Sept. 29, 1970 F. SCHNEIDER 3,531,037

BOLT SETTING TOOL

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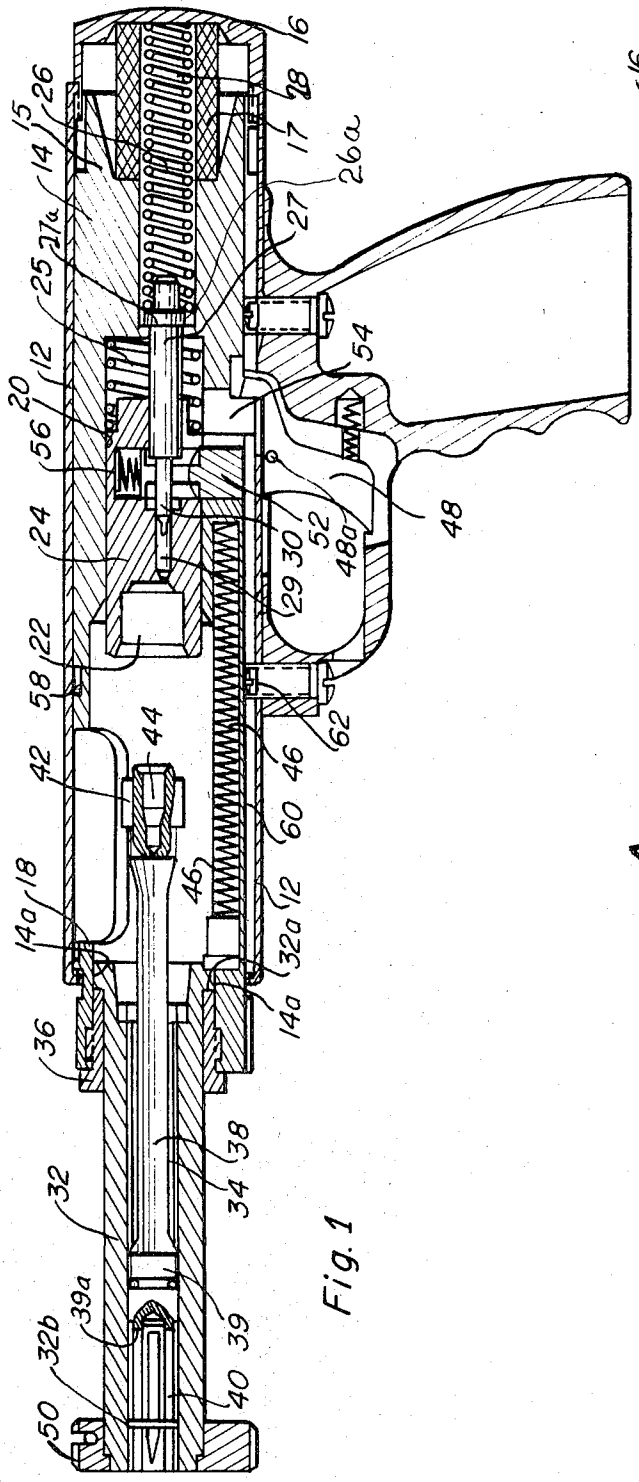

