United States Patent [19]

Gilbert

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[54] **POWDER ACTUATED DEVICES**

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[73] Assignee: **The British Screw Company Limited,** Leeds, England

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June 1, 1971 Great Britain 18280/71

[52] **U.S. Cl.** **227/10**

[51] **Int. Cl.** **B25c 1/14**

[58] **Field of Search** 227/7, 8, 9, 10, 11

[56] **References Cited**

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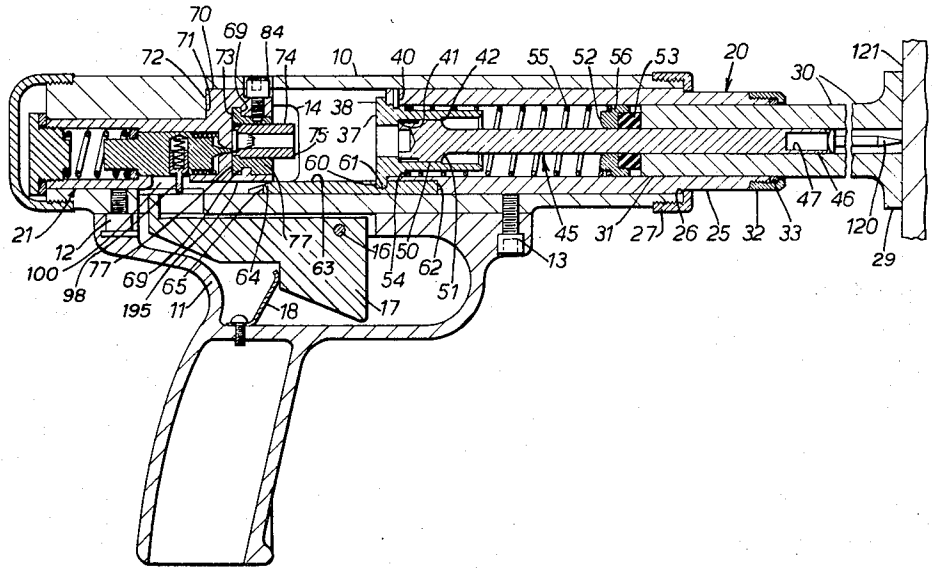
Primary Examiner—Granville Y. Custer, Jr.

[57] **ABSTRACT**

A cartridge actuated stud fixing tool is disclosed which is provided with a two chamber magazine slideable from side to side to bring one chamber to an ejection position and the other to a firing position and axial ejection means operated by the cocking movement of depressing the barrel against a workface which ejection means push the last fired cartridge backwards out of the chamber which is in the ejection position.

