

Dec. 17, 1940.

R. W. ANDREWS, JR., ET AL

2,225,292

WORK-HANDLING MECHANISM

Filed Aug. 3, 1939

4 Sheets-Sheet 1

Fig. 2.

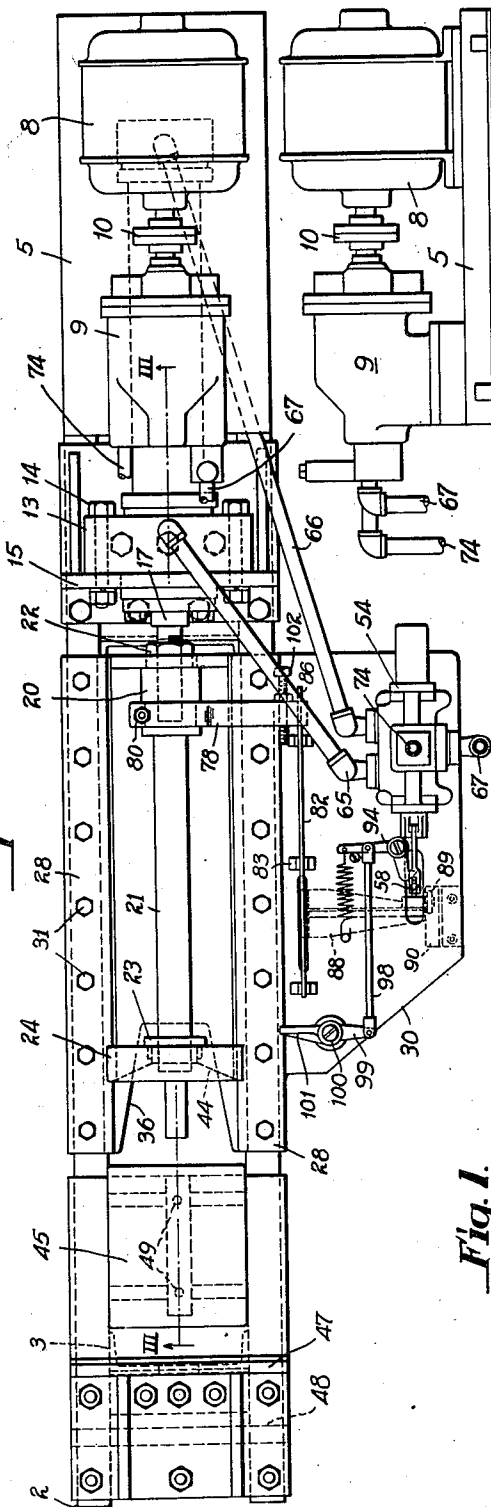
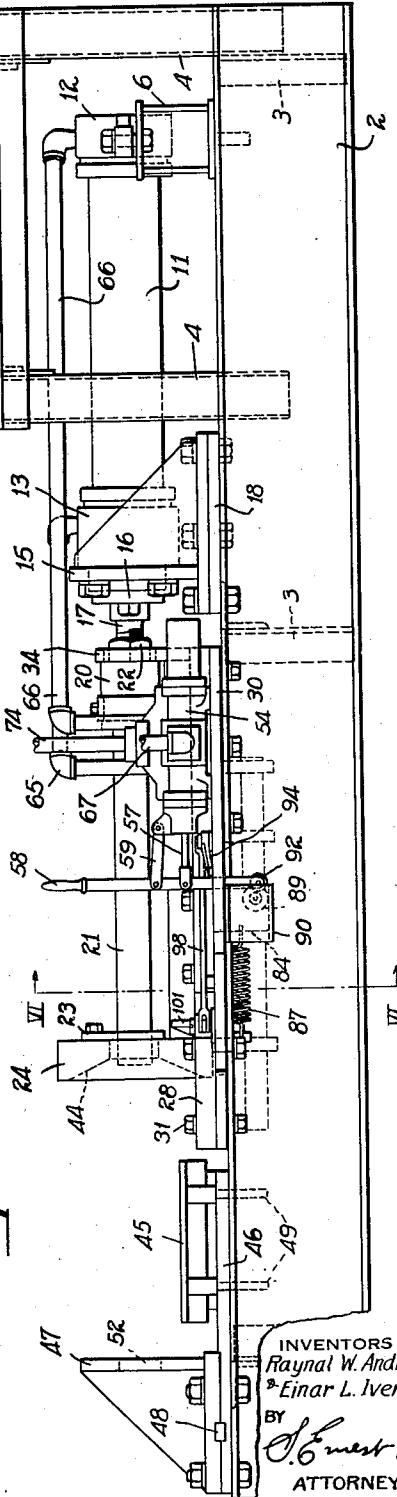


Fig. 1.



INVENTORS
Raynal W. Andrews Jr.
Einar L. Iverson
BY *S. Ernest Low*
ATTORNEY

Dec. 17, 1940.