Fig. 1

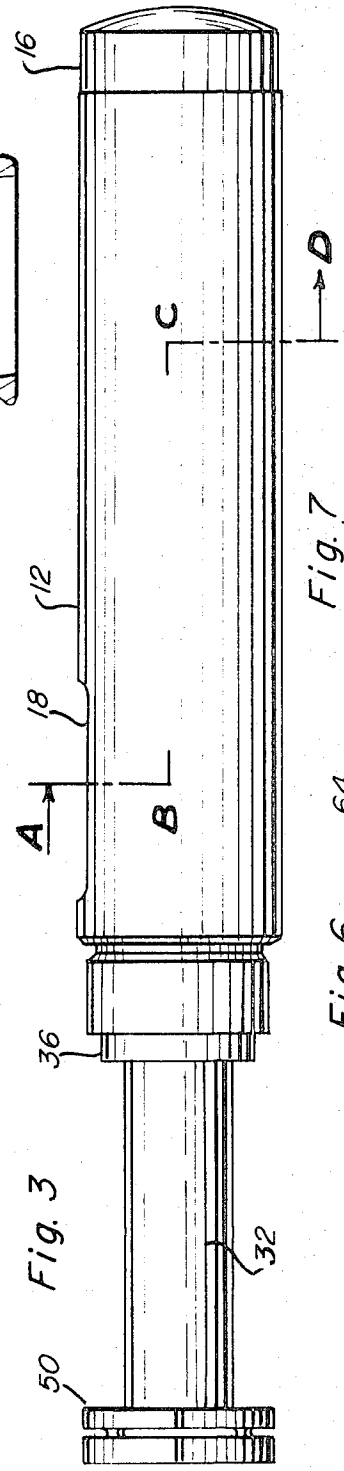

Fig. 3

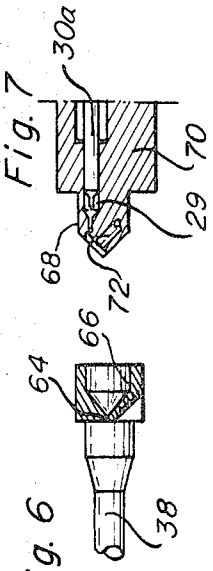

Fig. 7



Fig. 6

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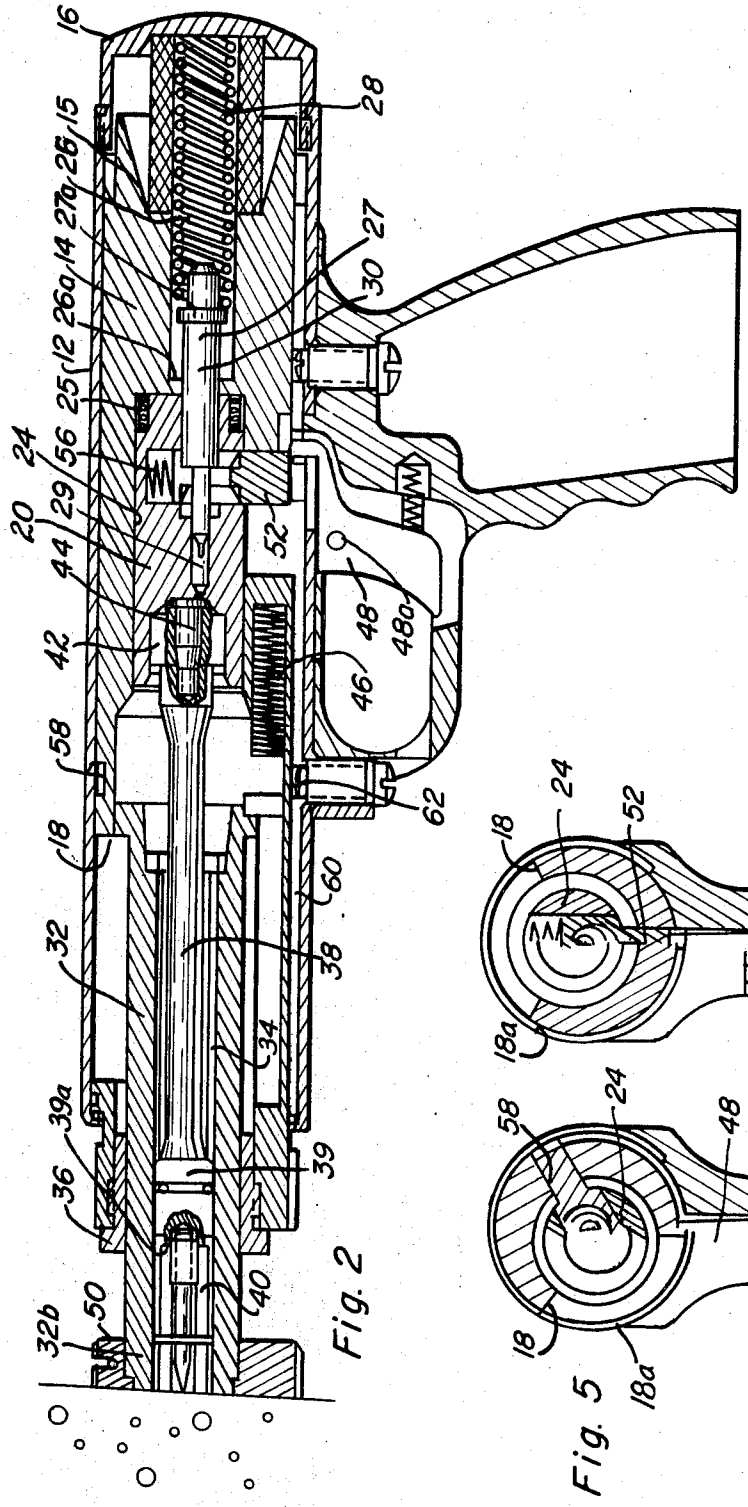


