

March 8, 1966

R. J. KOPF ETAL

3,239,121

PISTON POWDER ACTUATED TOOL

Filed Jan. 11, 1963

4 Sheets-Sheet 1

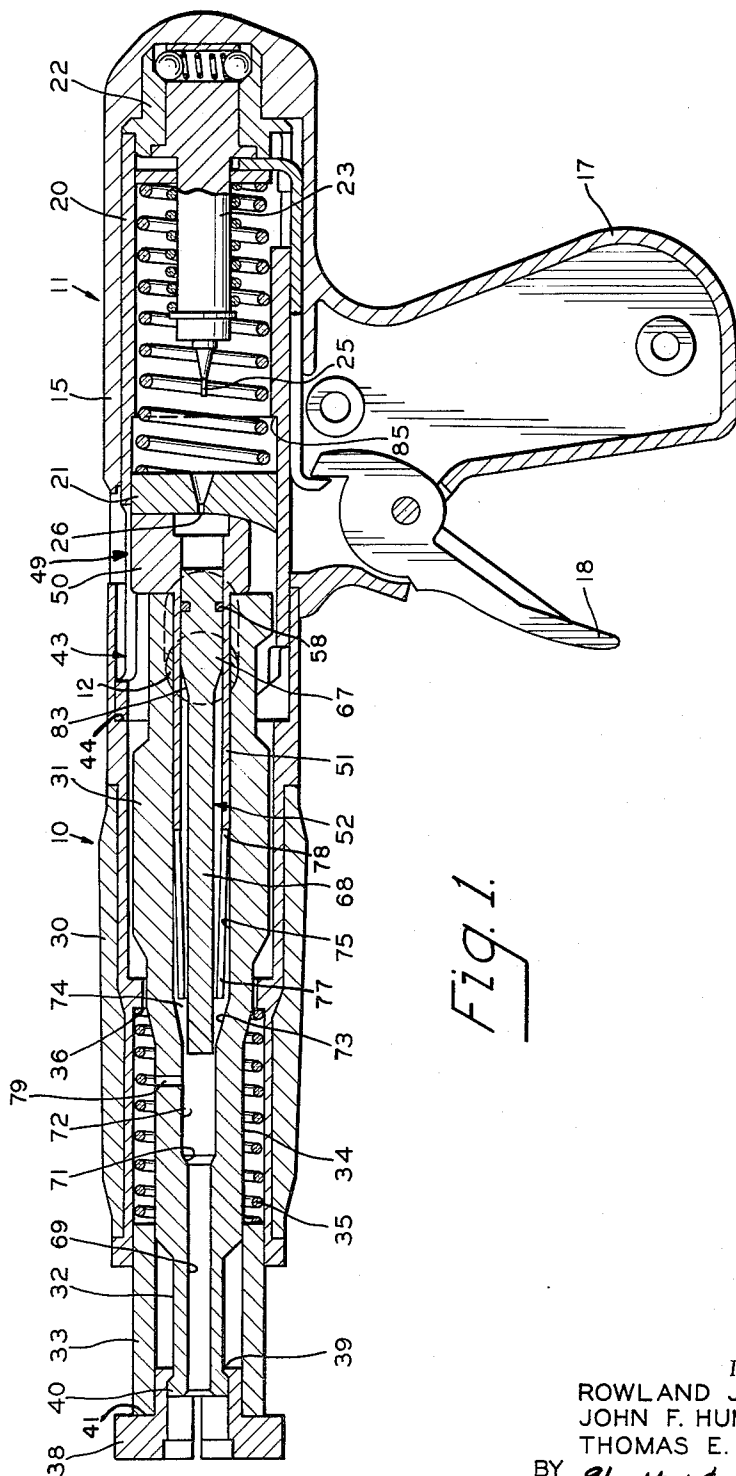


Fig. 1.

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4 Sheets-Sheet 2

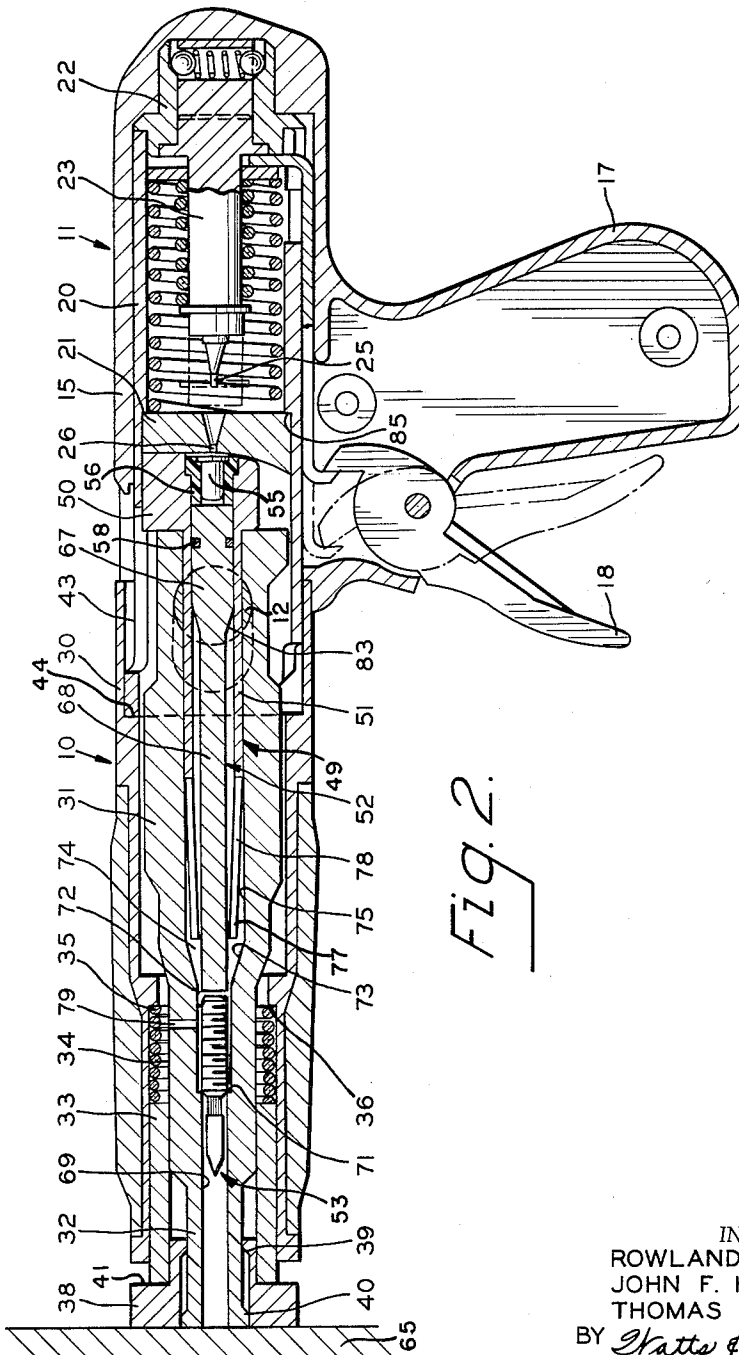


Fig. 2.

