

Jan. 16, 1962

R. MARSH ET AL
POWDER ACTUATED TOOL

3,016,539

Filed June 25, 1957

2 Sheets-Sheet 1

FIG. 1

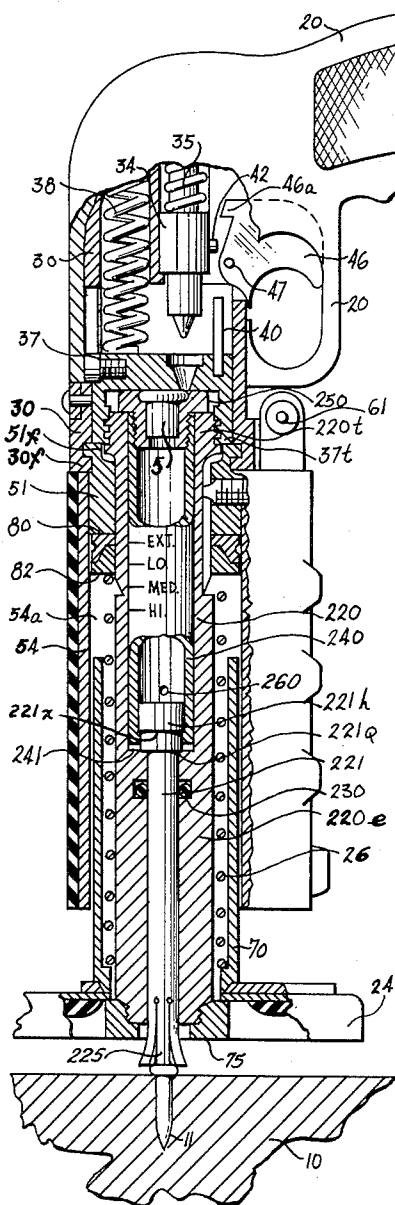


FIG. 2

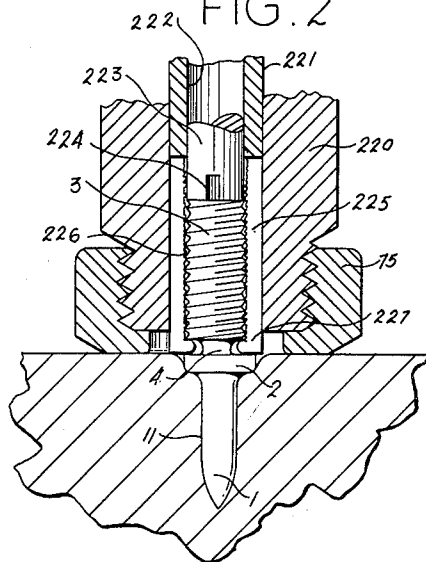


FIG. 3

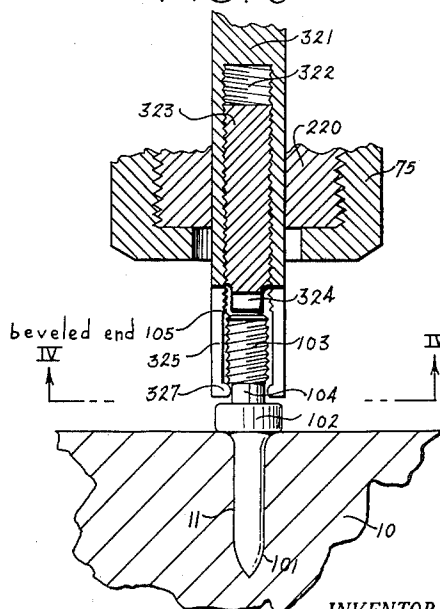
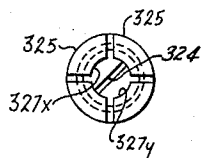