9 Claims, 8 Drawing Figures



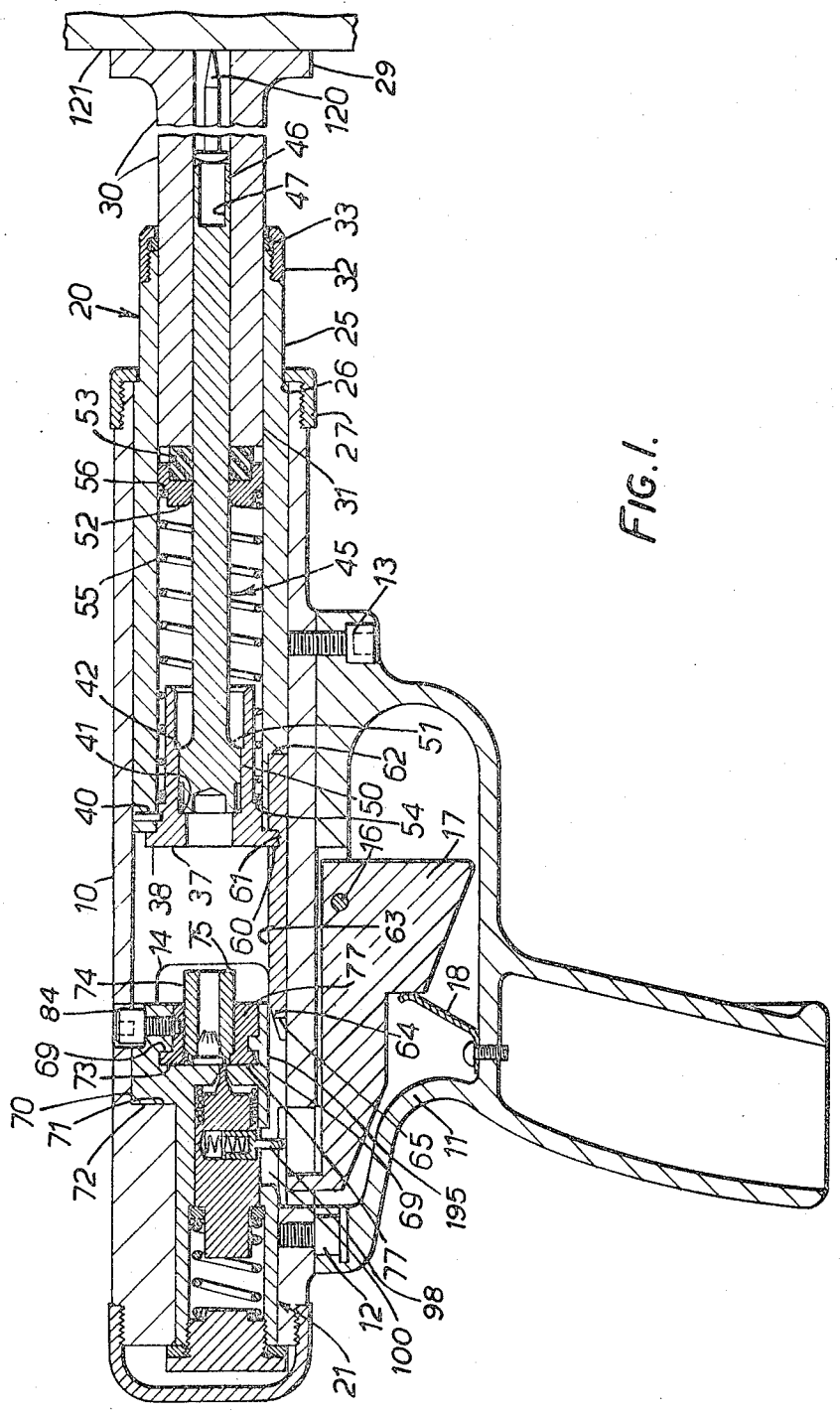

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FIG. 1.