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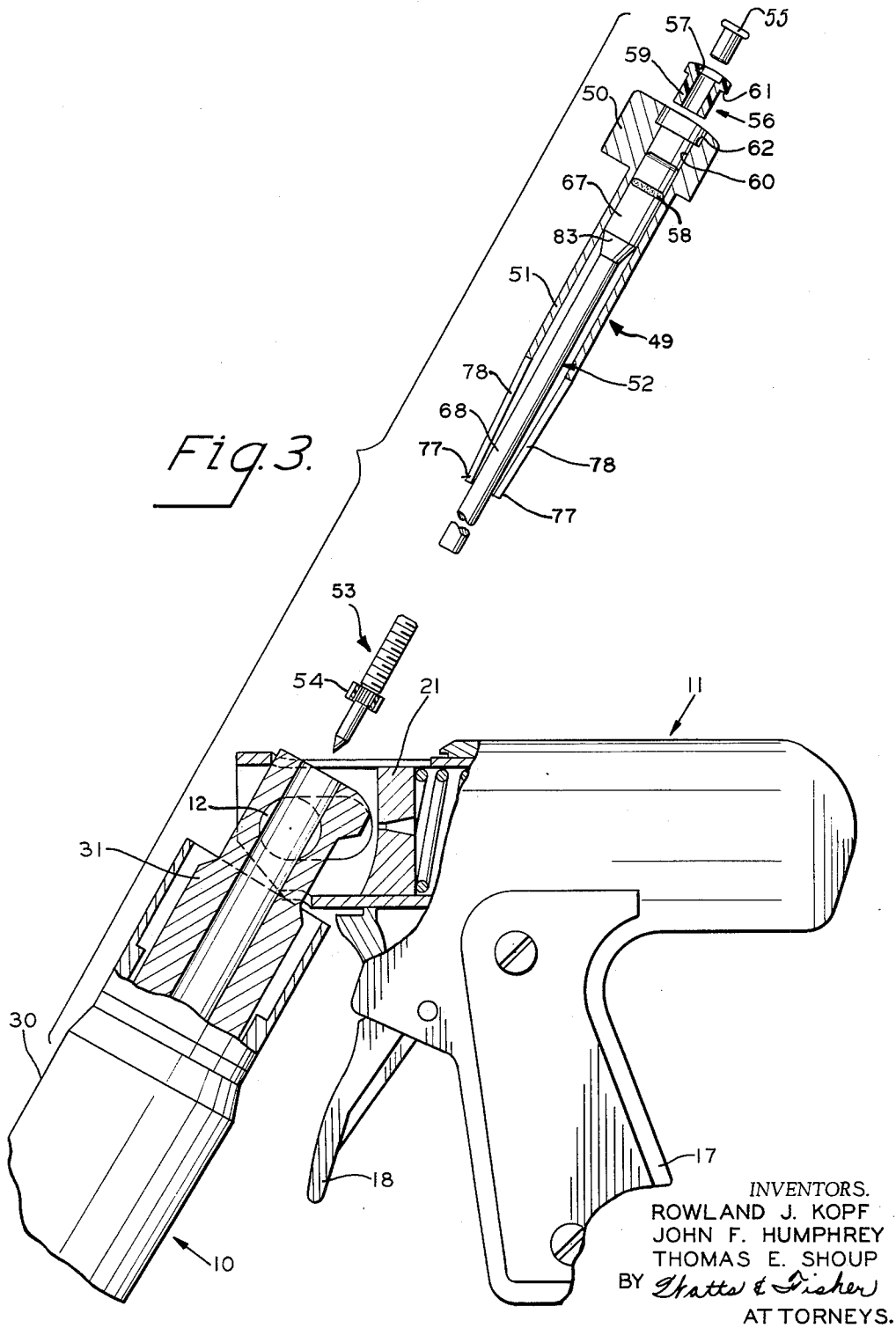
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4 Sheets-Sheet 4

