63 of a molding machine as also illustrated in the patent referred to. The inner section 10 of the middle core has lateral extensions 54 which engage with lateral extensions 20 on the lateral sections 11, which in turn are adapted to engage base parts 51 on the machine when the center core is moved to pouring position generally as shown in the patents referred to.

As shown, the external surface of the core assembly has a recess 14 with a projection 42 thereabove, in order to provide on the inside of the piston a ledge such as an inward annulus, 43, Figure 3. The lower part of the projection 42 is inclined to present a cam face and to form a complementary cam face on the upper part of the ledge cast on the piston. It will be apparent that in such a construction, the center core, including sections 10 and 11 cannot be withdrawn from the piston unless a special construction is provided. However, when the middle core assembly is withdrawn, then the side sections 12 may be moved into the space occupied by the middle core, in a manner as described in the patents.

As shown, the inner core section 10 has assembled therewith the pair of lateral sections 11, each of which is adapted to slide relatively along the inner section. The engaging faces may also be inclined upwardly towards the center of the inner section as in Patent 1,993,439. The inner section 10, however, has spaced therealong a series of sets of recesses 21 and projections 44 providing abrupt cam faces 22, and each lateral section 11 has spaced therealong a corresponding series of sets of recesses 23 and like projections 45, providing abrupt cam faces 24. The recesses and projections on the lateral sections 11 are thus complementary and mesh with the recesses and projections on the inner sections 10 when the sections are slid relatively to move the lateral section parallel to and against the inner section.

The core shaped to the interior of the piston therefore comprises an inner section and a lateral section permanently held in assembled relation to slide relatively while so held, but to remain parallel. The lateral section has an inwardly extending recess for molding an inwardly projecting ledge on the piston, which section has a projection extending outwardly above the recess. The inner and lateral sections have a series of sets of cooperating meshing cam elements on their inner engaging faces, and which are spaced therealong. These elements, however, project laterally to extend corresponding to said projection and cooperate 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.

The bottom of the section 10, i. e. its extensions 54 is arranged to abut against the extensions 20 on each section 10 at 25, and short cam faces 25 are provided at the bottom of each section 11 for cooperation with like cam faces 56 on section 10 as shown. In order to hold the sections 10 and 11 in assembled relation, a screw 27, threaded into each section 11 is provided with a flat head 28 adapted to lie in a slot 29, undercut laterally to provide an inside shoulder 30 extending along the inclined outer face of the section 10. In order to permit insertion of the head in the slot, the head may be narrow on one dimension to permit such insertion, so that when the head is in the slot and the head turned, it will extend behind the shoulder 30. That is a well known construction in mechanics in general, the insertion of the head in the slot being accomplished while the sections are held at right angles.

When the parts are in the position shown in Figures 1 and 2, the core sections will form a construction conforming to the inside of the piston. At this time complementary projections 44 and 45 will be in engagement to hold the lateral sections 11 extended on the inner section as shown, while the cam recesses between the inner and lateral sections will be closed at their ends by the side sections 12 and the side sections will complete the core structure. Assuming now that the outer mold halves are in position to form the outside of the piston 58 and its gate 59, the casting metal such as aluminum is cast in the mold and over the core as described, for instance, in Patent No. 1,952,199.

Assume now, Figure 1, that the piston metal has been cast over the core and solidified with the metal filling the recess 14 to form the ledge 43 in the piston, and assuming that the metal has set. Upon withdrawal of the middle section from the piston casting, the lateral sections 11 will first be held against movement by the ledge 43 in the casting filling the recess, causing the inner section 10 to slide with respect to the lateral sections 11. Upon the first movement of the middle section 10 with reference to the lateral sections 11, the engagement of the inside faces of the shoulder 30 with the head 28 will initially move the side sections in but only to an extent determined by the inclination of the shoulder 30 as in Patent No. 1,993,439. Such action will, however, be to simply break the middle core away from the inside of the casting, for the actual release of the core and particularly from the ledge 43 will be accomplished as follows:

The downward movement of the inner section with respect to the lateral sections 11 will continue while the projections 44 and 45 move into their respective recesses 21 and 23 as shown in Figure 3. During that time the lateral sections will move towards and collapse against the inner section, caused by the "cam" action of the complementary cam faces on ledge or annulus 43 on the casting, on the projection 42 on the lateral section, while the head 28 simply moves further laterally into the slot 29 and away from the shoulder 30. After the ledge annulus 43 is cleared by the projection 42, the entire middle core assembly will move down below the side section 12 so as to permit the side sections to move into the space left by the middle section. The piston casting will then be left standing on the side core sections 12 and can then be picked off; for the side sections 12 will move in sufficiently to clear even an annular projection like 43 inside of the casting. By reversal of these movements the core sections are again placed in assembled relation as shown in Figure 1.