R. W. ANDREWS, JR., ET AL

2,225,292

WORK-HANDLING MECHANISM

Filed Aug. 3, 1939

4 Sheets-Sheet 2

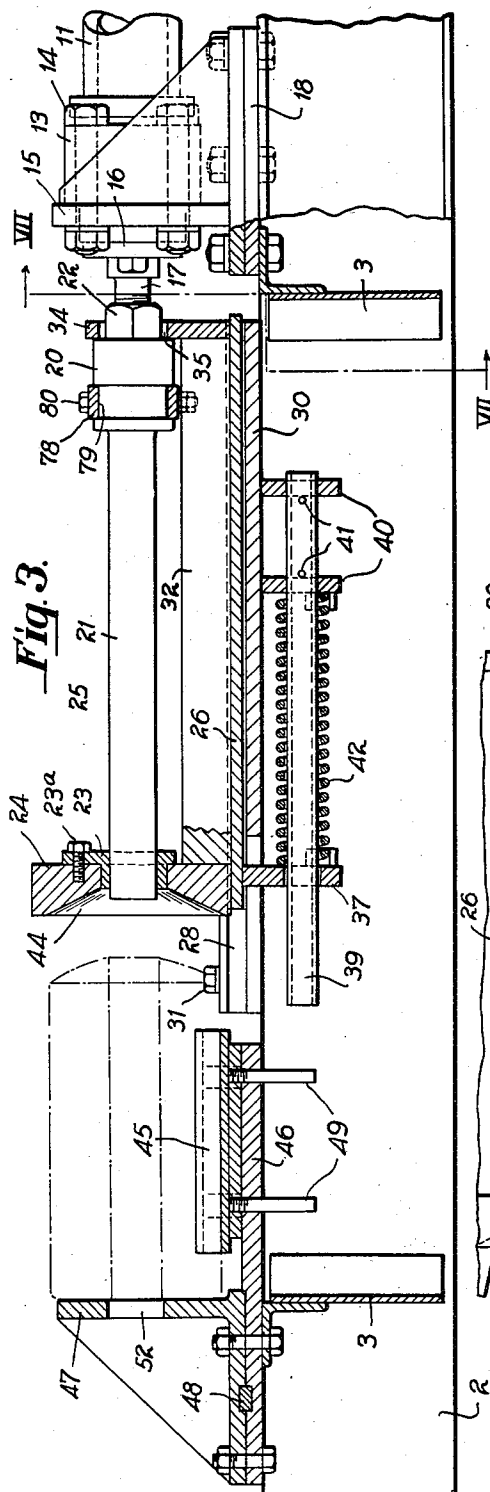


Fig. 3.

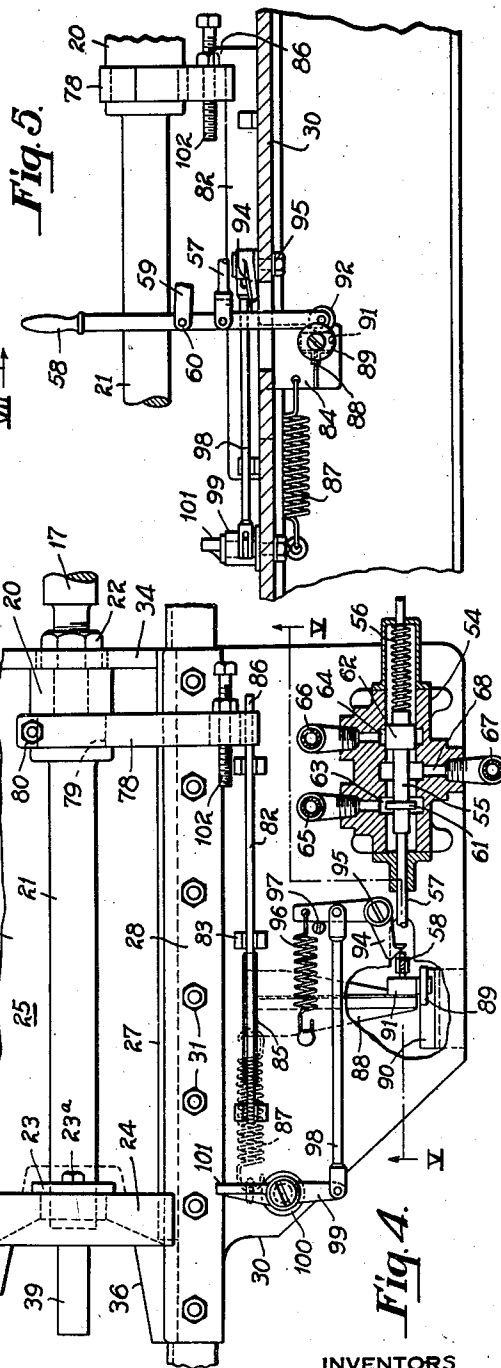


Fig. 5.

Fig. 4.

INVENTORS
Raynal W. Andrew's Jr.
& Einar L. Iverson
BY *J. Ernest Low.*
ATTORNEY

Dec. 17, 1940.