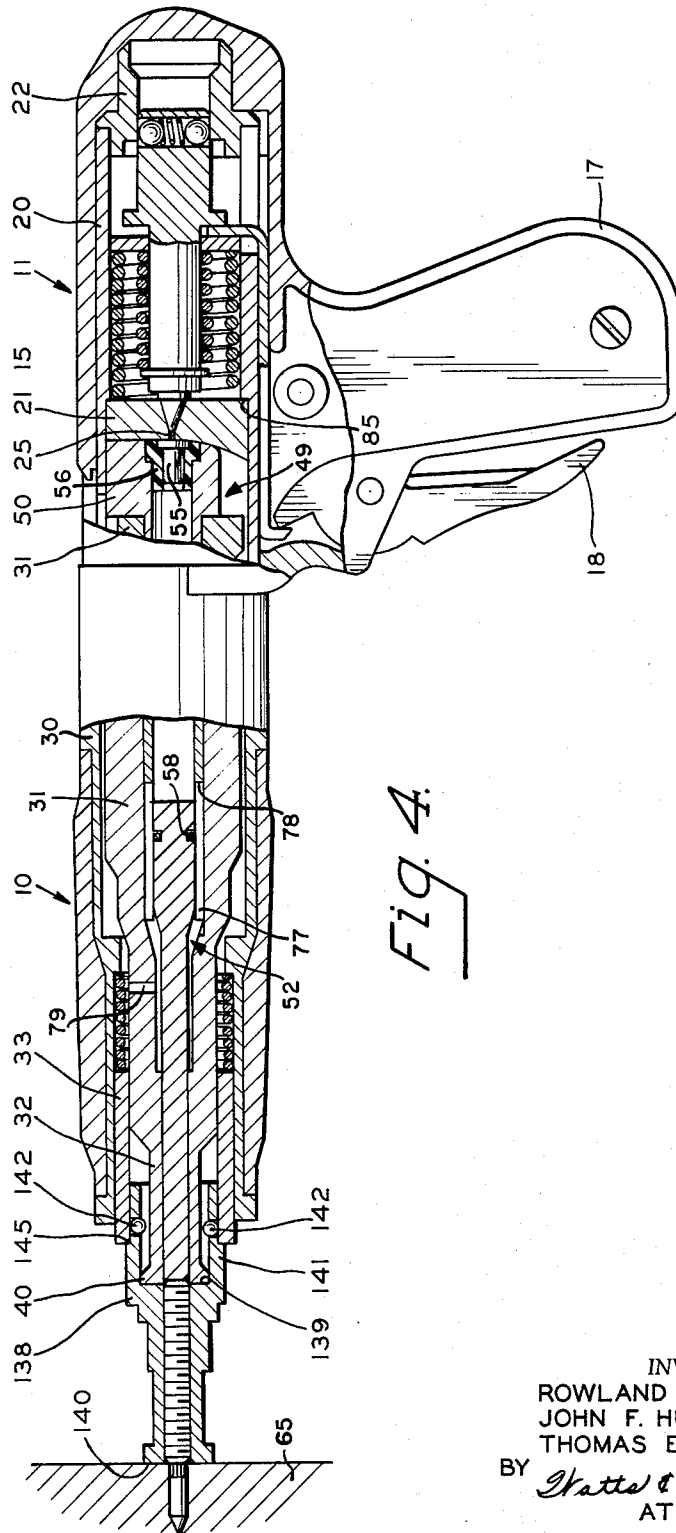


Fig. 4.

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PISTON POWDER ACTUATED TOOL

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Filed Jan. 11, 1963, Ser. No. 250,952

16 Claims. (Cl. 227-10)

This invention relates to powder actuated tools and more particularly to that class of powder actuated tools in which a piston is used to imbed a fastener in a construction member.

In the construction industry it is now quite common to use powder actuated tools to imbed fasteners in construction members such as concrete and steel. These tools are specialized tools with which a fastener may be imbedded in a construction member by igniting powder in a blank cartridge. The expanding gases resulting from this ignition are used to propel a ballistically shaped fastener from the tool into the construction member. Tools of this class fall generally into one of two well defined types. These types of tools are:

(1) A ballistic type where the forces of expanded gases are applied directly to the fastener to project it, ballistic fashion, from the tool;

(2) A piston type where a piston receives the force from the gases and in turn drives the fastener into the construction member. The present invention relates to this second type.

A piston type tool is desirable because, due to the relatively high mass of the piston, considerably lower velocities may be utilized than is the case with the ballistic type tool. A calculable quantity of foot pounds of energy are required to imbed a given fastener in a given construction member. Obviously the greater the mass involved the less velocity is required in order to obtain the appropriate product of mass times linear velocity.

Prior piston tools have had several inherent disadvantages and dangers. Principal among the dangers is that they may be "air fired." That is, it is possible to ignite the propelling cartridge at times other than when the gun is appropriately positioned for firing. Another danger with prior tools is that it is possible to produce ricochets and other dangerous situations even though piston type tools are utilized. A further danger with prior tools is that of expelling a portion of the piston from the gun on failure of the piston. The possibilities of ricochets and expelling the pistons and the problem of air firing are overcome in this gun through certain structures which will be described below and the use of a firing mechanism which is described in greater detail and claimed in copending application, Serial Number 250,926 filed January 11, 1963 under the title of "Power Actuated Tool."

A disadvantage of prior piston tools has been if the tool is fired under conditions which permit the piston to be over-propelled, severe damage, sometimes irreparable, is caused to the tool. Two conditions under which this can happen are either:

- (1) The firing of the tool when no fastener is present in the tool; and,
- (2) The firing of the tool when the propulsive charge is too great because:

- (a) the fastener is too small; and/or,
- (b) the construction member does not provide sufficient resistance to the fastener.

In a piston tool some arresting means must be provided to decelerate and stop the rapidly traveling piston both to prevent excessive imbedment of the fastener and to prevent the piston from being driven from the tool. In the past such arresting has been accomplished by the piston

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striking jaws, stops, or other equivalent metal members. Normally the resistance of the construction member to imbedment of the fastener is utilized to form the principal piston arresting action and the arresting mechanism of the tool is intended to absorb only the piston force in excess of that required to imbed the fastener. In the past, if any of the "over-propelling" conditions listed above has existed, the common result has been damage to the arresting mechanism of the tool.

As suggested above, with piston type tools it is normally intended that the piston will strike this arresting mechanism after each explosion. The prior proposals have worked on the principal that more than enough force to drive the fastener should be provided to slightly over-propel the piston and be certain that the fastener will be imbedded to the extent desired. At the same time the force provided in excess of that necessary cannot be very large or damage to the arresting mechanisms will be the result. Since it is difficult to control the overpropulsion of the piston by providing exactly the right amount of powder for each fastener imbedding operation, the arresting mechanisms of prior piston tools have had relatively short lives.

These problems are completely obviated by the present invention. In the preferred embodiment, novel porting is provided so that the gases from the explosion itself provide a substantial part of the arresting action. In this one embodiment porting of the expanded gases to the ambient atmosphere is totally through the muzzle end of the tool. Escape ports are exposed as the piston travels forwardly and the gases are allowed to travel around the piston. As the piston travels forwardly in the embodiment where porting is exclusively through the muzzle, and to a certain extent in the other disclosed embodiment, a quantity of this gas is momentarily trapped in a confined space forwardly of the piston. This trapped quantity of gas provides a dashpot-like cushion which arrests the piston travel and in certain instances actually partially retracts the piston after the fastener is imbedded. Part of the arresting, then, may be accomplished by a trapped quantity of gas so that the hammering damage to an arresting mechanism is substantially eliminated.