FIG. 4



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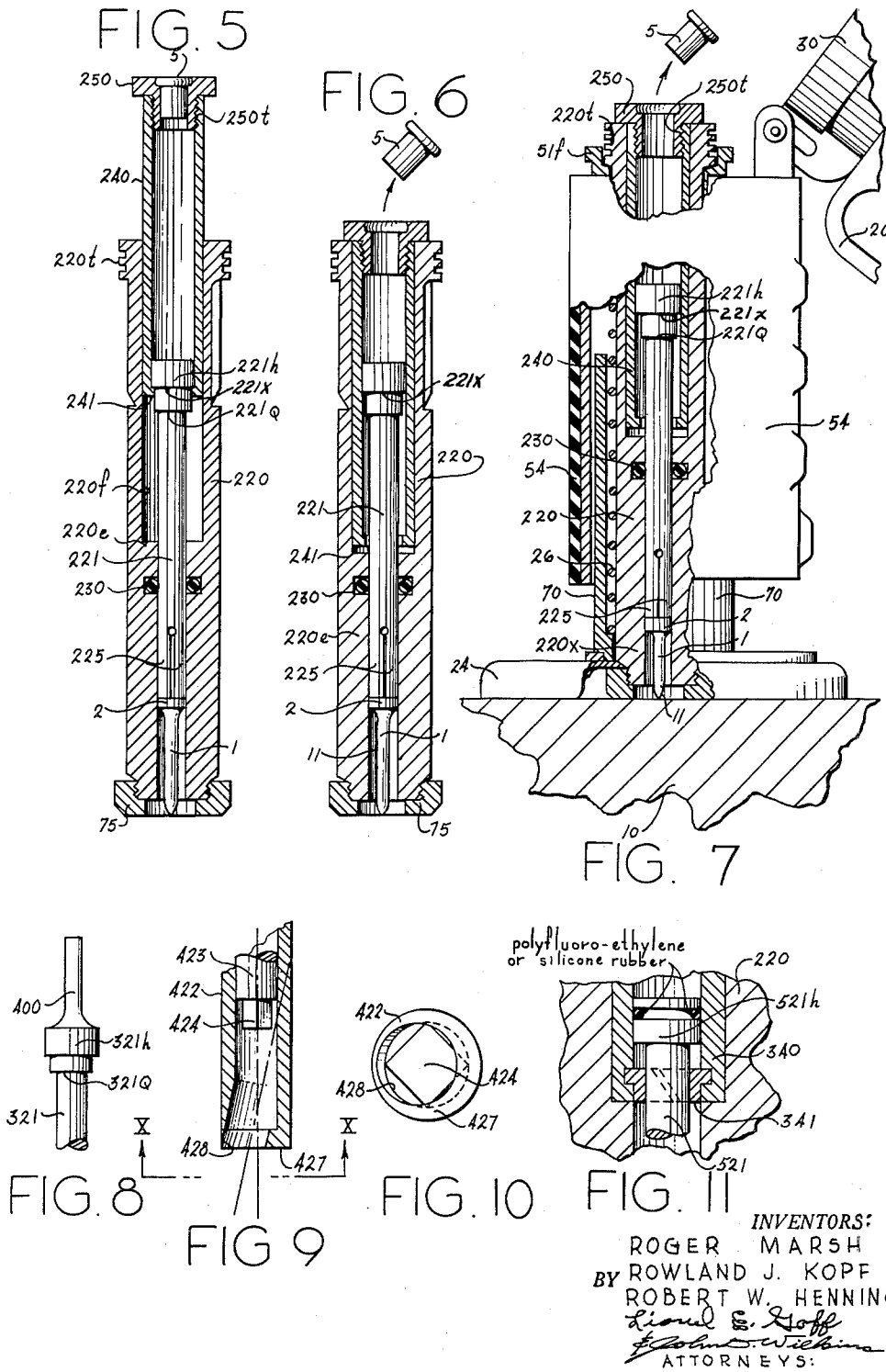
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POWDER ACTUATED TOOL

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9 Claims. (Cl. 1—44.5)

This invention relates to tools for driving various work members such as hammers, punches, cutters or fasteners including studs, pins and the like into wood, steel, masonry or concrete and more particularly relates to such tools actuated by an explosive cartridge.