R. W. ANDREWS, JR., ET AL

2,225,292

WORK-HANDLING MECHANISM

Filed Aug. 3, 1939

4 Sheets-Sheet 4

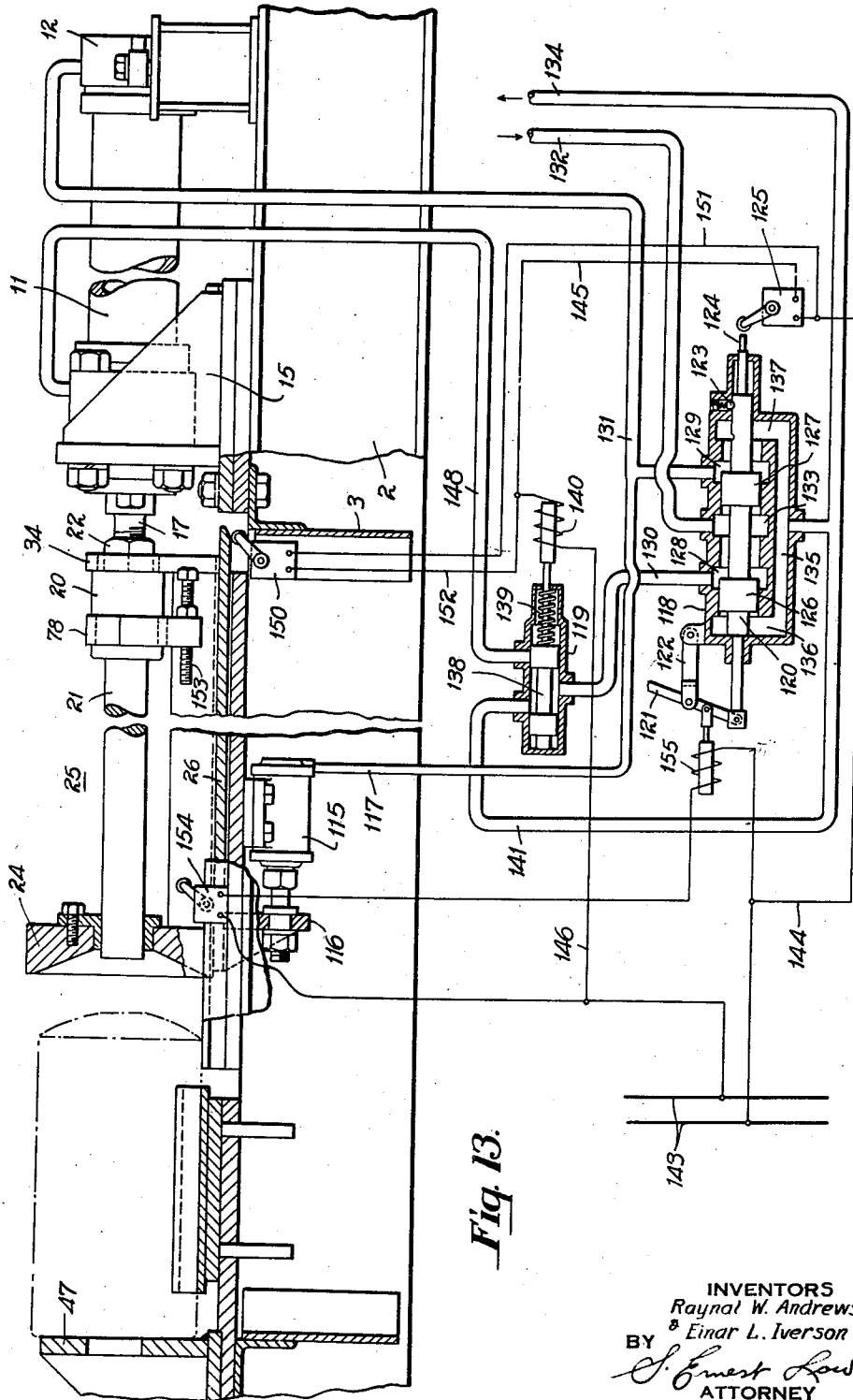


Fig. 13.

INVENTORS
Raynal W. Andrews Jr.
& Einar L. Iverson
BY *J. Ernest Lewis*
ATTORNEY

UNITED STATES PATENT OFFICE

2,225,292

WORK-HANDLING MECHANISM

Raynal W. Andrews, Jr., and Einar Lars Iverson,
New Kensington, Pa., assignors to Aluminum
Company of America, Pittsburgh, Pa., a corpo-
ration of Pennsylvania

Application August 3, 1939, Serial No. 288,162

18 Claims. (Cl. 22—93)

Our invention relates to apparatus for effecting removal or separation of one body or member from another, such as separating castings from molds, and more particularly to apparatus for removing or ejecting the cores of hollow cast billets or ingots.

Pierced or hollow ingots, i. e., ingots having longitudinal bores, such as those used for the extrusion of seamless tubing, are usually cast around a core consisting of a steel bar or pipe. Considerable adhesion exists between the metal ingot and the core, so that high working pressures are required to effect loosening and removal of the core from the ingot. Machines heretofore proposed for this purpose usually comprise a support for the ingot, an abutment and a hydraulically actuated plunger adapted to push the core from the ingot. In these machines, prior to and during the ejecting operation, difficulty has been experienced in supporting and maintaining the ingot in position with the core aligned with the plunger. In some cases, clamping mechanism has been employed, but usually such clamps operated in directions parallel to the axis of the ingot and plunger so that there existed the danger of lateral shifting of the ingot with consequent bending or breaking of the plunger or other parts of the equipment. In another type, the clamps operated perpendicularly to the axis of the ingot, but required overhead framework obstructing efficient manipulation of the work. Considerable time was lost in adjusting and releasing the clamps, and, since such machines were manually operated, constant supervision was required by the operator. For these and other reasons, such machines had a low operating efficiency.

One object of our invention is to provide an improved automatic power implement. Another object is to provide a stripping apparatus having a high operating efficiency and one in which castings may be separated from their cores rapidly. A further object is to provide means operable during advance movement of the work-engaging tool or plunger for centering and clamping the work-piece, in which the tool is supported by such centering and clamping means while the tool performs its operation upon the work-piece. A further object of the invention is to provide an improved ejecting or extracting machine that is automatically operable through an ejecting cycle, in which the ingot is automatically positioned to align its core for engagement with a reciprocable plunger and the ingot automatically clamped upon advance of the plunger, together

with means for automatically effecting return movement of the plunger after the core has been extracted and to effect release of the ingot during retraction of the plunger. Still another object of the invention is to provide an automatic core-extracting machine of generally simplified and improved form.

Briefly stated, the invention herein described comprises a power tool, a tool-supporting member which, upon relative movement between the work-piece and the tool, automatically clamps the work-piece in proper position during the working operation and automatically releases the work-piece after completion of said operation, and means for automatically controlling the movement of said power tool.

In the interest of convenience, the invention is hereinafter described and illustrated with reference to a power tool for ejecting cores from ingots. However, it is to be understood that the invention is not limited to such use but is capable and adaptable to other uses. For example, it may be employed for ejecting castings or ingots from molds, and by substituting suitable tools for the pusher element herein shown, hole-punching, broaching or reaming, and similar operations, in the shaping and forming of objects may be effected.

In the accompanying drawings, some of the forms which our invention may take are shown, wherein:

Fig. 1 is a side elevation of the machine with a part of the frame cut away; Fig. 2 is a plan view of the machine of Fig. 1; Fig. 3 is a view on an enlarged scale taken on the line III—III of Fig. 2; Fig. 4 is a fragmentary plan view of a portion of the apparatus of Fig. 3; Fig. 5 is a view taken on the line V—V of Fig. 4; Fig. 6 is a view on an enlarged scale taken on the line VI—VI of Fig. 1; Fig. 7 is a view taken on the line VII—VII of Fig. 3; Fig. 8 is an end view of the centering and clamping member of Fig. 3; Fig. 9 is a longitudinal sectional view of the control valve employed for controlling flow of fluid to the power-actuated tool; Fig. 10 is an elevational view, partly in section, showing a modified ingot-clamping arrangement; Figs. 11 and 12 are side and end elevational views, respectively, of the ingot support employed in the structure of Fig. 10; and Fig. 13 is a view similar to Fig. 3, showing a modified apparatus, the control mechanism therefor being shown somewhat diagrammatically.

Referring to Figs. 1 to 9 of the drawings, a suitable supporting frame is provided and is here

shown as comprising two parallel channels 2 that are connected at suitable longitudinally spaced points by transverse members or diaphragms 3. At the rear end of the framework, uprights 4 are secured to the channels 2 and support an elevated platform or table 5. A motor 8 and a pump 9 are supported on the table 5, the shafts of the motor and the pump being connected by a coupling 10.