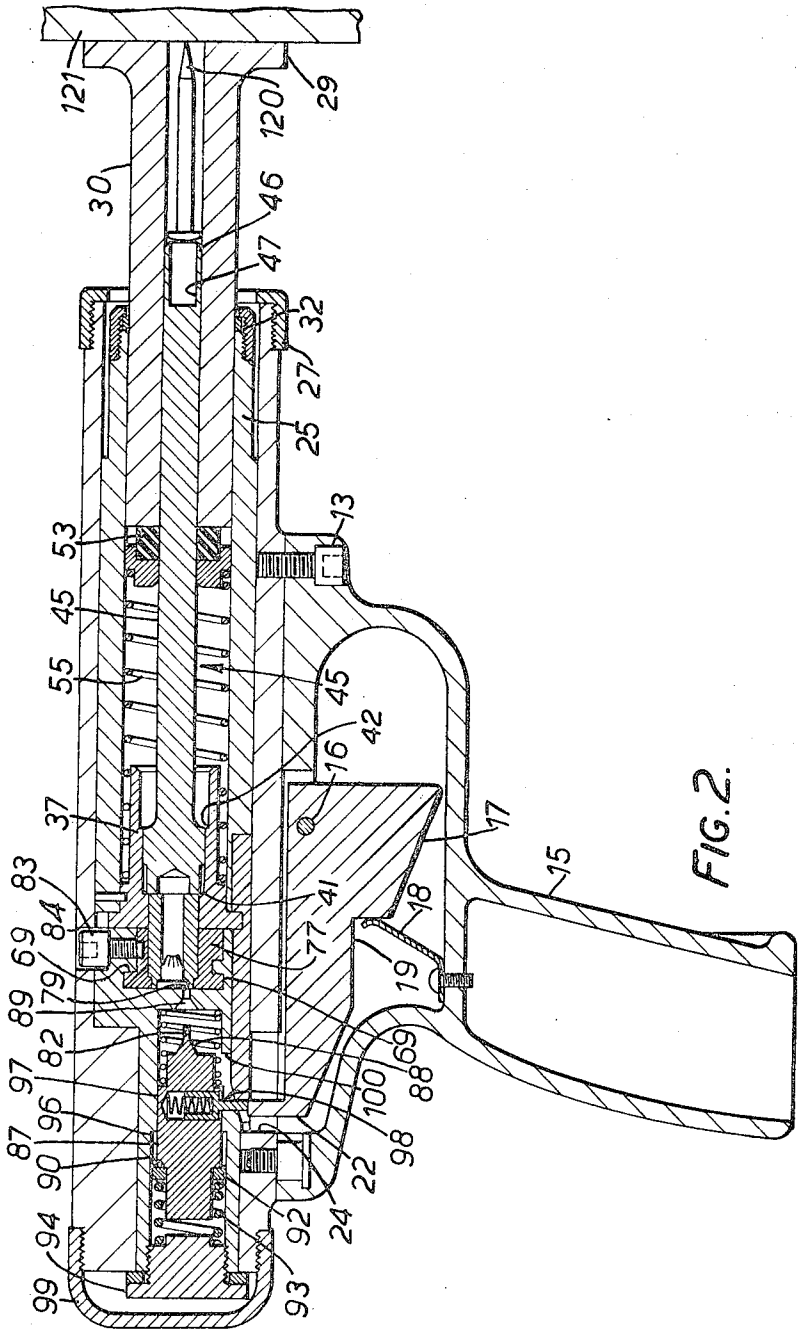
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FIG. 2.