The type of tools contemplated includes various kinds such as the fastener drivers shown in U.S. Patent 1,365,869 and also more recently in co-pending U.S. patent application, Serial No. 355,034, filed May 14, 1953, now U.S. Patent No. 2,945,236, granted July 19, 1960; and the invention will be described with reference to the latter. It is to be understood, however, that the utility of this invention is not to be limited to that or any other particular type of explosive actuated tool and that it may be applicable to various other explosive tools such as the hammer and/or punch shown in U.S. Patent 2,221,157, for example.

In the operation of various tools of the explosive operated type, and particularly the fastener driving tools, one disadvantage is the possibility of the inadvertent projection of a fastener into free flight with sufficient velocity so as to be dangerous. Another disadvantage of such tools has been inability to accurately control the power imparted to drive the working element. Still another disadvantage has been the difficulty of cartridge extraction and the resultant reduction in speed of operation.

A particular object of the present invention is the provision of a blank-cartridge actuated tool having a work-member-carrying piston or ram adapted to hold such member captive at least until the working operation, such as fastener driving, has been accomplished safely without danger of such member overpenetrating or escaping into free flight. Another object is to provide a powder actuated tool wherein the driving force may be varied with ease to suit the resistance encountered so as to drive the work members such as a fastener, satisfactorily as well as safely. Still another object is to provide such a tool characterized by greater reliability and safety as well as greater ease of operation than heretofore available. A further object is to provide explosive operated tools characterized by easy insertion and detachment of a fastener, punch or cutter and with a new and improved cartridge extractor.

The foregoing and other objects of the present invention are achieved by the provision of an apparatus comprising a barrel, a piston or ram slideably mounted in the barrel having means for carrying the working member of the tool in captive relationship and a specific arrangement for operating the piston so as to accomplish not only positioning of the parts in a desired ready-to-fire station and for work member attachment or detachment but also accomplish ejection of the spent cartridge case. These objects and advantages of the invention will be more readily understood from a description of a specific embodiment and the accompanying drawing of the same wherein:

FIGURE 1 is a side elevational view, partially in cross-section, showing an explosive operated fastener driving tool generally of the type described in the aforementioned patent application, but modified in accordance with one preferred embodiment of this invention, with the tool down at the fired position partly lifted from the work

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surface 10 and in position for separation of the tool from the driven fastener;

FIGURE 2 is an enlarged fragmentary view taken in cross section at the muzzle of the tool at the moment of driving to illustrate the captive condition of an over-driven fastener and just before the condition illustrated in FIGURE 1;

FIGURE 3 is an enlarged fragmentary view of a modified construction of the projectile safety piston illustrating a stage of operation similar to that shown in FIGURE 1, i.e., at the ready-to-extricate position, or at the fired condition regardless of whether the fastener has been driven or the tool has for some reason or other been inadvertently operated in the absence of any work surface 10 in abutment with the muzzle of the tool;

FIGURE 4 is an end view taken on line IV—IV of FIGURE 3;

FIGURE 5 is a semi-diagrammatic view of one stage of one mode of operation of the tool of FIGURE 1;

FIGURE 6 is a semi-diagrammatic view of a stage of operation following that of FIGURE 5;

FIGURE 7 is another side elevational view, partially in cross section, illustrating another mode of operation of the tool of FIGURE 1;

FIGURE 8 is a fragmentary view of a portion of a modified version of a part of the tool modified in accordance with a still further embodiment and suitable for still another mode of operation;

FIGURE 9 is an enlarged fragmentary view in cross section showing still further form of ram front end preferred for heavy duty operation;

FIGURE 10 is a plan view of the end of the ram shown in FIGURE 9; and

FIGURE 11 is a fragmentary cross sectional view showing still another modification.

In accordance with this invention, there is provided an arrangement of parts and novel construction of certain of the parts and specifically the provision of a tool having a primary member or element projecting barrel, a projectable high velocity piston or follower member, herein designated as the ram or piston adapted to carry the primary member, such as a fastener in controlled relationship, and an axially movable member for positioning and/or retracting the piston member so as to influence the control. This member takes the form of a slide or sleeve. The barrel is arranged to slideably carry a part of the piston member, one part of which carries the element in detachable captive relation while another part is mounted in relatively movable relationship with the positioning member which in turn is carried in another part of the barrel.