Beneath the table 5 is a cradle or small platform 6. A power cylinder 11 is disposed with its axis parallel to the channels 2, and at one end, is provided with a cylinder head 12 which is bolted or otherwise suitably secured to the cradle 6. At its other end, the cylinder 11 is provided with a collar 13 which is secured by means of bolts 14 to a supporting bracket 15. Axial movement of the cylinder 11 is resisted by the bracket 15, while the head 12 is permitted to move slightly relative to the cradle 6 to take care of stretch of the cylinder under load. The cylinder 11 is provided with the usual stuffing box 16 which extends forwardly through the upright portion of the bracket 15, through which stuffing box a piston rod 17 operates. The piston rod 17 is secured to a suitable piston contained within the cylinder 11. The bracket 15 is supported on a transverse plate 18, the bracket and the plate being secured to the top flanges of the side rails or channels 2.

The forward end of the piston rod 17 has screw-threaded connection with an enlarged shank portion 20 of a plunger 21, a locking nut 22 being provided to prevent loosening of the plunger relative to the piston rod 17. At its forward end, the plunger 21 extends through, and is supported by, a bushing 23 which is carried by a centering and clamping head 24. The bushing is firmly held by a suitable means such as a bolt 23a (Fig. 3) and is easily removed so that suitable bushings for different diameters of plungers may be substituted when desired. The head 24 is carried by a clamping slide indicated generally by the numeral 25.

As shown more clearly in Figs. 3, 4, and 6, the slide 25 comprises a plate 26, along each edge of which is secured a bar 27 that operates in a slide way 28. The slide ways 28 are disposed on a stationary supporting plate 30, the ways 28 and the plate 30 being secured to the top flanges of the channels 2 by means of suitable bolts 31. The clamping slide member 25 is provided with a longitudinally extending supporting web 32 which at its forward end supports the aforementioned block 24 in an upright position, and at its rear end is secured to a cross plate 34, which in turn is suitably secured to the base plate 26. The cross plate 34 is provided with an opening 35 which is sufficiently large to accommodate the lock nut 22, but is, however, of smaller diameter than the enlarged portion 20 of the plunger 21. As will be hereinafter seen, the plunger 21 may be moved forwardly, together with the slide 25, and the plunger can also be advanced appreciably relative to the slide. Likewise, upon return or retractive movement of the piston and plunger, the enlargement 20 of the plunger will engage the cross plate 34 and cause the slide 25 to be retracted.

At its forward edge, the stationary plate 30 is cut away at points between the channels 2, as indicated by the numeral 36 (Fig. 2). Secured to the underside of the plate 26 of the slide 25 is a bracket or arm 37 which extends downwardly through the cut-out portion 36 of the plate 30.

The arm 37 is perforated for slidably receiving therein a tube or bar 39 which is disposed in parallelism with the plunger 21. At its rear end, the bar 39 is supported by a pair of transversely extending plates 40 that are secured to the underside of the plate 30 and to the webs of the channels 2. Pins 41 extend through the tube adjacent to the sides of the plates 40, thereby holding the tube against shifting movement in an axial direction. A spring 42 is carried by the tube 39 and is disposed between the arm 37 and its adjacent cross plate 40. This spring is under compression for all positions of the slide 25, whereby the spring will cause the slide to move forwardly from its normal retracted position in unison with forward movement of the plunger 21.

The face of the head 24 is provided with an annular bevelled recess 44 so that when the slide moves forwardly the convex or arcuate shaped end of a work-piece will be received in the recessed face of the clamping head 24 and the work-piece brought into axial alignment with the plunger 21. The work is adapted to be supported on a cradle 45 which is supported on a stationary cross plate 46. An abutment or anvil 47 is also supported on the plate 46, the abutment and the plate being keyed together by means of a transversely extending key 48, and they are also bolted or otherwise secured to the frame members 2.

The cradle 45 is provided with a pair of downwardly extending pins 49 that extend through openings provided therefor in the plate 46, whereby the cradle may be adjusted vertically with respect to the axis of the plunger by suitable means, such as vertical adjusting screws or shims interposed between the cradle and the plate 46. Thus the position of the cradle may be adjusted to accommodate the machine to operate upon ingots or work-pieces of various diameters. Since, for a given size ingot, the diameters do not vary materially, this adjustment needs to be made only once when working upon ingots of a given weight, and it can be adjusted to the proper position to receive ingots of other weights and diameters when the occasion arises.

From the description thus far set forth, it will be apparent that with the plunger and clamp slide in retracted position, a casting or ingot containing a core to be extracted may be positioned upon the saddle 45, whereupon fluid under pressure may be admitted to the rear end of the cylinder 11 to effect forward movement of piston rod 17 and plunger 21. As the plunger moves forwardly, the spring 42 causes the slide 25 to advance in unison therewith. When the plunger engages the end of the ingot, it forces the ingot against the abutment 47 while the clamping head 24 engages the convex end of the ingot; and by reason of the contour of the recessed face thereof, the ingot is caused to be centered with respect to the axis of the plunger and also securely clamped in position against lateral or radial shifting relative to the plunger 21. The slide clamp 25 also serves to clamp the ingot against the abutment to prevent axial shifting thereof. The abutment 47 is provided with an aperture 52 which is of a diameter to permit passage of the core there-through, this aperture being in alignment with the plunger.

As the pressure in the cylinder 11 builds up to a point sufficient to overcome the adhesion of the metal of the ingot with the core, the core is loosened and the plunger moves forwardly relative to the clamping device and the ingot a dis-

tance sufficient to push the core completely through the aperture 52, whereupon fluid pressure is admitted to the front end of the cylinder 11, exhaust from the other end thereof being provided for in a manner hereinafter described, and the plunger retracted. During retractive movement of the plunger, the shoulder or enlargement 20 engages the member 34 of the slide 25 and returns the slide to normal position against the pressure of the spring 42.

Thus during preliminary movement of the plunger 21 and clamp slide 25, the ingot is forced against the abutment 47 and is automatically positioned to align its core for engagement with the plunger, while at the same time the ingot is automatically clamped in position to be operated upon by the plunger. Also, the ingot is automatically released upon retraction of the plunger. Prior to and during the actual ejecting operation, the bushing 23 supports the plunger 21 against displacement in lateral directions and also guides the plunger as it moves through the ingot during extraction of the core.

Control of flow of fluid pressure to the cylinder 11 is effected by means of valve mechanism that is preferably supported upon the plate 30. Referring more particularly to Figs. 4, 6, and 9, the valve mechanism comprises a suitable housing 54 in which is slidably mounted a valve-spool member 55. A spring 56 is interposed between one end of the member 55 and a wall of the casing or housing 54 so as to normally urge the member 55 to the left, as viewed in Figs. 4 and 9. At its opposite end, the valve-spool 55 carries a suitable stem 57 which extends through a suitable packing gland secured to the housing 54, and at its outer end is pivotally connected to an operating lever 58. A link 59 is pivotally connected to the lever 58 and to the valve housing 54, whereby the lever 58 may be rocked about the point 60 to shift the spool 55 to the right against the pressure of the spring 56; or by releasing the lever 58, the spring 56 will shift the spool to its other extreme position.