The arresting system of this invention has been so effective that tests made on guns constructed in accordance with this invention have shown that repeated firings of a tool may be made with no fastener present in the tool. In tests, repeated firings caused no damage to the tool. The novel construction also provides very quiet operation substantially eliminating the objectionable noise characteristic of prior powder actuated tools and also substantially eliminates a condition described below which is known as "spall."

With the present invention the piston is carried by a removable piston sleeve. The sleeve is longitudinally slotted near its forward end and the portions between the slots provided the arresting fingers. At the conclusion of a firing, the piston head is near the forward end of the sleeve and engaged by arresting fingers. These fingers serve to extract the piston from the tool after a firing. Thus, the sleeve and piston are removable together from the gun as an assembly unit. Further, the spaces between the fingers provide the porting for the tool so that as the arresting commences, gases may travel around the piston to reduce the driving power applied to the piston.

In the past, piston type powder actuated tools have been muzzle loading tools. That is, it has been necessary to load at least the fastener through the muzzle end of the tool. There is obviously inherent danger in pressing a fastener into the barrel from the muzzle end because an accidental firing of the tool at the time when the fastener is being loaded can cause very severe physical injury to the

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operator. In addition to this danger, there is the disadvantage that in muzzle loading piston tools, the piston is out of contact with the fastener. The shock loading imposed on pistons by striking fasteners after ignition results in very short piston life. There is an additional disadvantage with muzzle loading of fasteners because muzzle loading requires either:

- (1) The tool must be lifted and tilted after each firing in order to accomplish this fastener loading; or,
- (2) The loading must be accomplished in a blind manner without the muzzle opening visible.

The present tool obviates these dangers and disadvantages through the provision of a piston type powder actuated tool in which both the fastener and the cartridge are breech loaded. This feature is obtained through the novel piston and sleeve assembly that is removal as a unit. Thus the removable piston and sleeve assembly provides a tool in which:

- (1) An improved arresting mechanism is obtained which mechanism is both effective and easily repaired or replaced if and when required;
- (2) Fasteners may be breech loaded and the piston can be maintained in contact with the fastener throughout its entire travel; and
- (3) Improved porting and the novel gas check of the piston are obtained.

The provision of a breech loaded tool has produced an unexpected result which greatly enhances the safety of the tool. The barrel passage includes a fastener receiving portion of a diameter less than the piston assembly portion and larger than a muzzle portion adjacent the muzzle end of the barrel. When the tool is fired, the head of the piston may strike a surface connecting the piston and fastener receiving portion. If the piston continuously strikes this surface, the piston will ultimately break. When the piston breaks the fracture occurs at a diameter substantially equal to the diameter of the fastener receiving portion of the passage. Thus, the segment of the piston which breaks off has a diameter greater than the muzzle portion of the barrel passage so that the broken part of the piston will not be expelled from the tool. Accordingly, the entire piston remains captive in the tool even if it is broken.

As is described in greater detail in the co-pending application referenced above, one of the problems with prior powder actuated tool has been the problem of spalling. This is the condition where the construction material surrounding the place where the fastener is imbedded is fractured, or spalled away, damaging and defacing the material. With the present device, this spalling is so effectively controlled that it is possible, for example, to nail wood trim in place without defacing or otherwise damaging the wood. This is accomplished primarily through the novel porting.

When a unique barrel extension, which is described below, is used, the porting alone is the improvement which eliminates spalling. When shorter fasteners are imbedded, a novel construction is provided in which double rings of contact are applied to a construction member and after firing, the rings of contact are sequentially released. The third ring of contact for a ballistic tool described in the co-pending case is not required because of the novel porting and because of the relatively lower velocities encountered with a piston type tool.

The novel barrel extension is a device which is easily connectable to the tool to convert the tool from one suitable for short fasteners to one suitable for long fasteners. The barrel extension is substituted for a muzzle ring when the tool is so converted. This barrel extension also facilitates positioning of fasteners in confined spaces and permits the use of specialized adaptors and the like.

Accordingly, the object of this invention is to provide a novel and improved powder actuated tool of the piston type.

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Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a sectional view of the tool of this invention;

FIGURE 2 is a sectional view of the tool loaded and positioned for firing;

FIGURE 3 is an exploded view showing the tool broken, and a fastener, the piston assembly, and a cartridge holder in relative positions for loading; and,

FIGURE 4 is a side elevational view, with parts broken away, showing the tool equipped with a barrel extension attached at the conclusion of a firing but ignoring the recoil effect.

Referring now to the drawings, FIGURES 1 and 2 are sectional views of a piston type powder actuated tool. This tool has a barrel assembly 10 and a breech assembly 11. The barrel assembly 10 is pivotally connected to the breech assembly 11 by a pivot pin 12. To permit breech loading of the tool, the tool may be manually "broken" by relative rotation of the barrel and the breech assemblies about the pivot pin 12.

THE BREECH ASSEMBLY

The breech assembly 11 is described in greater detail in the referenced co-pending application. In order to provide an understanding of the present invention the breech assembly will be described briefly here. The breech assembly has a housing 15 which includes a handle 17. A trigger 18 is pivotally connected to the handle 17. A reinforcing sleeve 20 is carried within the housing 15 and a breech block 21 is slidably carried by the forward end of the reinforcing sleeve 20. An annular seal retainer 22 is positioned in the housing 15 rearwardly of the sleeve 20.

A hammer 23 is within the sleeve 20. The hammer 23 has a rearward portion telescoped in the seal retainer 22 and a firing pin 25 on its forward end. The hammer is selectively movable to cause the firing pin 25 to project through a firing pin aperture 26 in the breech block 21 as shown in FIGURE 4 whenever the tool is in the firing position of FIGURE 2.

BARREL ASSEMBLY

The barrel assembly 10 includes a barrel housing 30 and an elongated barrel 31 reciprocally mounted in the housing 30. The barrel 31 includes a reduced diameter muzzle portion 32 which extends forwardly past the forward end of the housing. A muzzle sleeve 33 concentrically surrounds and is spaced from the muzzle portion 32. The muzzle sleeve 33 is slidable along a cylindrically contoured guiding portion 34 of the barrel 31 which is provided adjacent and rearwardly of the muzzle portion 32. A positioning spring 35 surrounds the guiding portion 34. The positioning spring is compressed between the muzzle sleeve 33 and a housing shoulder 36.