Fig. 2

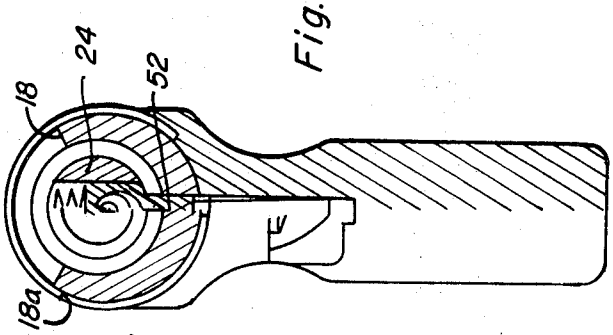


Fig. 4

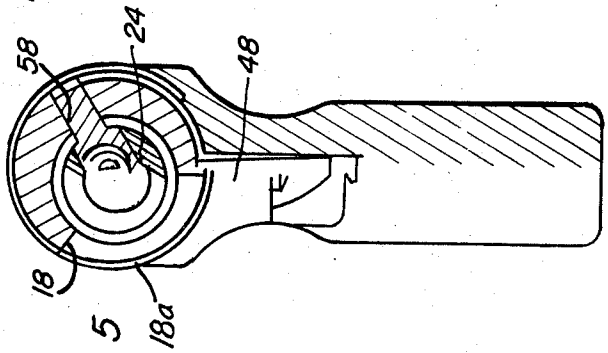


Fig. 5

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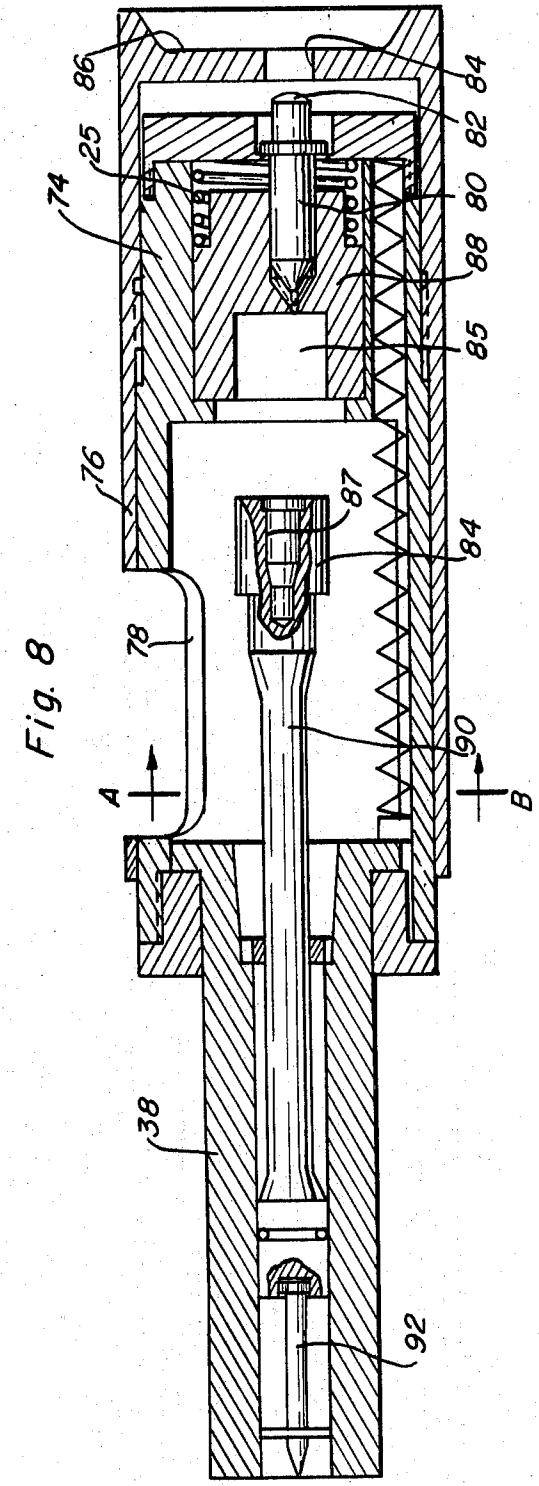


Fig. 8

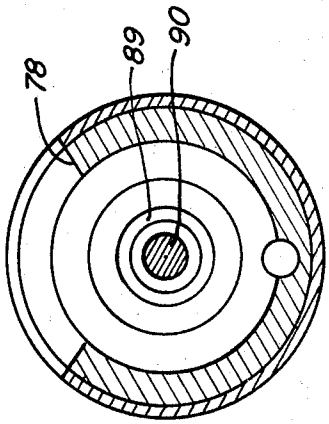


Fig. 9

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3,531,037

# BOLT SETTING TOOL

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Claims priority, application Germany, Oct. 3, 1966, J 31,909
Int. Cl. B25c 1/14
U.S. Cl. 227—10 9 Claims

## ABSTRACT OF THE DISCLOSURE

A bolt setting tool for driving bolts, pins or similar fastening or securing means into surfaces of construction materials, which includes a barrel for containing the bolt, a piston for driving the bolt in the barrel, a cartridge and associated firing mechanism and combustion chamber for providing explosive impetus to the piston on firing of the cartridge, which tool is characterized by adaptability for a variety of bolt sizes, safety, simplicity of operation and reduced tendency to accumulate powder residue which would interfere with smooth operation of the piston and driving mechanisms.

## BACKGROUND OF THE INVENTION

This invention relates to a bolt setting tool for driving bolts or similar fastening means solidly into various construction materials and surfaces. More particularly the invention relates to a bolt setting tool which is provided with a piston that is operated by the explosion of a cartridge. The type of tool provided herein includes a movable barrel for containing the bolt, a piston located in the barrel having a driving surface or shank at one end in contact with the bolt, and a cartridge seat or combustion activated piston surface at the other end in cooperative relation with a combustion chamber which in operation drives the piston and bolt forward with a short driving stroke. Because of the longitudinal travel of the barrel with the present bolt setting tool and the feature of a fixed ignition point of the charge, bolts of different lengths can be put into the barrel or against the front face of the piston in such way that the tip of the bolt in the ignition point position of the piston and associated combustion chamber bushing, sits exactly at the provided drive-in spot. The path of travel of the barrel provided must thus be of approximately the length for fitting to bolts having a variety of lengths and this makes necessary a correspondingly long spring for the spring mounting of the barrel against the tool housing. The combustion chamber bushing has only a comparatively short driving stroke, which means that the power gas that arises from the combustion chamber only acts upon the piston for a comparatively short axial distance, and then it expands quickly by virtue of the construction and flows sideways and out of the chamber. Therefore, only very little residue of powder deposits in the short bore of the combustion chamber or combustion chamber bushing which in turn guides the rear end of the piston. Accordingly, the use of the bolt setting tool, especially the setting of bolts and the thereby following back-stroke of the piston, are rather facilitated.