The spool 55 is provided with a pair of axially spaced enlargements forming valve members 61 and 62 that cooperate with annular ports 63 and 64, respectively, to control flow of fluid through pipes or conduits 65 and 66, respectively. The pipe 65 connects with the front end of the cylinder 11 and the pipe 66 connects with the rear end thereof. Fluid under pressure is delivered by the pump 9 through a conduit 67 to a port 68 (Fig. 4) in the valve housing intermediate the spaced ports 63 and 64. Exhaust ports 70 and 71 are formed in the housing 54 adjacent to the ends thereof, and are connected by a passageway 72, a duct 73 establishing communication between the passageway 72 and an exhaust pipe or conduit 74 leading to the low pressure side of the pump.

With the spool 55 in its neutral position, that is, with the lever 58 in upright position N, as indicated in Fig. 9, the valve member 62 cuts off flow through the associated port 64, while the valve member 61, which is of narrower axial width than the annular port opening 63, is centered with respect to its port opening, thereby forming a by-pass for flow of the fluid through the valve. Fluid flows, therefore, through pipe 67, port 68, past valve member 61 to valve-exhausting means 70, 72 and 73, from whence it flows through pipe 74 to the low pressure side of the pump. Thus, the pump may be constantly operated, the fluid merely being circulated

through the system when the valve is in its neutral or by-passing position.

When it is desired to admit fluid pressure to the rear side of the cylinder 11, the lever 58 is moved in a counter-clockwise direction to the dotted line position F in Fig. 9, thereby shifting the spool member 55 so that its valve members 61-62 are positioned to the right of the ports 63-64. In this position of the valve, the member 61 is moved out of by-passing position relative to port 63 and the port 64 is uncovered, so that fluid under pressure is no longer diverted but flows through the port 64 and pipe 66 to the rear end of cylinder 11. Exhaust from the opposite end of the cylinder 11 is effected through conduit 65, port 63, along the valve stem to exhaust port 70 and through passageway 72, duct 73, and pipe 74 to the low pressure side of the pump.

Likewise, when the spool 55 is moved to its reverse position, with the lever 58 in dotted line position R (Fig. 9), the valve members 61 and 62 are positioned to the left of ports 63-64, whereupon fluid under pressure is directed through port 63 to the forward end of the cylinder 11 while exhaust from the rear end thereof is effected through the conduit 66, port 64, to exhaust port 71 communicating with the return line 74.

Means are provided for automatically actuating the control valve in order to effect automatic operation of the plunger 21 through a complete ejecting cycle. Referring more particularly to Figs. 4, 5 and 6, the mechanism for automatically controlling operation of the valve includes a curved arm 78 which is bifurcated at one end and embraces a reduced portion 79 of the boss or enlargement 20 of the plunger 21, and is clamped thereon by means of a bolt 80. The other end of the arm 78 is slotted, as indicated at 81 (Fig. 6), and slidably engages the upper side of a drag bar 82. The bar 82 is slidably supported on the plate 30 by means of guide blocks 83, and is provided with a projection 84 which extends downwardly through a slot 85 in said plate 30. The drag bar 82 is provided with an upstanding lug 86 which is located behind the arm 78 so that when the plunger 21 is retracted the arm 78 will engage the lug 86 and retract the bar 82 also.

One end of a spring 87 is secured to the plate 30, while its other end is secured to the depending arm portion 84 so that the drag bar 82 will be moved forwardly, that is, toward the ingot, when the plunger 21 advances. An arm 88 is secured at one end to the member 84, and at its other end carries a roller 89 which is supported on a track 90 suitably secured to the underside of the plate 30. The arm 88 carries a block 91 (Figs. 4 and 5) that is adapted to engage a roller 92 secured to the lower end of the valve lever 58, which lever extends downwardly through a slot provided in the plate 30.

With the slide and plunger in their retracted positions (extreme right as viewed in Fig. 3), the drag bar 82 is maintained in such a position that the block 91 will maintain the valve lever 58 in its neutral position so that the pump is by-passed by the valve connections heretofore described. When it is desired to move the plunger through an ejecting cycle, the lever 58 is manually moved to the dotted line position F (Fig. 9), whereupon the valve-spool member 55 is moved into position to establish pressure flow to the rear end of the cylinder 11 and exhaust from the front end, as 75

heretofore described. As shown more clearly in Figs. 4 and 5, the lever 58 moves behind a latch 94 which is pivotally mounted at 95 upon the plate 30, the latch serving to retain the lever in its forward position F against the tension of the spring 56. The latch 94 is yieldably maintained in latched position by a spring 96, a stop 97 serving to limit swinging movement of the latch in one direction. A push rod 98 is pivotally connected at one end to the latch 94, and at its other end to a release lever 99 which is pivotally mounted at 100 on the plate 30. The lever 99 is provided with an arm 101 that is disposed in the path of movement of a screw stud 102 that is adjustably supported in the curved arm 78.

During forward travel of the plunger (toward the left as viewed in Fig. 3), the clamping slide 25 and the drag bar 82, and the parts connected thereto, move forwardly toward the ingot, the block member 91 carried by the drag bar 82 being moved a sufficient distance to permit the valve lever 58 to move from its position F to its position R under the influence of spring 56, when the latch 94 is released. The forward movement of the drag bar is terminated by engagement of the depending portion 84 thereof with the end wall of the slot 85 in the plate 30 through which it extends, the lug 86 of the drag bar 82 and the enlargement 20 of the plunger 21 preventing over-travel of the drag bar and the clamp slide during early stages of movement of the plunger.

The ingot is brought into centered position relative to the plunger and clamped in such position by the movement of the clamping block 24 into engagement with the convex end of the ingot, as heretofore described, whereupon the plunger continues its traveling movement to effect ejection of the core from the ingot. During this movement, the arm 78 merely slides along the drag bar 82. As the plunger approaches the point where complete ejection of the core is effected, the stud 102 engages the arm 101 of the lever 99 and moves the bar 98 in a direction to cause the latch to be swung in a clockwise direction, thereby releasing the valve lever 58.