The control exercised is with respect to the attachment retention and extrication of the primary element or fastener in relationship to the tool and, as desired, also with respect to the level of power acting to project the primary element. A still further function performable with this arrangement is the accomplishment of extraction of the power cartridge.

Specifically one embodiment of this invention involves reception of a drivable fastener in a velocity ram in captive relationship, reception of part of the ram into an adjustable positioning sleeve in captive relationship and reception in turn of the sleeve in captive relationship with respect to the direction of driving in a bore portion of an explosive cartridge operated driver. The sleeve is mounted to have limited reciprocatability in each bore portion with respect to the barrel of the driver; and the ram is also mounted to have limited reciprocation. Abutments on the barrel, sleeve and ram coact to provide mechanical interconnections acting not only to limit movement and hold certain parts at least forwardly captive, but also to couple the ram and sleeve together for re-

traction as will be more specifically described in connection with the embodiments illustrated. In particular there is provided an inwardly extending flange or shoulder means on the sleeve for acting with mating shoulder means on the ram.

The interconnected ram and sleeve enable not only positioning of both the sleeve and working element carried by the ram but also put the parts in position for accomplishing cartridge extraction.

The front end of the ram is constructed so as to interconnect the working element, as it is being projected in the barrel, together with the projected ram and to hold these parts together in interlocking relationship until high velocity projection and the work has been completed safely. The construction permits disconnection of the element, such as a fastener, only after completion of the tool operation, such as driving of the fastener. In the event of tool operation under improper conditions this ram construction by coacting with the barrel and sleeve construction holds the parts captive for resisting free ejection in the forward direction and thereby prevents forcible projection of the fastener at dangerous velocities.

In accordance with this invention, the illustrative embodiment of FIGURE 1 involves a tool having the barrel 220, the ram 221, with fastener receiving means 225 and the barrel sleeve 240.

The tool in general includes a front housing tube 54, to the rear end of which is fixed a barrel housing collar 51 for slideably carrying the tool barrel 220 of this invention and the tool also includes a rear housing portion pivotally connected at slot mounted hinge pin 61 to the front portion of the tool so that these parts, although inseparable, may be opened and not only pulled apart but also pivoted apart to a limited extent sufficient to permit loading the tool and discarding the spent powder cartridge 5 carried in the breech plug and cartridge chamber forming member 250 which is fixed as by threads 250*t* to the barrel sleeve 240.

The front tool portion as described in greater detail in the hereinbefore mentioned patent application includes outer tube 54, collar 51, the safety shield 24, safety shield tube 70 and shield compression spring 26 which together with the shield 24 and its tube 70 are restrained axially in one direction by the muzzle cap 75 attached threadedly to the barrel. There are also included barrel lock elements 80 and 82.

The front portion, in addition to hinge 61, is connected in locked position by means of lugs 51*f* coacting with female lugs 30*f* to the rear portion of the tool which comprises (a) the firing pin housing 30, (b) the outer housing casing 20, which takes the form of and includes a pistol type grip including a trigger guard, (c) the firing pin 34, (d) trigger 46 having a sear 46*a* for receding (e) the firing pin pawl 42 carried by (f) firing pin 34 so as to protrude laterally and yieldably under the action of an internal pawl spring and the sear 46*a*. The rear portion of the tool further includes pin spring 35, breech block 37 slideably mounted in housing 30 and the block spring 38. Also included is a cocking rod 40 carried on block 37 so that when the tool is pressed against the surface 10 worked upon in abutment with the muzzle nut 75 and the shield 24, the rod 40 abuts pawl 42 and cocks the pin 34 against its spring 35 until pawl 42 is aligned with sear 46*a* for recession and resultant release of the pin for firing the cartridge 5.

The rear end of the barrel includes interrupted threads 220*t* for locking it to the breech block 37 at its threads 37*t*.

The barrel 220 of this invention includes a front end portion 220*e* with a reduced barrel bore for guiding the ram and a rear portion with an enlarged barrel bore 220*f*. There is also included a ram retainer ring 230.

Carried in the barrel is the drivable ram 221 of elongated shape slideably mounted in the guide bore of barrel portion 220*e*. The rear end has an enlarged head 221*h* a

front shoulder 221*q* of which is adapted in the event of over-drive to bottom on the barrel shoulder between portions 220*e* and 220*f* and an intermediate shoulder 221*x* of which is adapted to be regularly acted upon by the sleeve 240 at the sleeve flange 241.