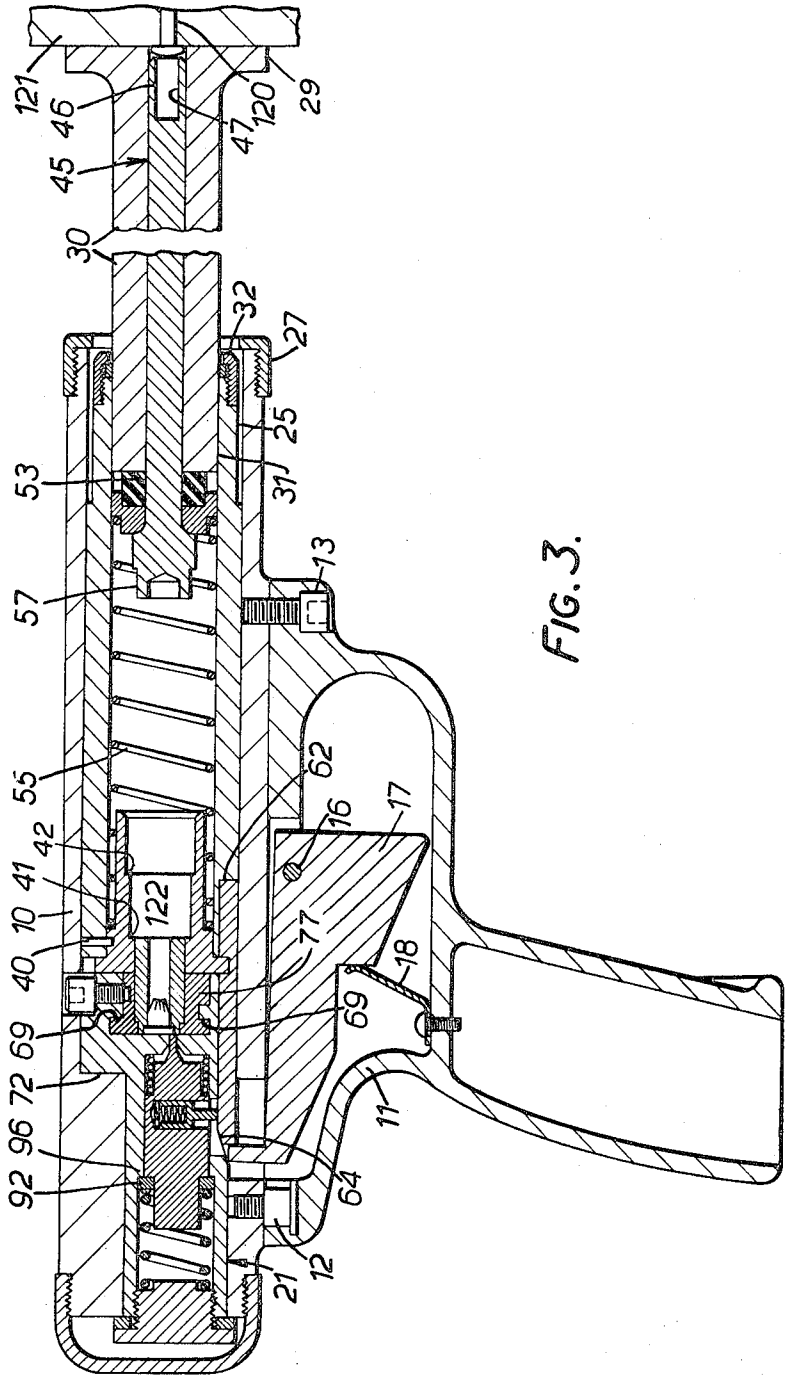
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FIG. 3.

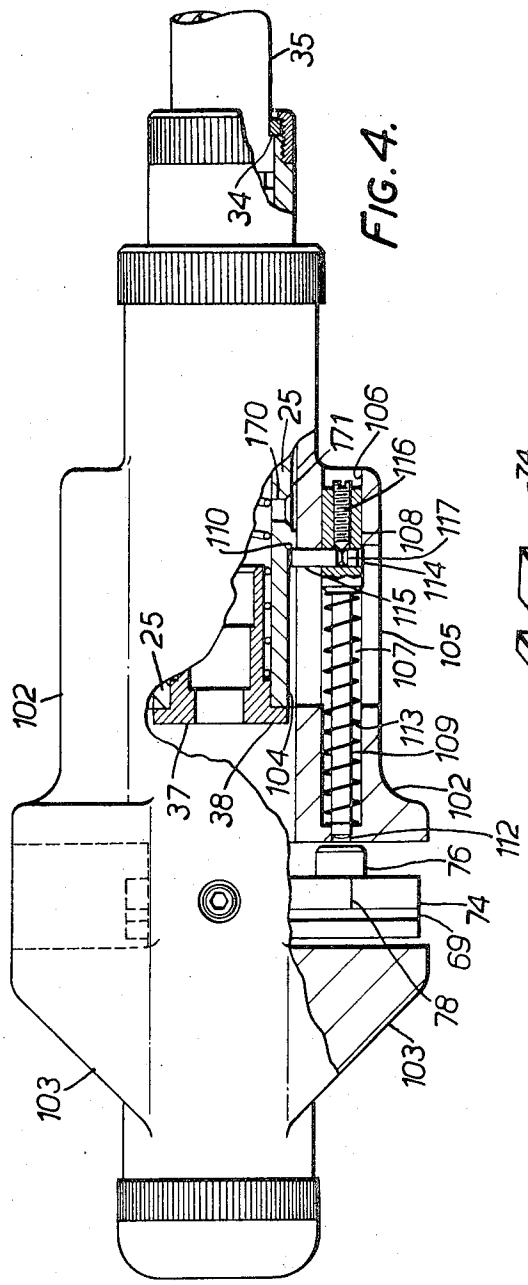
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FIG. 4.