In the assembly of FIGURES 1 and 2 for shorter fasteners, a split muzzle ring 38 telescopes into the forward end of the muzzle sleeve 33. The split muzzle ring 38 has inwardly projecting finger portions 39 which overlie an outwardly projecting annular anchor flange 40 on the muzzle end of the barrel 31. The positioning spring 35 maintains the muzzle sleeve 33 against a shoulder 41 on the split muzzle ring 38 so that sleeve is maintained in telescopic relationship so as to prevent breaking of the ring. This telescopic relationship of the sleeve 33 together with the biasing action of the spring 35 maintains the fingers 39 in abutment with the flange 40.

The positioning spring 35 not only drives the muzzle sleeve 33 forwardly to maintain the split muzzle ring 38 in its proper and assembled position, but also drives the housing 30 rearwardly. The housing 30 telescopes over the forward end of the breech reinforcing sleeve 20 in an area designated by the numeral 43. The forward end

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of the breech reinforcing sleeve 20 normally abuts an annular shoulder 44 in the housing 30. The reinforcing sleeve 20 and the housing 30, then, are maintained in telescopic relationship so as to prevent breaking of the tool.

In order to break the tool to shift it from the position of FIGURE 1 to the position of FIGURE 3, the housing 30 is manually moved forwardly against the action of the positioning spring 35 until the breech sleeve 20 and the housing 30 are no longer in telescopic engagement. At this time the barrel assembly 10 and the breech assembly 11 can be pivoted relatively about the pivot pin 12 to shift the tool to the position shown in FIGURE 3.

A carrier 49 includes an enlarged cartridge holder 50 and a smaller, elongated, sleeve portion or piston sleeve 51. The cartridge holder 50 is interposed between the breech block 21 and the rearward end of the barrel 31 when the tool is in a closed position. The piston sleeve 51 is secured to the forward end of the cartridge holder 50. A piston shown generally at 52 is reciprocally disposed in the piston sleeve 51. The cartridge holder 50, the piston sleeve 51 and the piston 52 form together a piston assembly which is removable as a unit, FIGURE 3.

The piston 52 has a head portion 67 which is in close, slidable engagement with the inner surface of the sleeve 51. In the disclosed embodiment a piston ring 58 is carried by the head 67. This ring may be eliminated in most instances other than when relatively high driving force is required. The piston has a forwardly extending, cylindrically contoured anvil or ram portion 68 which imparts the imbedding force to the fastener 53. The piston head 67 and anvil portion 68 are connected together by a tapering piston stop surface 83. The piston stop surface 83 has a contour corresponding to the contour of a barrel piston stop surface 73 coacting with it in a manner which will be described presently.

The piston sleeve includes ports 78 which take the form of a plurality of longitudinally extending, circumferentially spaced, slots that extend rearwardly from the forward end of the sleeve 51. The functioning of these ports 78 will be described in greater detail below. The ports 78 are sufficiently narrow so that fingers 77 remaining between them serve as guides and arrestors for the piston head 67 during its forward travel. These fingers are bent inwardly to provide piston extracting members. The fingers are obviously moved outwardly when the piston head moves therebetween and, of course, are of resilient material so as to spring back when the piston head is moved back beyond the fingers. The fingers obviously may be of steel. Thus, the fingers both provide aid in stopping piston travel and also serve to pull the piston from the tool when the cartridge holder 50 and sleeve 51 are removed from the barrel.

In FIGURE 1 the barrel 31 is shown as having a port 79 but may be imperforate to define a through stepped bore extending from the muzzle end to the breech end of the barrel. Such an imperforate barrel construction provides a quiet tool and a "gas check" arresting action which will be described presently. The construction shown in the drawings sacrifices some of the quietness and gas checking action but is nonetheless preferred in some applications.

The barrel bore includes a muzzle portion 69 adjacent the muzzle end of the barrel. Rearwardly of the muzzle portion the bore has an outwardly flaring fastener locating shoulder 71 which terminates at the forward end of a fastener receiving portion 72. The port 79 extends from the fastener receiving portion 72 radially through the barrel. The fastener receiving portion 72 is, axially speaking, centrally disposed. The barrel bore includes the conically tapered piston stop surface 73. The piston stop surfaces 73, 83 define the extremities of a gas space 74. The piston stop surface 73 connects the fastener receiving portion 72 to a piston assembly receiving portion 75. The piston assembly receiving portion 75 is

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cylindrically contoured, and in axial alignment with the portions 69 and 72. The piston assembly receiving portion 75 extends from the piston stop surface 73 to the breech end of the passage and carries the piston sleeve 51 when the tool is in use.

While the fastener receiving portion 72 was designed primarily as a receiving and guiding portion for a deformable fastener locator 54 and its fastener 53, it has been discovered that the disclosed barrel construction produces a very favorable and unexpected result. Especially in the embodiment having the port 79, during use the piston stop surfaces 73 and 83 will come into abutment repeatedly. Over a period of time the piston will fail due to this repeated abutment. Because the diameter of the fastener receiver portion 72 is somewhat larger than the anvil portion 68 this failure will occur in a ring located between the ends of the piston stop surface 83 and ultimately the piston will fracture in a plane including this ring so that a part of the stop surface 83 will remain attached to the anvil portion 68. This part of the surface 83, resulting from such fracture, will have diameter greater than the muzzle portion 69 of the barrel bore. Accordingly, the shoulder 71 will act as a stop abutting this part of the surface 83 and maintaining the anvil captive in the barrel even though the piston has fractured.

During loading the piston assembly is removed and the fastener is breech loaded. The fastener 53 is dropped through the breech end of the barrel 31 and allowed to fall until the deformable plastic fastener locator 54 carried by the fastener is disposed in the fastener receiving portion 72. Next the piston is moved rearwardly in the piston sleeve from the spent position of FIGURE 4 to the position shown in FIGURES 1 through 3. When the piston is so moved along the piston sleeve, a spent cartridge 55 and its carrier 56 will be ejected from the holder 50. A carrier 56 then is placed in the holder 50. The piston assembly is then inserted in the assembly receiving portion 75 and pressed forwardly until the cartridge holder 50 abuts the breech end of the barrel 31. As the piston assembly is telescoped into the gun the anvil portion 68 comes into abutment with the fastener driving it forward to the position shown in FIGURE 2.