Ram positioning and cartridge extractor sleeve 240 has the cartridge carrying plug 250 fixedly carried at its breech portion. In effect sleeve 240 and breech plug 250 also function as parts of the barrel during the firing of a driving cartridge in the plug.

The sleeve flange 241, as shown in FIGURES 1, 5, 6, and 7, extends radially inwardly but clears the ram stem 221 by a clearance sufficient to pass the front ram shoulder 221*q* but not the intermediate shoulder 221*x*. The length of the sleeve 240 is such that when the rim of plug 250 is seated on the rear end of barrel 220, the flange 241 is spaced only slightly from the barrel front portion 220*e* so that barrel portion 220*e*, rather than flange 241, is made to take the brunt of the blow in the event of over-drive. Flange 241 supported by the tubular side wall of the sleeve 240 constrained by the rim of plug 250 constitutes an abutment extending between shoulder 221*x* and the abutment shoulder in the barrel bore between its portions 220*e* and 220*f* for taking part of the shock in the event of ram overtravel whereupon shoulder 221*x* abuts flange 241 and shoulder 221*q* abuts the barrel shoulder at the rear of portion 220*e*.

The shock is still further reduced by a venting orifice 260 in the front end of sleeve 240 communicating with suitable escape channels in the barrel, all of which serves to vent the explosive gases just before an over traveling ram would bottom as shown in FIG. 1.

The front end of ram 221 is provided with a collet type of structure 225 for receiving the working element, i.e., the fastener 11 with either captivation or detachability as shown in FIGURES 1 and 2. This embodiment of the fastener receiving and grasping means is characterized by fingers 225 forming an integral continuation of the elongated ram 221 and tending to spring outwardly an action resisted only by the barrel portion 220*e* or by the resistance of the surface 10 in the event of over-drive as shown in FIGURE 2. The leading edge of each finger 225 includes an inward abutment extension 227 and the inner surface is roughened for frictional retention.

The front end of the ram (FIGURE 2) is hollow as well as split as to be adapted to receive a fastener such as one having a penetrating projectile type anterior portion 1 with a point and also having a posterior portion 3, for further fastening or affixing purposes as for threaded connections, together with an abutting flange 2 back of which is a circumferential groove 4. It will be understood that the fastener may take other forms such as a headed stud or a flangeless pin with or without rear threads, but in any event it is preferred that the fastener have an abutment shoulder of some type equivalent to that occurring between flange 2 and groove 4 for coaction with abutment extensions 227.

In FIGURES 3 and 4, the modification of the fastener receiving and holding structure involves fingers 325 which also have an end flange 327 forming a segmented ring containing each inner flange or extension such as 327*x* and 327*y* (FIG. 4) for applying thrust normally and pull in the event of unexpected lack of resistance to the projection of the fastener. These fingers 325 tend to spring inwardly and the fastener corresponding is provided with a beveled rear end 105 to facilitate receipt of the fastener.

In both forms the rams 221 or 321 have an inner abutment plug such as 223 and 323 respectively having screw slots 224 and 324 for screw threaded adjustment to accommodate fasteners of different rear end lengths. Similarly in the form shown in FIGURES 9 and 10 there is a plug 423 mounted in the same way for the same purpose.

For heavy-duty driving or other work, the working element holder shown in FIGURES 9 and 10 has been found advantageous. Here the ram 422 is a member hollow at

least at the front with an axial bore, as are the trams 221 and 321, and having a front abutment flange 427 inwardly extending except for the angularly cocked opening 423 for receiving and freeing the fastener. The ram has an inner abutment plug 423 having a polygonally headed end 424 for adjusting the axial position of the plug which is screw-threadedly mounted in the ram 422 for varying the ram space for receiving various lengths of fastener ends.

The tool is capable of various modifications and variations both in structure and operation.