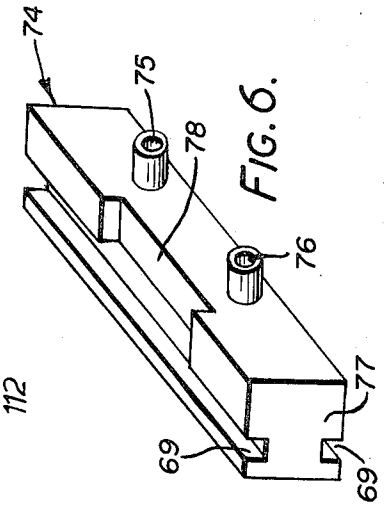
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FIG. 6.

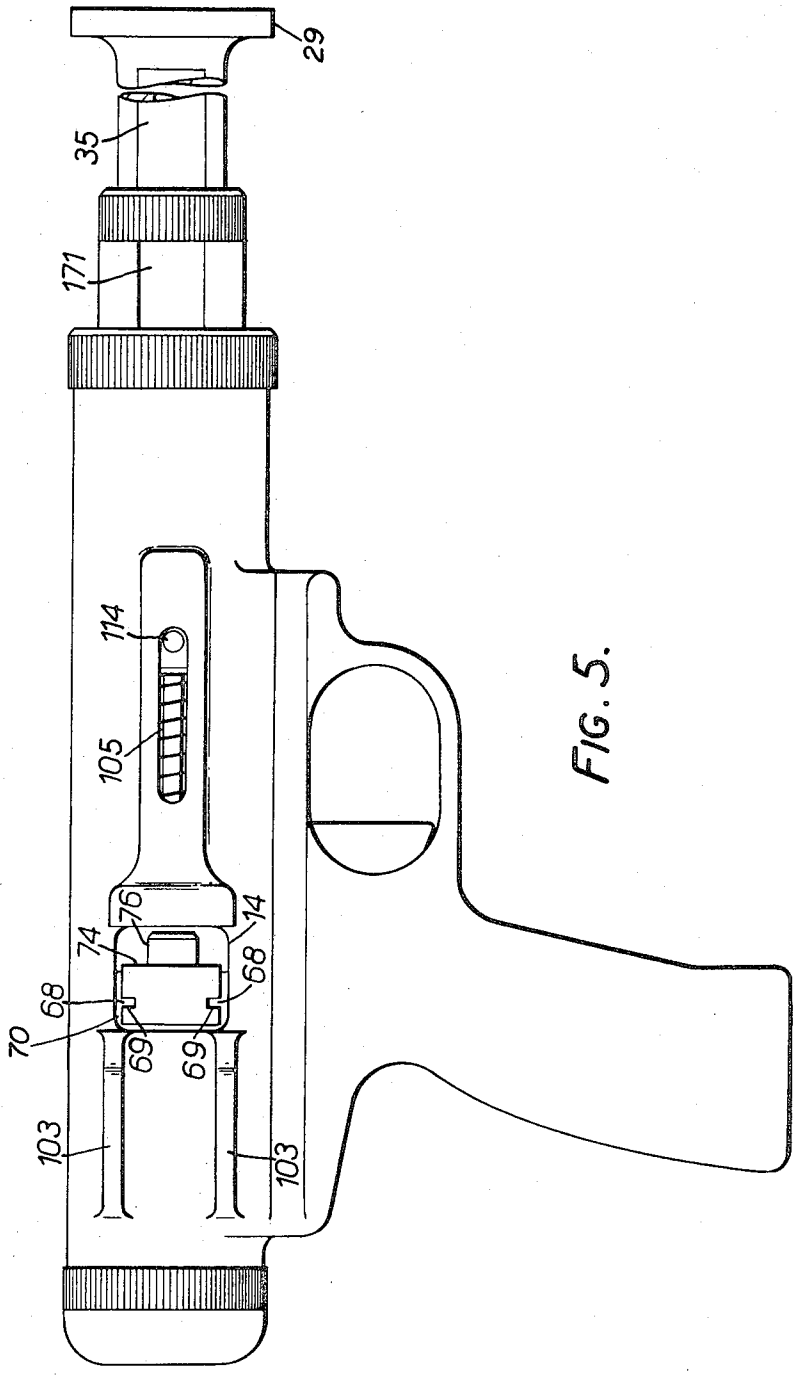

FIG. 5.

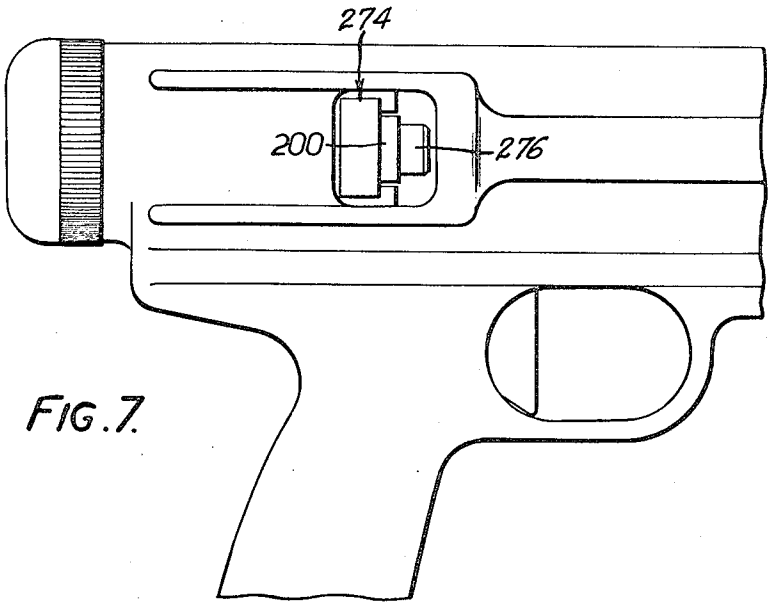

FIG. 7.

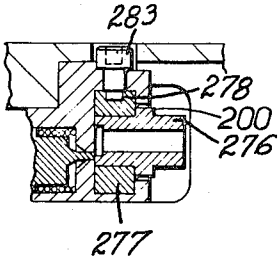

FIG. 8.

POWDER ACTUATED DEVICES

The present invention relates to powder actuated devices and includes devices which fire projectiles, such as pistols, rifles, machine guns, or other hand guns, devices in which a captive tool such as a chisel or hammer is driven only partly out of the tool and more particularly to powder actuated stud or nail fixing tools, e.g., using a powder filled cartridge though cartridgeless powder charges could also be used and these are included whenever a cartridge is referred to herein. Stud fixing tools can be of the flying piston or pusher piston type. In a flying piston tool the stud is located in the end of the barrel and the piston is driven along the barrel to strike the stud and drive it out of the tool into a work piece. In a pusher piston tool the piston and stud remain in contact throughout the cocking and firing sequence and this is a safer type of tool because the muzzle velocity of the stud is low compared to flying piston tools. The cartridge can be one which is detonated by percussion by a pin or can be one which can be electrically detonated or can be of any other suitable type capable of generating adequate gas pressure.