If, for some reason, one wishes to reduce the power level of the gun, the piston may be pressed forwardly from the position shown in FIGURE 2 as to a position in which the piston is spaced from the cartridge 55. When so positioned, the space between the piston and the cartridge will provide an expansion space reducing the propulsive force applied to the piston.

The cartridge 55 is telescoped into an axial bore in the distensible plastic cartridge carrier 56, which comprises a breech member. The cartridge is pressed forwardly until its flange rests in a cartridge flange recess 57 at the rearward end of the cartridge carrier.

After the cartridge 55 has been telescoped into the cartridge carrier 56, the cartridge carrier is telescoped into a bore 60 in the cartridge holder 50. The carrier is urged forwardly until a shoulder 61 on the cartridge carrier abuts a complimentary shoulder 62 in a counter bore in the rearward end of the cartridge holder. The tool is now loaded and ready for closing.

As the tool is closed, the breech block 21 cams the cartridge holder forwardly tightly against the barrel 31 and simultaneously cams the cartridge carrier tightly into the holder somewhat expanding the rearward portion of the carrier to effect a tight circumferential gas seal between the carrier and the holder.

On ignition of the powder in the cartridge, expanding gases from the cartridge act rearwardly on the carrier expanding the walls of the cartridge carrier radially outwardly. This expansion of the carrier forces it into tight, circumferential sealing abutment with cylindrical walls of the cartridge carrier bore 60 in the cartridge holder 50. This tight seal provided by the explosion coupled with the second seal effected by the camming

of the cartridge carrier by the breech block provides a double action gas seal preventing rearward escape of the expanding exploding gases.

OPERATION

When the tool is ready for firing, the muzzle ring 38, is positioned around the place where the fastener is to be imbedded. The handle 17 is then pressed to telescope the housing 15, 30 forwardly over their housed assemblies. This moves the barrel forwardly until the muzzle end of the barrel 31 is also in compacting engagement with the construction member 65.

When the powder in the cartridge 55 is ignited, the expanding gases act against the piston head portion 67 which is in tight sliding, but gas sealing engagement with the inner walls of the sleeve 51. The piston and the cartridge, together with parts of the cartridge holder and sleeve, define an expansion chamber wherein the gases are confined as the piston is driven forward.

As the piston travels forwardly, the anvil portion 68 telescopes into the muzzle portion 69 of the barrel passage. As the piston head 67 moves forwardly in the piston sleeve 51, and after the anvil portion 68 has entered the muzzle portion 69, the ports 78 are exposed to the enlarging expansion chamber. These ports 78 permit expanding gases to pass from the expansion chamber around the head 67 and into the space 74. The gases flow from the space 74 into the fastener receiving portion 72. Most of the gases are ported to the atmosphere by the port 79.

When the tool is constructed as described above to omit the port 79, all escape of the expanding gases must be out the muzzle end 40 of the barrel. Since the anvil portion 68 and the muzzle portion 69 of the barrel passage are in closely spaced relationship, an effective check on the escape of expanding gases is provided. This not only reduces the velocity of escaping gases to reduce the noise of operation and spall, but also contributes to the novel arresting system provided in this tool.

The effectiveness of this check will, of course, depend upon the clearance between the anvil portion and muzzle portion 69 of the passage and the extent to which the anvil portion has telescoped into the muzzle portion 69. This is true because the amount of drop in the pressure of gases as they pass from the gas space 74 to the muzzle end of the barrel is proportional to the cross sectional area of the space between the anvil portion and the muzzle portion and also proportional to the length of the annular passage provided between them. Accordingly, as the piston approaches the forward end of its travel, the maximum gas checking effect is obtained. At the same time the gas space 74 is of a continually decreasing volume. When the piston is in the spent position of FIGURE 4, gases thus tend to become momentarily trapped in the space 74 between the tapered surfaces 78 and 83 and between the walls of the barrel passage and the piston. This trapped pocket of gas serves as a cushion which arrests and stops the forward movement of the piston. Ultimately enough of the gas ports out of the muzzle end of the gun to equalize the pressure in the expansion chamber with the pressure of ambient atmosphere.

Because of the substantial pressure drop experienced by the gases passing through the small space between the anvil portion and the muzzle portion 69, the gases are metered out of the muzzle end of the barrel at a very low velocity. Spall normally caused by the sudden impact of the expanding and escaping gases is substantially eliminated because gases are never expelled from the muzzle of the tool at a high velocity. The noise normally inherent in the operation of this class of gun is substantially muffled and very silent operation is obtained because of this low muzzle velocity.

On firing of the tool the initial recoil force drives the barrel 31, the cartridge holder 50, and breech block

21 rearwardly. The retraction spring 35 will drive the housing rearwardly but the retraction spring 35 will also act to maintain the split muzzle ring 38 in its engagement with the construction member 65 until lifted by the barrel flange 40. Because these recoil actions occur quickly and sequentially, they have been ignored in the showing in the drawing.

DISMANTLING

One of the outstanding features of this invention resides in the ease with which the tool can be completely dismantled for cleaning and/or repair. To dismantle the tool, the muzzle sleeve 33 is manually moved rearwardly against the action of the positioning spring 35 until the telescopic relationship of the muzzle sleeve 33 and the split muzzle ring 38 is ended. Once the sleeve 33 and the ring 38 are out of telescopic relationship, the sections of the split muzzle ring 38 may be easily lifted out of place and in fact will usually fall out of place. With the split muzzle ring 38 removed, the muzzle sleeve 33, the positioning spring 35, and the barrel housing 30 are all readily moved forwardly from around the barrel 31. The housing 30 covers the ends of the pivot pin 12 when the gun is in its assembled condition. Once the housing 30 has been removed, the pivot pin 12 is exposed.

Next the tool is broken and the piston assembly is removed. As is plain from an examination of FIGURES 1 and 2, the piston sleeve telescopes through a bore in the pin 12. Once the piston assembly and the barrel housing 30 has been removed, the pivot pin 12 may be pressed out of the barrel 31 and the elongated slot in the breech reinforcing sleeve 20. This separates the barrel from the breech assembly and permits the breech assembly to be dismantled in the manner described in greater detail in the referenced co-pending application.