The spring 56 thereupon moves the valve member 55 to its other extreme position so that fluid pressure is cut off from the rear side of the cylinder 11, and such pressure is directed to the front side of said cylinder to effect retraction of the plunger. During retraction of the plunger, the boss 20 thereof engages the cross piece 34 of the clamp slide 25, and the arm 78 engages the lug 86 of the drag bar 82, thus causing these parts to be returned in unison with the plunger. During return movement of the drag bar 82, the block 91 engages the roller 92 and moves the valve lever 58 to its neutral position N. Thus the valve 55 is shifted to its by-passing position, and retractive movement of the piston in cylinder 11 ceases with the plunger and the clamping device in normal retracted position.

The ingot with its core extracted may readily be removed from the cradle 45 and another ingot brought into position to be worked upon, the cycle of ejecting operations as heretofore described being repeated.

It will be seen that a minimum of attention is required by an operator to effect operation of the apparatus, since it is merely necessary for him to position an ingot on the cradle 45 and move the valve lever 58 to latched position, the operations of centering, clamping, and supporting the plunger during ejection of the core being au-

tomatically carried out and the parts returned to retracted position because of the above-described interlocking arrangement between the valve lever 58 and slide 25.

In the preferred form of the invention, a pump is employed which provides for flow of fluid under relatively low pressure and high volume when the load is low; but when the load increases to a certain point, it will automatically supply fluid under high pressure but at lower volume or pumping rate. Such pumps are of well known construction and are readily available. By using a pump of this type, the plunger 21 may be actuated at relatively high speed into engagement with an ingot and the high pressure employed only to effect loosening and ejection of the core from the ingot, whereupon the travel of the plunger is accelerated through delivery by the pump of fluid under high volume but low pressure. This effects a considerable saving in time in a core-ejecting cycle. The plunger is, of course, retracted by the use of the high volume rate fluid flow and is, therefore, returned more quickly than otherwise would be the case.

Referring to the modification shown in Figs. 10, 11, and 12, the abutment 105, which corresponds to the abutment 47 of Fig. 3, has in its face an ingot-centering recess 106 which conforms with the rounded end of the ingot and is concentric with an aperture 107 through which the core is pushed. The abutment 105 carries an auxiliary clamp 108 comprising a fluid cylinder 109 that contains a piston which is connected to a piston rod 110 provided on its lower end with a clamping member 111 of suitable shape. In this form of the invention, the ingot is supported on a support which preferably has a Y cross section, as shown more clearly in Fig. 12, the support being adjustably mounted in the frame of the machine in the same manner as is the previously described cradle 45. A clamping head 112 corresponds to the clamping head 24, but it may be adapted to engage the flat end of an ingot by inserting a disc adapter 113 which has a flat face on one side and conforms with the recess on the other side, which adapter may be welded or otherwise suitably replaceably secured in position.

In the operation of this modification of the machine, an ingot is placed upon the support with its rounded end toward the clamping head 105, the support being so adjusted that the core is approximately in line with the discharge aperture in the abutment. The clamping head and plunger are then actuated in the manner heretofore set forth, the clamping head and plunger engaging the ingot and forcing it into engagement with the centering recess in the abutment 105. Fluid pressure is then admitted to the upper end of the cylinder 109 to force the clamping member 111 into engagement with the upper side of the ingot. The plunger is then further advanced to eject the core from the ingot in the same manner as described in connection with the operation of the machine of Figs. 1 to 9. Successive ingots of substantially the same size may be aligned, clamped, and the cores removed therefrom without further adjustment of the ingot support. The form of the invention shown in Fig. 10 is particularly useful in cases where the core tapers down toward the flat end of the ingot and must therefore be ejected through the rounded end.

In the modified structure shown in Fig. 13, the core-ejecting mechanism is substantially the same as that shown in Figs. 1 to 9, and the same

reference characters have been applied to corresponding elements. In this structure, however, instead of employing the spring 42 for advancing clamp slide 25, we employ a cylinder 115 which contains a piston that is connected to a depending bracket 116 secured to the slide plate 26. Pipe 117 connects the rear end of the cylinder 115 to the feed line leading to the rear end of the power cylinder 11. Thus, when fluid pressure is admitted to the cylinder 11 to advance the plunger 21, the pressure is admitted also to the cylinder 115, and the clamping slide 25 advances in unison with the plunger.

Over-travel of the slide relative to the plunger is prevented by the cross plate 34. The ingot, therefore, is centered and clamped in position for ejection of its core. Since, as heretofore described, greater fluid pressure is utilized to initially loosen the core than that employed subsequently to eject the core, it will be apparent that the clamping forces will be greatest while the core is being loosened.

Automatic operation of the mechanism through an ejecting cycle is effected by means of a simplified control system, which includes a control valve 118 and an auxiliary valve 119. The valve 118 is provided with a slidable spool member 120 that is pivotally connected to an operating lever 121 having a pivoted fulcrum link 122. The spool 120 has two positions of control, and is shifted directly from one position to its other position. A spring-pressed detent 123 serves to retain the spool in each of its control positions. The spool is provided with a stem 124 which extends through the valve housing and is adapted to actuate a limit switch 125 for a purpose to be hereinafter described.

The valve-spool 120 is provided with spaced valve members 126 and 127 that cooperate with ports 128 and 129, respectively, to control flow of fluid through pipes or conduits 130 and 131, respectively. The pipe 131 is connected to the rear end of the cylinder 11, and the pipe 130 is connected to the auxiliary valve 119. The fluid from the pressure side of the pump (not shown) is delivered through a conduit or pipe 132 to a port 133 in the valve housing intermediate the ports 128 and 129. An exhaust conduit 134 is connected to a passageway 135 in the valve housing which connects with exhaust ports 136 and 137.

Thus, with the spool member 120 in its plunger-retracting position of control, as shown in Fig. 13, the valve members 126 and 127 are disposed to the left of their associated valve ports 128 and 129, and pressure is admitted to the pipe 130 leading to the auxiliary valve 119. In this position of the valve 118, the stem 124 is in retracted position relative to the switch 125, and the switch remains in its normal open position.

The auxiliary valve 119 is provided with a valve-spool 138 which is normally, yieldably maintained in one position by a spring 139. A solenoid or electromagnet 140 is operatively connected to the spool 138 in order to shift the spool against the pressure of the spring 139 when the coil of the electromagnet is energized. In the normal position of the valve communication is established between the pipe 130 and a conduit 141 which is connected to the exhaust conduit 134, thereby normally forming a by-pass for circulation of the fluid from the high pressure side of the pump to the low pressure side thereof, so that the pump can be constantly operated.