According to one mode of operation, sleeve 240 has indicator marks "EXT" for indicating the minimum retraction of the sleeve for effecting cartridge extraction as shown in FIGURE 6, mark "LO" for the lowest power operation, mark "MED" for obtaining the medium power level, and mark "HI" for the high power level for heavy job installations.

In operation, with the front and rear parts of the tool in open position and with the front end of the ram protruding from the barrel muzzle the operator forces a fastener 11 into the receiving front end of the ram such as 225 of ram 221 which is held in place by either the action of retainer 241 alone or together with the outward spring of fingers 225. Then the operator withdraws the sleeve 240 to a desirable extent as shown in FIGURE 5 so as to position the ram 221 and its captive fastener 11 for extracting before they are positioned finally for driving. Next with the point of the fastener forced against an appropriate work surface, the sleeve is pushed home again with resultant creation of pneumatic cartridge ejection pressure in the sleeve bore for spent cartridge extraction. Then sleeve 240 is withdrawn to place the ram for driving, pushed home finally and a loaded cartridge is inserted into the cartridge receiving plug 250, after which the tool halves may be closed and locked on each other in readiness for operation. The remaining operation of the tool is as described in the aforementioned patent application, but to extricate the driven fastener as shown in FIGURE 1 it is necessary to lift the entire tool from surface 10 until the fastener receiver is pulled out from the muzzle to expose the collet or other modified structures of the ram's front end.

Another mode of operation is that shown in FIGURE 7 where for some types of operations with fasteners of various penetrating point lengths and with suitable barrel extensions 220x, the mere push back of the ram 221 and its captured fastener 11 serves to position the ram and eject the spent cartridge case 5 just prior to reloading with a loaded cartridge 5 and closure of the tool halves.

With a further modification it is also possible to modify the ram 321 (FIGURE 8) so as to add a rearwardly protruding cartridge extractor pin 400 to assure ejection of "blown" cartridge cases swelled to a swage fit because an overload was inadvertently inserted. It stands to reason that the pin 400 is short enough so as not to interfere with cartridge reception even with the longest fasteners and to be adapted to act as a poker for emergency extraction with the aid of any suitable fastener, pin, or extension longer than the longest fastener normally employed with the tool shown.

FIGURE 11 illustrates a still further modification of the ram sleeve 340 by inclusion of a shear flange 341 to minimize the impact in the event of overdrive of the ram 521 the head 521h of which carries suitable high temperature resistant sealing and retaining means in the form of a resilient ring of the type shown in the drawing.

Since many other embodiments may occur to those skilled in the art, it is to be understood the foregoing is intended by way of illustration of an embodiment now believed preferred and not as a limitation of the scope of the present invention except as set forth in the appended claims.

What is claimed is:

1. An explosive actuated apparatus for driving a work-

ing element comprising a barrel, a member axially slideably mounted in the barrel bore in forwardly constrained captive relationship with respect to said tool barrel for travel between a forward element driven position of said member and a rear ready-to-project adjustable position of said member in said bore, means on said member for receiving said element in detachable captive relationship with respect to said member ready for driving, and control means axially slideably mounted in the rear end of said barrel with telescoping relative movement between said barrel, member and control means, said control means having breech means for receiving an explosive blank cartridge therein and being adapted in one direction of said relative movement for manually positioning said member to a predetermined cartridge extraction position and subsequently to a ready-to-project position of said member and its captive element and in the opposite direction of said movement for manually extracting the spent cartridge and returning said control means for reception of another cartridge for actuation with said member remaining in ready-to-project position.

2. The apparatus of claim 1 for driving a fastener element having an enlargement forming a shoulder thereon, wherein the element receiving means of the apparatus includes a rigid tubular receptor the front end of which is recessed to form an axial bore and is inwardly extended on a side to form an eccentrically offset interior flange for axially constraining said fastener element therein at said shoulder and wherein the receptor has another bore laterally extending to the opposite side of said front end and intersecting at an acute angle with said axial bore to clear said eccentric flange for inserting and removing said element respectively into and from said axial bore and the axial constraint of said flange when the element is inserted in said axial bore.