An already known bolt setting tool of this general type has a combustion chamber with an axial short shell, open at both ends, and in which the rear end of the piston is to push in from the front and from the other end of which a recoil damper projects. The cartridge is placed laterally in about the middle of the combustion chamber and transverse to the chamber's axial longitudinal direction. The firing pin provided for



firing the cartridge is also principally placed vertically or at right angles to the moving direction of both piston and recoil damper in the handle. The handle also houses the rest of the firing mechanism. For inserting and ejecting, respectively, of the cartridge and cartridge case, the handle must be lifted, which causes corresponding difficulties in construction and use. As the combustion chamber bore is open not only in the front but also in its rear end and, further, at the firing of the cartridge not only the piston but also the recoil damper leaves the combustion chamber, the deposit of an unburned residue of powder is inherent in the system. This residue in time will cause the parts which are to move into the combustion chamber, especially the piston, to run heavy.

## SUMMARY OF THE INVENTION

Accordingly, it is one aspect of the present invention to provide a bolt setting tool with a short-stroke combustion chamber and bushing of the before-mentioned type which does not show the above defects but works unobjectionably in spite of a comparatively very simple construction and that especially makes possible a simpler inserting of the bolts and the thereby necessary relative pushing-in of the piston in cooperation with the combustion chamber bushing. This invention is substantially attained by providing a combustion chamber bushing which is closed at its rear end except for receiving the firing mechanism or firing pin. Furthermore, the combustion bushing is horizontally movable within a breechblock, so that at the firing of the cartridge which lies between the piston and the combustion chamber bushing, the bushing is disposed rearwardly within the breechblock. As the combustion chamber bushing is, after firing, only open in the front for the reception and guiding of the rear end of the piston, soiling of the combustion chamber by residue of powder is completely avoided. This is obviously due to the combustion temperature that is comparatively high in the present invention; thereby, first, the powder is burned more completely and, second, premature powder-gas condensation is avoided.

According to a further aspect of the present invention, the part of the breechblock which lies in front of the combustion chamber bushing is provided with a charging hole that surrounds the rear part of the piston and at the same time is a space for the expanding gas. Further, the breechblock is placed in the housing which has a correspondingly arranged charging aperture adjustable by turning in such a way that its charging hole is shut by the housing and in this shut position the firing mechanism of the combustion chamber bushing can be operated. In this manner both the charging operation as well as the ejection of the empty cartridge case are facilitated.

The total result of the combination of the short piston firing stroke and the combustion chamber bushing closed at its rear portion is that after the rear portion of the piston has been driven from the combustion chamber the powder gas expands without restraint into the rather large expansion space formed by the charging hole. The eventual deposit of powder or gas residue in the large charging hole does not interfere with the operation of the bolt setting tool, particularly as any such residue can easily be removed through the opened charging hole. In any event, the burning of the powder is substantially improved by the rearwardly closed short-stroke combustion chamber bushing and the forwardly placed, rather large charging hole, because the expansion of the powder gas from the combustion chamber in only one direction makes the burning temperature fall an inconsequential degree.

The cartridge which is between the combustion chamber bushing and the piston should, in the preferred embodiment, be placed in the rear end of the piston, though it is also possible to put it into the combustion chamber with its ignition rim facing toward the piston.