When it is desired to initiate a complete cycle

of ejecting movement, the lever 121 is moved in a counterclockwise direction, thereby shifting the spool 120 to its plunger-advancing position, wherein the members 126 and 127 thereof are positioned to the right of the ports 128 and 129. During such shifting movement of the spool, the stem 124 thereof operates the limit switch 125 to close an energizing circuit for the coil of the solenoid 140. This circuit extends from one side of a power line 143, conductor 144, through the closed contacts of the limit switch 125, conductor 145, through the winding of the solenoid 140, and through conductor 146 to the other side of the line 143. The solenoid 140 is thus energized to shift the spool 138, thereby interrupting circulation of fluid through the system by cutting off communication of the conduit 141 with the pipe 130. Shifting the spool 138 also establishes communication between the pipe 130 and a pipe 148 which is connected to the front end of the cylinder 11.

It will thus be seen that with the valves 118 and 119 actuated, as just described, fluid under pressure is permitted to flow through the pipes 131 and 117 to the rear ends of the cylinders 11 and 115, respectively, and fluid is permitted to exhaust from the front end of the cylinder 11 through pipes 148 and 130 to the exhaust port 136 in the valve 118, which is in communication with the exhaust conduit 134. Thereupon, the plunger 21 and the clamp slide 25 are moved toward an ingot, the ingot first being rigidly clamped and held in centered position relative to the plunger by the clamping head, the plunger continuing its movement relative to the slide to effect ejection of the core.

As the slide 25 moves from its normal retracted position, a limit switch 150, which is held in open position when the slide is retracted, is permitted to operate and close a holding circuit for the solenoid 140, so that the spool 120 may be shifted to its plunger-retracting position. The holding circuit through the limit switch 150 extends from the line 143 through conduit 144, conductor 151, through the closed contacts of the switch 150, through conductor 152 to the coil of the solenoid 140, and thence to the other side of the line through conductor 146.

As the plunger approaches the point where complete ejection of the core is effected, an adjustable stud 153, carried by the bifurcated arm 78, actuates a switch 154. The switch 154 completes a circuit for a solenoid 155 which is operatively connected to the lever 121, thereby causing the lever 121 to be swung in a clockwise direction and shift the valve-spool 120 to its plunger-retracting position. Flow of fluid under pressure to the rear ends of the cylinders 115 and 11 is thereby discontinued and exhaust from such cylinders effected through the port 129 and the exhaust port 137. Also, fluid pressure is admitted through the port 128, through the auxiliary valve 119 in its actuated position to the front side of the cylinder 11, thereby effecting retractive movement of the plunger 21. During such retractive movement, the enlargement 20 engages the cross piece 34 and causes the slide to be retracted. Thus the ingot is automatically released and the switch 154 is permitted to return to its normal open position, thereby breaking the circuit for the solenoid 155.

As the plunger and slide approach their normal retracted position, the slide plate 26 actuates the limit switch 150 to open the holding circuit for the solenoid 140. Thereupon, the spool 138 is

shifted by the spring 139 to its normal by-passing position, and interrupts fluid flow to the front end of the cylinder 11, whereby residual pressure in the cylinder will maintain the plunger and clamping device in normal retracted position. Thus the mechanism can be maintained in retracted position even when a power spring, such as the spring 42 (Fig. 3), is employed.

When it is again desired to initiate a complete cycle of operations, the lever 121 is shifted in a counter-clockwise direction, as heretofore described, and the control apparatus operates automatically to effect advance and return of the mechanism to their retracted positions.

Since clamping, aligning, core ejection, retraction of plunger, and releasing of the ingot are automatic in the machine above described, time is saved and efficiency increased. Further efficiencies are gained by automatic retraction of the plunger and clamping head, and the automatic termination of the plunger's return travel, thus affording more time for the operator to change ingots. This, in combination with the provision for rapid advance of the plunger and clamping head before contacting the core and the rapid ejection and retraction of the plunger after the core has been loosened, gives improved operating characteristics in apparatus of this type.

Various modifications may be made in the invention without departing from the spirit thereof, or the scope of the claims, and, therefore, the exact form shown is to be taken as illustrative only and not in a limiting sense, and it is desired that only such limitations shall be placed thereon as are imposed by the prior art, or are specifically set forth in the appended claims.

We claim:

1. In a machine for performing operations upon objects by relative movement between said objects and a tool in engagement therewith, comprising the combination with said tool, of a clamping means including a movable member in slidable engagement therewith, means carried by said member in position to engage and align an object with said tool, and means operable upon said relative movement for moving said member into engagement with an object, whereby said object is maintained clamped in alignment with said tool during the performance of said operations.

2. In a machine for performing operations upon objects by a reciprocable tool which engages said objects, the combination with said reciprocable tool, of clamping means including a movable member, and means operable to advance said tool and said member in unison into engagement with an object to maintain said object in position for the performance of said operations, said tool being adapted to further advance relative to said member to perform said operations.

3. In apparatus for removing cores from ingots, the combination with a plunger having a normal retracted position, of means operable to impart advancing movement to the plunger and effect ejection of a core, means operable to impart retractive movement to the plunger, means for controlling the operation of said plunger-retracting means, and a member movable with said plunger and operable during said retractive movement thereof for actuating said control means, thereby rendering said plunger-retracting means inoperative when the plunger reaches said normal retracted position.

4. In a machine for separating adhering objects wherein the objects are separated by means

of a plunger, the combination with said plunger and means for actuating the same, of a reciprocable member slidably supporting said plunger and operable to position said objects for separation, and means for advancing and holding said member in operative position effective upon advance of said plunger.

5. In a core-ejecting machine, the combination with a core-ejecting plunger, of advancing and retracting means for the plunger, control mechanism for said means including a shiftable member having an intermediate position in which said mechanism is neutral and being movable alternately in opposite directions to actuate said mechanism, thereby to control operation of said advancing and retracting means, resilient means for urging said member in a direction to effect operation of said retracting means, and means movable with said plunger for engaging said member during retraction of the plunger for moving said member to said intermediate position, whereby to terminate retraction of said plunger.