In order to further explain the above operation, it will be noted that after the metal has been cast upon the core, as shown in Figure 1, the casting will, after solidification, begin to shrink on the core so as to not only adhere to lateral sections 11, but to force these lateral sections against the inner section 10, as well as to force the side sections 12 against the lateral sections. There will, therefore, be frictional drag between the inner section 10 and the lateral sections 11, so that upon downward movement of the inner section 10, it will tend to drag the lateral sections 11 with it. While upon the initial downward movement of the inner section 10, the inclination of the shoulders 30 will tend to move the lateral sections inwardly, such movement will be slight because of the slight inclination; how-

ever, there will again be frictional drag between the heads of the screws 27 and the shoulders 30. The slight inclination will simply be to break the adhesion or the incipient weld between the casting and the lateral sections. The frictional drag between the lateral sections and the inner section will continue, tending to drag the lateral sections down until the projections 44 and 45 move into the respective recesses 21 and 23. However, then the cooperation of the cam face on the projection 42 on the lateral sections with cam face of the ledge 43 on the casting will keep up the frictional drag between the lateral sections and the inner section, while cam faces 22 and 24 on the sections permit inward movement of the lateral sections as the cam faces of 42 and 43 move the lateral sections inwardly. It will be understood, of course, that the inner section 10 is moved downwardly rapidly because such movement is accomplished hydraulically as in Patent No. 1,952,199, so that frictional drag effectively comes into play to secure the above described operation. The final result will be that the parts will reach the position shown in Figure 3 where the projections 42 will have cleared the ledge 43. Thereafter, the entire core will move further down from the position shown in Figure 3 with the projections 42 passing the ledge 43. Thereafter, the entire middle section 10-11 can move down entirely clear of the casting, because any tendency for the lateral sections to again move outwardly is prevented when the projections 42 of the lateral sections come opposite the ledge 43 on the casting. However, as will be seen from Figure 3, the projections 44 and 45 are somewhat shorter than the recesses 21 and 23 so that some idle movement is provided for.

In order to prevent dubbing or damage to the upper corner 35 of the inner section by the cam surface 36, the top cam projections 37 are made shorter than the remaining cam projections 44 and 45, and the recesses 67 in the sections are longer than 21 and 22 therebelow. Accordingly, the cam surface 36 will have cleared the corner 35, while the other cam parts 44 and 45 are still in full engagement. As shown, this construction causes the engaging sections to ride upon the intermediate projections 44 and 45 while the projection 37 is still free at the top of the core. Likewise, the projection 38, at the bottom of the inner section 10 is made shorter than are the intermediate projections 44 and 45 and the cam surfaces 26 and 56 are provided. It will thus be seen that the upper corner 35 is never engaged by the face 36; when the lateral section 11 is moved from Figure 1 to Figure 3 positions, for the cam faces 22 and 24 below 36 will engage to move the side sections out before the face 36 reaches the corner; thereafter the faces at 37 will simply slide relatively. Upon reverse movement of the sections 10 and 11, from Figure 3 to Figure 1 positions, the cam sections 44 and 45 will engage and will remain in engagement until the cam faces 36 have passed the corners 35 at the top of the core so as to again avoid dubbing. Wearing of the core corners at the top, and the formation of objectionable casting fins is therefore avoided.

After the inside core 10-11 has moved below the side section 12, after the side sections have moved into the space left by the inside core and after the outer mold sides are moved away from the casting, the piston casting may be picked off in the manner described in Patent No. 1,952,199. The machine is then placed in condition for another pouring by moving the side cores out and

by raising the middle core, causing the parts to resume the position shown in Figure 1. During that movement, the projections 44 and 45 will move out of the recesses 21 and 23 by the inter-engagement of the cam faces 22 on the projections.

This invention enables a casting having inside recesses to be produced 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 middle 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 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.

Having thus described the 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 held in assembled relation to slide relatively, said lateral section having a recess for molding said ledge and having a projection above the recess, the lower part of said projection having a cam face to form a cam face on the upper part of the ledge, and meshing projections on the interengaging faces of the sections adapted to hold them extended laterally and meshing with recesses therein adapted upon relative sliding movement of said sections and by engagement of said cam faces to collapse said lateral section against said inner section.

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 held in assembled relation to slide relatively, said lateral section having a recess for molding said ledge and having a projection above the recess, the lower part of said projection having a cam face to form a cam face on the upper part of the ledge, and meshing projections on the interengaging faces of the sections adapted to hold them extended laterally and meshing with recesses therein adapted upon relative sliding movement of said sections and by engagement of said cam faces to collapse said lateral sections against said inner section, the top meshing projection being formed to clear the top of the core before the sections are extended or collapsed.

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 comprising, an inner section and a lateral section held in assembled relation to slide relatively, said lateral section having a recess for molding said ledge and having a projection above the recess, the lower part of said projection having a cam face to form a cam face on the upper part of the ledge, and meshing projections on the interengaging faces of the sections adapted to hold them extended laterally and meshing with recesses therein adapted upon relative sliding movement of said sections and by engagement of said cam faces to collapse said lateral section against said inner section, the meshing projection at the top of the core being shorter than the meshing projection therebelow.

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 held in assembled relation to slide relatively, said lateral section having a recess for molding said ledge and having a projection above the recess, the lower part of said projection having a cam face to form a cam face on the upper part of the ledge, meshing projections on the interengaging faces of the sections adapted to hold them extended laterally and meshing with recesses therein adapted upon relative sliding movement of said sections and by engagement of said cam faces to collapse said lateral section against said inner section, and side sections cooperating with said inner and lateral sections to complete the core and movable into the space vacated by said sections.

5. 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, and 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.

6. 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, and 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 by engagement of

said projection with the ledge of the casting, upon sliding of said inner section with respect to said lateral section and while the lateral section is held against longitudinal movement by the casting to move said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge.

7. 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, the lower part of said projection having a cam face to form a cam face on the upper part of the ledge of the casting, and 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 by the casting and by engagement of said cam faces to move said lateral section toward and against said inner section in order to retract said projection inwardly to clear said ledge.

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