The bolt setting tool of the present invention is preferably provided with a hand trigger that releases the firing mechanism. However, it also can be fitted for corresponding hand-hammer operation. For this purpose it will be advantageous to make the breechblock with charging hole turnable and axially adjustable against the housing by means of a steep thread; thereby, the firing pin which penetrates the rear parts of the combustion chamber bushing and the breechblock at ignition position, extends through the back of the housing for reception of the ignition stroke.

According to a further aspect of the invention, a spring is provided in the cylindric casing of the breechblock which surrounds the charging hole. This spring is disposed and operates axially parallel to the bore and urges the mouthpiece and piston assembly to hold the same away from the breechblock to the most forward position. As the breechblock contains in its front part the charging hole and in its rear part the combustion chamber bushing with the firing mechanism, it has a rather long axial dimension. The spring, therefore, can easily be compressed in the casing of the breechblock so that travel of the barrel is accommodated by a corresponding length of the spring travel in the fitting of bolts of different lengths without lengthening the whole tool.

For a more complete understanding of the invention, reference is made to the drawings in which:

FIG. 1 is a vertical longitudinal cross section view of the new bolt setting tool of this invention, showing piston and mouthpiece in front charging position;

FIG. 2 is a section according to FIG. 1 but with the tool parts in firing position;

FIG. 3 is a top plan view of the tool shown in FIG. 1;

FIGS. 4 and 5 are vertical sections along the line A–B–C–D of FIG. 3, respectively illustrating the shut and opened charging hole;

FIG. 6 is a fragmentary view in partial section of a portion of the rear end of a modified piston for use in this invention showing a combustion chamber formed therein;

FIG. 7 is a fragmentary sectional view of a modified bushing with the cartridge placed in it for use with the modified structure of FIG. 6;

FIG. 8 is a further embodiment of the bolt setting tool of this invention in transverse cross section, which is fired by hand-hammer operation; and

FIG. 9 is a cross sectional view of FIG. 8 taken along the line A–B.

Referring to FIG. 1 of the drawings, there is illustrated a bolt setting tool **10** in accordance with the present invention, comprising a housing or casing **12**, in generally cylindrical form enclosing a breechblock **14** movably or slidably and rotatably disposed within the housing **12**. The breechblock **14** is contained within the casing at the rear portion **15** by means of a cap **16** secured to the housing **12** and a rubber buffer or snubber or other resilient means **17** interposed between the cap **16** and the rear portion **15** of the block **14**. The breechblock **14** contains a charging hole **18** which is readily accessible in the charging position of the breechblock as shown in section in FIG. 5 through the charging window **18***a* shown in that figure formed in the housing **12**. FIG. 4 shows the charging window closed by partial rotation of the breechblock **14** to the closed position. In FIG. 1 the charging hole **18** is also shown in the closed position forming a charging cavity which also functions as an expansion chamber for gas formed by the explosion of the cartridge used to provide driving force.

A bushing **24** is illustrated, having a combustion chamber **22**, facing forwardly, and is slidably disposed within a cavity **20** formed within the breechblock **14**. The bushing mounted for longitudinal sliding movement within the cavity **20** is urged forwardly from the breechblock by means of a spring **25**. The breechblock **14** is also provided with a centrally located bore **26** in which the rearward portion of the firing pin **27** is slidably disposed. The pin **27** is urged forwardly by a spring **28** disposed within the cavity formed at the rearward end **15** of the breechblock **14** and is supported at the rearward portion thereof against the cap **16** forming a closure in the housing **12**. A shoulder **27***a* limits forward movement of the pin **27** with respect to the block **14** by abutment against the constriction **26***a* of bore **26**. The bushing **24** is also provided with a relatively small aperture **29** also adapted to slidably fit the forward portion **30** of the firing pin **27**. The forward pin portion **30** is of reduced diameter with respect to other rearward portion of the pin **27** and fits within the aperture **29** formed in the bushing **24**. This aperture extends to the rearward portion of the combustion and firing chamber **22** formed in the bushing **24** and is adapted to strike the rearward portion of a cartridge, as hereinafter described, when the bolt setting tool is assembled in firing position, as shown in FIG. 2.