BARREL EXTENSION

In FIGURE 4 a barrel extension 138 is secured to the remainder of the tool in lieu of the muzzle shield 38. The barrel extension 138 is used when a long fastener is to be imbedded in a construction member, when a fastener is to be imbedded in a confined space, and/or when specialized adapters are required. The extension 138 has an internal shoulder 139 that abuts the muzzle end of the barrel when the tool is in the firing position of FIGURE 4 so that outer end 140 of the extension becomes the muzzle of the tool.

The extension 138 has a retaining portion 141 which extends rearwardly from the shoulder 139 and telescopes over the muzzle end of the barrel 31. The retaining portion has at least three circumferentially spaced, radially extending through holes. Each of the holes carries a ball 142. When the holes are drilled, each drill is stopped before it passes completely through the hole so as to leave an annular ball retaining shoulder at the inner end of the hole. The retaining portion is staked at the outer end of each hole to retain each ball 142 in its hole.

When the extension 138 is on the tool, the sleeve 33 abuts an external shoulder 145 on the extension and holds the balls 142 inwardly so that they are abutable against the flange 40 to hold the extension on the barrel. To remove the extension one merely slides the sleeve 33 rearwardly to release the balls and permit the extension to be pulled from the gun.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A powder actuated tool comprising,
 - (a) connected breech and barrel assemblies;
 - (b) said barrel assembly including a housing and an elongated tubular barrel disposed within the housing;
 - (c) said barrel having muzzle and breech ends and walls defining a passage extending from the muzzle to the breech end;
 - (d) said barrel passage including:
 - (i) a muzzle portion adjacent the muzzle end;
 - (ii) a fastener receiving portion of a diameter larger than the muzzle portion in axial alignment with the muzzle portion and rearward of the muzzle portion; and,
 - (iii) a piston portion of a diameter larger than the fastener portion and between the fastener portion and the breech end of the gun;
 - (e) said passage including a fastener arresting shoulder between the muzzle portion and the fastener portion and a piston stop surface between the fastener portion and the piston portion;
 - (f) a piston assembly telescoped into the piston portion and including and elongated reciprocal piston and surrounding sleeve;
 - (g) said piston including a rearward enlarged head reciprocally disposed in the sleeve and a forwardly extending ram of a size adapted to telescope closely into the muzzle portion of the barrel passage;
 - (h) said sleeve being positioned in the piston portion of the barrel passage and including longitudinally disposed slots near its forward end defining gas ports;
 - (i) cartridge ignition means carried by the breech assembly, said piston assembly including a breech member secured to the sleeve and interposed between the barrel and the breech assembly; and,
 - (j) said breech member including a cartridge receiving chamber in fluid communication with the barrel passage.
2. A barrel extension for a powder actuated tool or the like comprising,
 - (a) an elongated tubular extension body including a through extension passage and a rearwardly oriented outwardly extending shoulder,
 - (b) laterally moveable lock means for connecting engagement with a barrel shoulder to lock the extension on a barrel with the passage in alignment with a barrel bore; and,
 - (c) said laterally moveable means being disposed between the shoulder and the rearward end of the extension body and projectable into the extension passage.
3. The device of claim 2 wherein the extension includes a plurality of radially extending through bores between the shoulder and the rearward end and wherein the laterally moveable means comprises a plurality of balls, each in a different extension bore.
4. In a powder actuated tool, the combination of:
 - (a) a barrel including a through bore extending from a breech to a muzzle end and anchor means projecting laterally outwardly near the muzzle end;
 - (b) a barrel extension including an elongated tubular body having a through bore and a rearwardly oriented outwardly extending shoulder;
 - (c) said extension including laterally moveable lock means in connecting engagement with the anchor means locking the extension on the barrel with the bores in alignment;
 - (d) said laterally moveable means being disposed between the shoulder and the rearward end of the extension and moveable outwardly to release the locking and permit the extension to be pulled off the barrel;
 - (e) a sleeve around the moveable means and main-

- taining the moveable means in locking engagement with the anchor means;
- (f) biasing means maintaining the sleeve against the shoulder and around the moveable means; and,
- (g) said sleeve being moveable to release the locking of the moveable means.
5. In a powder actuated tool, barrel means having a breech end and a muzzle end and provided with a passage extending from the breech end to the muzzle end, an insert sleeve having a frictional gripping portion, and a captive piston engageable by the gripping portion of the sleeve and slidable along the sleeve to drive a fastener positioned in the passage when a cartridge positioned near the breech end of the barrel means is fired, the sleeve and the piston being adapted to be freely inserted into and freely removed from the breech end of the passage in the barrel means and the sleeve serving to normally hold the piston in a selected retracted position relative to the sleeve during insertion of the sleeve and piston into the passage in the barrel and thereafter prior to firing a cartridge to drive the piston forwardly of the sleeve.
6. The powder actuated tool of claim 5 wherein the barrel is provided with a gas escape port, and the insert sleeve is provided with porting means closed from the port of the barrel by the captive piston when the piston is in a retracted position thereof and open to the port of the barrel when the piston has moved along the insert member a predetermined distance from the retracted position thereof.
7. In a powder actuated tool, a barrel having a passage therethrough having a breech end and a muzzle end, a captive piston, and a sleeve freely insertable into and freely removable from the breech end of the passage, mounting the captive piston slidably therein and having a sleeve portion at the breech end thereof and a plurality of spring, gripping fingers at the other end thereof for gripping the piston.
8. The powder actuated tool of claim 7 wherein the sleeve is of a predetermined length, the captive piston being of a length that the forward end thereof extends forwardly beyond said other end of the sleeve when the breech end of the piston is adjacent the breech end of the sleeve.
9. In a powder actuated tool, a barrel having muzzle and breech ends and walls defining a barrel passage extending from the muzzle end to the breech end, the barrel passage including a muzzle portion adjacent the muzzle end, a piston receiving portion of a diameter larger than the muzzle portion and adjacent the breech end and a safety portion between the muzzle and piston portions and of a diameter larger than said muzzle portion and smaller than said piston portion, the barrel passage including a tapered piston arresting surface between the piston receiving portion and the safety portion, the barrel also having a tapered piston stop surface positioned between the muzzle and the safety portions, a piston telescoped into said passage and including a ram portion closely fitting within the muzzle portion and a head portion closely fitting within the piston portion and a piston stop surface positioned between the ram and the head portions, and a breech assembly adjacent the breech end of the barrel and including firing means for firing a cartridge to create a gaseous force behind the piston for driving the piston forward in the barrel passage

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until the piston stop surface and the piston arresting surface engage,
 only the outer annular portions of the piston stop surface being aligned and engageable with the piston arresting surface, whereby any fracture in the piston from striking the piston arresting surface generally occurs at a line approximating the diameter of the safety portion of the barrel passage so as to leave a shoulder on the ram portion which is larger than the muzzle portion of the barrel passage.