3. The driving apparatus of claim 1 having the control means on return in abutment with the barrel and including first abutment means on both the barrel and the member for mating abutment in the event of a tendency to overtravel of said member beyond the forward position and having second abutment means on said barrel, said member and the slidable control means for mating abutment in the event of said tendency to overtravel, said first and second abutment means each receiving part of the initial impact of said member upon overtravel.

4. The apparatus of claim 3 wherein the second abutment means includes an inwardly extending flange on the control means disposed between the barrel and member subject to shearing in the event of overtravel to prevent overtravel at dangerously excessive velocity.

5. The driving apparatus of claim 1 having abutment means on both the barrel and member and intermediate abutment means on the slidable control means extending between said barrel and member, each of said means being adapted for transmitting part of the impact of stopping said member to said barrel in the event of overtravel of said member beyond the forward position.

6. The driving apparatus of claim 1 wherein the element receiving means is a forwardly open ended recess in said member and includes a circumferential array of spring fingers carried by said member at said open end, each finger being extendable inwardly around said recess for holding said element back in said recess in driving abutment, and wherein the inner end of the recess is closed by a plug threadedly carried on said member for driving abutment with said element with axial adjustability for varying the length of element accommodation in said recess.

7. In a fastener projecting tool of the explosive actuated type, a barrel having a bore adapted to receive a fastener, said barrel having an enlargement of the bore adjacent the breech thereof, a tubular breech member slidably mounted in said enlargement for axial movement between a forward ready-to-project position and a rearward extended position and adapted for receiving an explosive

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blank cartridge, a fastener driving piston mounted in both said barrel bore and the tubular breech member in forwardly constraining captive relationship with respect to said barrel in axially slidable relationship between a forward position whereat the front end of said piston protrudes in exposed relationship from the muzzle of said barrel and a predetermined ready-to-project rearward position, retention means yieldably retaining said piston with respect to said barrel at any given axial position, said piston having means on the front end thereof for receiving said fastener in said bore in normally captive relationship with respect to said piston and in detachable relationship when said end protrudes, said tubular breech member having a manually engageable portion extending rearwardly from said barrel, both said member and piston having mating abutting portions engageable with each other as said member is moved toward its extended position for moving said piston from its forward position as said retention means yields, whereby said breech member may be withdrawn with respect to said barrel and moved therealong to adjustably position said piston and received fastener within the barrel at said ready-to-project position and whereby said member may then be repositioned forwardly to said forward position with respect to said barrel into cartridge loading and actuating position while leaving said piston member retained in ready-to-project position.

8. In a working element driving tool of the explosive actuated type, a barrel having a bore adapted to receive said element, said barrel having an enlargement of the bore adjacent the breech thereof and joined to said bore by a barrel shoulder, a tubular breech member slidably mounted in said enlargement for axial relative movement between a forward ready-to-drive position and a rearward extended position and adapted at its rear end for receiving a piston driving explosive propellant cartridge, said member having a driving bore, an element driving piston movably mounted in said barrel bore and having an enlarged piston head slidably received in said driving bore in the tubular breech member for retention of said piston in forwardly constrained captive relationship with respect to said barrel in axially slidable relationship between a

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forward driven position and a predetermined ready-to-drive rearward position, said piston having means on the front end thereof for receiving said working element in normally attached relationship, both said member and piston head having abutable mating portions for engagement with each other in the direction of relative movement of said member and barrel for moving said piston to said predetermined position and in the direction of driven movement of said piston driven forward by said cartridge in said barrel and said member in said forward position, said abutable portion of said member being a disposable insert mounted in fixed position in the driving bore of said member spaced from its front end, said insert being shearable in the event of excessive driven movement of the piston and forceful abutment between said portions.

9. An explosive actuated driving apparatus comprising a cylinder having a bore and an enlargement thereof joined by a shoulder, a sleeve in said enlargement for movement between a normal received position adjacent said shoulder to an extended position, said sleeve having an explosive barrel chamber, a piston forming a movable wall of said bore and having a head in said chamber, said sleeve having an abutment flange extending between said shoulder and head, said piston being movable by said flange acting on said head to an adjustable normal retracted position when said sleeve is moved to said extended position for adjusting said chamber and said normal retracted position for piston movement therefrom by said explosive to a forward piston position adjacent said flange of said sleeve in said normal position.

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