A barrell or bolt holding structure **32** of generally cylindrical shape having formed therein a central bore **34** is provided, which barrel is slidably disposed in the cylindrical aperture **14***a* formed at the forward end of the breechblock **14**. The barrel is secured within the breechblock by ringnut **36** affixed to the forward end of breechblock **14**, i.e., aperture **14***a* and by the shoulder **32***a* formed at the rearward end of the barrel **32**.

A piston **38** having a forward portion **39** and drive face **39***a* at the forward end is disposed in the bore **34**. The forward portion **39** is shaped to fit in smooth sliding relationship to the surface of the aperture or bore **34** and is adapted to drive a bolt or similar fastener **40** disposed in the forward end **32***b* of the barrel **32**. The rearward end of the piston **38** is provided with an enlarged sector or driving plug **42** containing a cartridge cavity **44**. The enlarged sector or driving plug **42** is sized for sliding fit into the cavity **22** of bushing **24**. A cartridge may be placed in cavity **44**, which cavity is chamfered to receive a suitable cartridge. A spring **46** is disposed in a cavity of the breechblock **14** to supply spring tension between the barrel **32** and breechblock **14**. The barrel **32** containing bolt **40** and piston **38** is forced rearwardly in breechblock **14** against spring **46** until plug **42** engages the combustion chamber or cavity **22** in bushing **24** and the assembly of barrel **32**, piston **38** and bushing **24** are urged rearwardly against spring **25** until in firing position, as shown in FIG. 2, by pressure on the muzzle piece **50**. The firing pin **30** is prevented from striking a cartridge in the cartridge holder by means of a retaining element or sear **52** which is urged downwardly in slot **54** of breechblock **14** by spring **56**.

When in the firing position, as shown in FIG. 2, the sear **52** may be raised by trigger mechanism **48**, releasing the firing pin **30**, and thereby driving the piston forward by means of the explosion of a cartridge activated by the pin **30**. In order to make certain that the tool can be fired only when in position, as shown in FIG. 2, when charging hole **18** is completely shut, a cross slot **58** and a longitudinal slot **60** are provided. A guide pin **62** is provided and catches the slot **58** when the tool is in the open position, as shown in FIG. 1, but when the tool is in the closed position (FIG. 2) the breechblock is rotated and the pin **62** passes out of the ring slot **58** into longitudinal slot **60** and the sear **52** is positioned over the trigger **48**. See also FIGS. 4 and 5 for the closing arrangement.

The tip of the screw **62** engages the annular groove or slot **58** until the breechblock **14** is rotated, relative to the housing **12**, bringing the longitudinal slot **60** into alignment with the tip of the screw **62**. Then the breechblock can be slid rearwardly in the housing.

In operation, a cartridge is inserted into the cartridge cavity **44** at the rearward end of the piston **38**. The car-

tridge is loaded through the aligned window **18***a* in the housing **12** and hole **18** in the breechblock **14**. Thereafter the breechblock **14** is rotated relative to the housing **12**, and the muzzle piece **50** is pushed against the work. The bolt **40** is driven into the work when the trigger **48** is pulled. Then, by grasping the forward protruding end thereof, the breechblock **14** is rotated to the loading position, and the expended cartridge is allowed to drop out of window **18***a*.

FIGS. 6 and 7 show alternate embodiments of this invention wherein the rear end **64** of the piston **38** is provided with a combustion chamber **66** (see FIG. 6) which slidably fits the forward end **68** of modified bushing **70** (shown as a fragmentary view in section in FIG. 7). In this embodiment a cartridge accommodating formation **72** is provided on the bushing and the pin **30***a* strikes the cartridge rim (for rim fire cartridges) as shown. The assembly otherwise is the same as shown in FIGS. 1 and 2.