10. In a powder actuated tool,
 barrel means having an external stop at the muzzle end thereof,
 shield means having a tubular shank portion slidable on the external stop,
 the tubular shank portion having expansible internal stop means adapted to engage the external stop to limit forward travel of the shield means relative to the barrel means,
 a sleeve slidable on the tubular shank portion between a first position holding the expansible internal stop means against release and a second position permitting releasing movement of the expansible internal stop means,
 and means normally holding the sleeve in the first position thereof.

11. In a powder actuated tool,
 a barrel having an external collar at the muzzle end thereof,
 a split, tubular shield having an enlarged head portion and a reduced shank portion slidable on the external collar and provided with an internal collar for engaging the external collar to limit forward travel of the shield relative to the barrel,
 a sleeve slidable on the shank portion of the split, tubular shield for preventing separation of the elements of the shield,
 and spring means normally holding the sleeve in position on the shank portion and permitting movement of the sleeve off of the shank portion.

12. A powder actuated tool comprising
 breech and barrel assemblies pivotally connected together;
 said barrel assembly including a housing and an elongated tubular barrel disposed within the housing;
 said barrel having muzzle and breech ends and walls defining a passage extending from the muzzle end to the breech end;
 said barrel passage including a muzzle portion adjacent the muzzle end and a fastener receiving portion of a diameter larger than the muzzle portion in axial alignment with the muzzle portion and rearward of the muzzle portion;
 a piston portion of a diameter larger than the fastener portion and between the fastener portion and the breech end of the gun;
 said passage including a fastener arresting shoulder connecting the muzzle portion to the fastener portion and a tapered piston stop surface connecting the fastener portion to the piston portion;
 a piston assembly slidably insertable into the piston portion and including an elongated reciprocal piston;
 said piston including a rearward enlarged head and a forwardly extending ram of a size adapted to fit closely and slidably into the muzzle portion of the tool;
 cartridge ignition means carried by the breech assembly;
 and a breech member interposed between the barrel and the breech assemblies and including a cartridge receiving chamber positioned for powder igniting coaction with the cartridge ignition means and in fluid communication with the barrel passage;

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said piston having a tapered piston stop surface connecting the ram and head portions and wherein the piston stop surfaces are coactable to define a gas space.

13. A powder actuated tool comprising
 connected breech and barrel structures;
 said barrel structure including a housing and an elongated tubular barrel disposed within the housing;
 said barrel having muzzle and breech ends and walls defining a passage extending from the muzzle to the breech end;
 a piston assembly slidably insertable into the passage near the breech end freely removable from and insertable into the barrel structure and including a sleeve and an elongated piston;
 said piston including a rearward, enlarged head reciprocally disposed in the sleeve and a forwardly extending ram of a size adapted to fit slidably and closely into the barrel passage near the muzzle end;
 cartridge ignition means carried by the breech assembly;
 said structures including means adjacent the ignition means including a cartridge receiving chamber positioned for powder igniting coaction with the cartridge ignition means and in fluid communication with the barrel passage;
 said sleeve including inwardly extending resilient finger portions adjacent its forward end providing a piston extraction means;
 said sleeve including a plurality of circumferentially spaced elongated porting slots extending rearwardly from the forward end thereof with the finger portions therebetween.

14. In a piston assembly quickly insertable into and removable from a breech end of the barrel of a powder actuated tool,
 a sleeve having a first end and a breech end provided with a cartridge chamber,
 the sleeve also having a plurality of inwardly inclined, resilient fingers at the first end thereof and an imperforate sleeve portion at the breech end thereof and being freely insertable into and removable from the breech end of the barrel,
 the sleeve being provided with porting slots extending from the imperforate sleeve portion forwardly along and between the resilient fingers,
 and a piston member having a reduced shank portion of a predetermined diameter extending slidably between the resilient fingers and also being provided with an enlarged head fitting closely in and slidably along the sleeve portion of the sleeve,
 the piston being movable from a first position in which the head is located in the sleeve portion to close off the breech end of the sleeve portion from the porting slots to a second position in which the head is located forwardly of the sleeve portion and opens the ports to the interior of the sleeve portion.

15. In a powder actuated tool,
 barrel means having a breech end and a muzzle end and provided with a passage extending from the breech end to the muzzle end,
 an insert sleeve,
 and a piston means fitting slidably in the sleeve and slidable along the sleeve to drive a fastener positioned in the passage when a cartridge positioned near the breech end of the barrel is fired,
 the sleeve and the piston means being adapted to be freely inserted into and freely removed from the breech end of the passage in the barrel means,
 the sleeve and the piston means being provided with frictionally interengaging means serving to normally hold the piston means in a selected retracted position relative to the sleeve during insertion of the sleeve and the piston means into the passage in the barrel

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and thereafter prior to firing a cartridge to drive the piston means forwardly of the sleeve.

16. In a powder actuated tool,
barrel means having a breech end and a muzzle end
and provided with a passage extending from the 5
breech end to the muzzle end,
an insert sleeve,
and a piston means fitting slidably in the sleeve and
slidable along the sleeve to drive a fastener posi-
tioned in the passage when a cartridge positioned 10
near the breech end of the barrel is fired,
the sleeve and the piston means being adapted to be
freely inserted into and freely removed from the
breech end of the passage in the barrel means,
the sleeve and the piston means being provided with 15
frictionally interengaging means serving to nor-
mally hold the piston means in a selected retracted
position relative to the sleeve during insertion of the

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sleeve and the piston means into the passage in the barrel and thereafter prior to firing a cartridge to drive the piston means forwardly of the sleeve and including a ring extending around the piston means and engaging the piston means and the sleeve.

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