6. Apparatus for removing cores from ingots comprising an ingot support, an abutment having an aperture, a plunger aligned with said aperture, a slidably supported clamp block, the forward end of said plunger being slidably supported in said block for movement therethrough, means for moving the plunger and the block in unison toward said abutment to clamp an ingot endwise therebetween, said block having a bevelled ingot-engaging recess in its forward face concentric with said plunger for centering the ingot relative to said plunger and for maintaining the ingot against lateral shifting movement relative to said plunger.

7. A machine for ejecting cores from ingots comprising a reciprocable core-engaging plunger, a reciprocable member slidably supporting said plunger, means for forcing said member into engagement with one end of said ingot upon advance of said plunger, an abutment member having a perforation therein, said abutment member being positioned at the other end of the ingot to receive the force exerted by said plunger and reciprocable member whereby the ingot is clamped longitudinally, means associated with said member for engaging said ingot and aligning the core thereof with the said perforation and the said plunger, and means for advancing the plunger while the ingot is so clamped and aligned, whereby the core is ejected from the ingot through the perforation.

8. In apparatus for removing cores from ingots, the combination with a core-ejecting plunger, of a slidably supported clamping member having an ingot-centering recess in one face and slidably supporting the forward end of said plunger, and means for moving said plunger and said member in unison into engagement with an ingot, whereby to align the core thereof with said plunger and to maintain the ingot against shifting in axial and lateral directions during removal of said core by continued advance movement of said plunger.

9. Apparatus for removing cores from ingots comprising a support for an ingot, a fixed member at one end of the support, a movable member at the other end of the support, means for forcing said movable member toward said fixed member to clamp the ingot endwise therebetween, a plunger slidably supported at one end in said movable member, one of said members having an annular bevelled recess in one face

concentric with the plunger for engagement with an exterior surface of the ingot to align the core thereof with said plunger and to maintain the ingot against lateral shifting movement during continued movement of said plunger through the ingot to push the core therefrom.

10. In a core-extracting machine, the combination with a normally retracted plunger, of advancing and retracting means for the plunger, manually operable means for actuating said advancing means for moving the plunger to eject a core, means for holding said manual means in actuating position, means actuated by said plunger during its ejecting stroke for releasing said holding means, means operable in response to release of said holding means for rendering said advancing means inoperative and for actuating said retracting means, and means actuated by said plunger during retractive movement thereof for rendering said retracting means inoperative when said plunger reaches its normal retracted position.

11. In a core-ejecting machine, the combination with a core-ejecting plunger, a hydraulic cylinder having a piston for advancing and retracting the plunger, a plurality of valve means for controlling flow of fluid pressure to opposite ends of said cylinder, an operating member associated with said valve means and having an intermediate position wherein said valve means are inoperative, said member being movable in opposite directions alternately whereby one of said valve means is operative and the other is inoperative, means for holding said member in one position to effect advancement of said plunger, releasing means for said holding means actuated by said plunger during advance movement thereof, resilient means for moving said member to its other position to effect retraction of said plunger, and means movable with said plunger for engaging said member during retraction of the plunger for moving said member to its intermediate position.

12. In apparatus for ejecting cores from ingots, the combination comprising a core-engaging plunger, means for actuating the plunger to eject the core of an ingot, clamping means including a movable member for clamping the ingot during ejection of its core, and actuating means connected with said movable member and operable in response to ejecting movement of said plunger for forcing said member into clamping engagement with said ingot.

13. In apparatus for ejecting cores from ingots, the combination comprising a core-engaging plunger, means for actuating the plunger to eject the core of an ingot, clamping means including a movable member for clamping the ingot during ejection of its core, and actuating means connected with said movable member and operable in response to ejecting movement of said plunger for forcing said member into clamping engagement with said ingot, the said member being movable in a path substantially paralleling the path of movement of said plunger.

14. In apparatus for ejecting cores from ingots, the combination comprising an axially-movable core-engaging plunger, means for actuating the plunger to eject the core of an ingot, means including a movable member for clamping the ingot in a position with its core in alignment with said plunger, means for supporting said member for movement in a path substantially paralleling

the path of movement of the plunger, said plunger extending through said member and being slidably supported thereby in a complete circumferential direction, and means effective upon advancing movement of said plunger for moving said member into clamping engagement with said ingot.

15. In a machine for ejecting cores from ingots by action of a plunger, the combination with said plunger, of means for clamping the ingots including a movable member slidably associated with said plunger, means effective upon advancement of the plunger for moving said member into clamping engagement with an ingot, and lost-motion-connecting means between said plunger and said member for accommodating forward movement of said plunger with respect to said member after the latter has engaged the ingot and for retracting said member during retraction of said plunger.

16. In apparatus for ejecting cores from ingots, the combination with a core-ejecting plunger, of a support therefor in slidable engagement therewith, a multiple pressure source of fluid pressure, means for forcing said plunger and said support into engagement with the core and an ingot, respectively, by means of fluid from said source under low pressure, said pressure being automatically increased to high pressure after said ingot and its core have been engaged by said support and said plunger.

17. In ejecting apparatus, the combination with a reciprocable tool having a normal retracted position, of means for moving said tool comprising a piston and cylinder, reversible valve means movable into alternate positions to control flow of fluid pressure alternately to the opposite ends of said cylinder, to advance and retract said tool, said valve means being manually movable into one position to initiate advancement of said tool, means actuated by said advancing tool to shift said valve to its alternate position to retract the tool, and means actuated by said retracting tool to interrupt flow of fluid from said valve means, thereby rendering said tool-retracting means inoperative when said tool reaches said normal retracted position.

18. In ejecting apparatus, the combination with a reciprocable tool having a normal retracted position, of means for moving said tool comprising a piston and cylinder, reversible valve means movable into alternate positions to control flow of fluid pressure alternately to the opposite ends of said cylinder, to advance and retract said tool, said valve means being manually movable into one position to initiate advancement of said tool, means operatively connected to said valve means for shifting the same from said one position to its alternate position, means controlled by said advancing tool for actuating said shifting means, to effect retraction of said tool, a second valve means interposed between said valve means and the retracting end of said cylinder for controlling flow of retractive pressure to said cylinder, means controlled by said tool whenever it is out of said normal retracted position for maintaining said second valve open for flow of fluid therethrough, and means responsive to return of said tool to said normal position to close said second valve and cut off said retractive pressure to said cylinder.

RAYNAL W. ANDREWS, JR.
EINAR LARS IVERSON.