In FIG. 8 an alternative embodiment is shown where a firing pin is driven by hammer pressure. In this embodiment the breechblock **74** is rotatable against the housing **76** by means of a steep thread which serves to rotate the breechblock and close the charging hole **78**. The firing pin **80** is driven forward by a hammer blow on the projecting end **82** which protrudes from an aperture **84** formed in end cap **86**. This drives the pin **80** forward in bushing **88** exploding the cartridge in the cavity **87** of end **89** of piston **90** closely fitted into the combustion chamber **85** of bushing **88**. The piston **90** is driven forward with the bolt **92** and the gases escape from chamber **85** to charging hole chamber **78** then in closed position, as shown in FIG. 4.

FIG. 9 shows a section along the line A–B of FIG. 8 where the charging port **78** is in the open or charging position.

While several particular embodiments of the invention have been illustrated in the foregoing, it will be appreciated that other embodiments may be provided which do not depart from the true spirit and scope of this invention and such embodiments are intended to be included herein.

I claim:

**1.** A bolt fastener setting tool for driving bolts into construction materials by means of a piston driven by a cartridge explosion which comprises:

(a) a housing of generally hollow cylindrical form,

(b) a breechblock rotatably and slidably disposed within said housing and having a bushing cavity formed in the forward end thereof,

(c) a bushing slidably disposed within the cavity of the breechblock, and having a forward-facing first chamber portion therein,

(d) a barrel slidably cooperating with the breechblock and having an axial bore adapted to hold a bolt or other fastening means,

(e) a driving piston disposed at one end in said barrel in driving relationship to a bolt disposed therein,

(f) a second chamber portion formed in the other end of the piston, juxtaposed with said first chamber,

(g) said first and second chamber portions forming a combustion chamber, and



(h) a firing pin mechanism slidably disposed within said bushing for discharging the cartridge whereby explosive gases from said cartridge force the said other end of the piston in bolt driving fashion.

**2.** A bolt setting tool according to claim **1** wherein the second chamber portion of said piston includes a rearwardly facing first cavity formed at the other end thereof and the bushing has a corresponding element for fitting relationship into said first cavity, said first chamber portion being formed in said element.

**3.** A bolt setting tool according to claim **1** wherein the first chamber portion is a forwardly facing cavity formed in the bushing, the rearward end of which is adapted to receive a firing pin from the firing pin mechanism.

**4.** A bolt setting tool according to claim **1** wherein the breechblock and housing have a charging cavity formed therein forward of the combustion chamber formed by the associated piston and bushing and adapted to receive explosive gases from the combustion chamber after the other end of the piston is driven forwardly and away from the bushing.

**5.** A bolt setting tool according to claim **4** wherein means are provided to render the firing mechanism operative only when the housing has been rotated with respect to the breechblock to place the charging hole in the breechblock out of register with the corresponding charging hole in the housing to form thereby a discharge cavity for the reception of explosive gases from the combustion chamber.

**6.** A bolt setting tool according to claim **1** wherein a spring means is provided between the barrel and the breechblock to accommodate barrel travel of varying amounts when bolts of varying dimensions are used.

**7.** A bolt setting tool according to claim **1** wherein one of said combustion chamber portions is disposed for close sliding relationship within the other of said combustion chamber portions.

**8.** A bolt setting tool according to claim **4** wherein an end of the firing pin selectively protrudes from the housing at the end opposite the barrel for impact firing by a hammer.

**9.** A bolt setting tool according to claim **8** wherein the housing and breechblock are in coarse threaded engagement and have respective charging holes which are aligned in one position of relative rotation, whereby rotation of the said housing and breechblock to another position of relative rotation closes the charging hole in the breechblock and causes the said end of the firing pin to protrude from said housing.


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