It has been proposed in U.S. Pat. No. 3,473,719 (to Jephson dated Oct. 21, 1969) to provide a cartridge operated tool with a multi shot magazine arranged to be fed shot by shot transversely to the tool by the action of cocking the tool.

This arrangement however depends on interengaging pawls and cam surfaces and under the severe conditions which occur on building sites would be liable to damage and jamming, e.g., by sand.

Also the magazine has to have the spent cartridges removed by hand.

The invention finds its most preferred embodiment in the form of a percussion actuated pusher piston stud fixing tool and will be described with particular reference to such a tool, however it will be appreciated that the invention is not limited to such tools.

It is an object of the present invention to provide a simpler more robust form of stud fixing tool with a more rapid and simple firing sequence. More specifically it is an object to provide a tool with an automatic mechanism for ejecting spent cartridges.

A powder actuated device in accordance with the present invention has a body housing, a barrel assembly, a firing assembly and magazine means located between the barrel assembly and the firing assembly which affords means for firing a cartridge in the magazine means, the magazine means being secured to the said firing assembly so as to prevent relative movement there between in a direction parallel to the longitudinal axis of the device whilst permitting movement transverse to the said longitudinal axis, the magazine means having at least two cartridge chambers arranged so that the magazine means can be moved to bring the last fired cartridge into an ejection position and simultaneously bring a new cartridge into the firing position and ejection means mounted on the body and displaceable into or through the cartridge chamber which is in the ejection position so as to eject the spent cartridge without detaching the magazine means or the ejection means from the device. Desirably the ejection means are automatically displaced so as to eject the spent cartridge between firing successive cartridges. This may be achieved during the cocking of the tool or by the action of the gases released by the cartridge on firing.

The device in its preferred form of a stud fixing tool has a barrel slide mounted to slide longitudinally in a housing and in order to cock the tool the barrel slide is pushed rearwardly into the housing towards the magazine and the associated firing mechanism. This movement of the barrel slide into the housing can be used to actuate the ejection means, preferably by forcing the ejection means, e.g., a rod, rearwardly so that the rod clears the chamber, e.g., pushing out the spent cartridge. Alternatively the ejection means can be carried on the rear of the barrel slide. Also the barrel slide movement could merely release the ejection means which could be spring actuated, (the forward movement of the barrel slide could be used to in effect cock the spring of the ejection means in this arrangement).

In a further alternative the ejection means are manually operable by a handle and can again comprise a rod or tube mounted for axial movement parallel to the barrel so as to be capable of being forced rearwardly so as to clear the spent cartridge from the chamber.

In the preferred arrangement in which a two chamber magazine is mounted for sliding movement from side to side relative to the housing a pair of ejection means are located outside the housing (though in an integral casting with the housing) and on either side of the housing. However with other magazine arrangements where the ejection positions are at other angular dispositions relative to the housing the location of the ejection means can be varied to suit the ejection positions so that the preferred axial ejection, e.g., by movement of a rod in a direction parallel to the longitudinal axis of the tool, can be achieved.

This applies to both the automatic and manual arrangements though in the manual arrangement it may be desirable to inter-connect or gang the handles so that both ejectors can be operated with one hand, e.g., the right hand.

It has been mentioned above that the barrel slide preferably actuates the ejection means.

Thus the barrel slide may be arranged to force the ejection means rearwardly against the action of spring means and the spring means may be used to return the barrel slide to the extended position. The return movement of the barrel slide to the extended position can also be used to return the ejection means to the forward position, thus the spring means may act directly on the ejection means. This can conveniently be achieved by having a pin or other protuberance on the ejection means extending through a slot in the wall of the housing so as to co-operate with the barrel slide, e.g., a shoulder or slot in the barrel slide. (However a reverse arrangement could also be feasible).

The magazine is secured to the firing pin housing and preferably slides therethrough in keyed relationship to it.

Alternatively the magazine may be arranged to rock from side to side about a pivot or to revolve about an axis and also be keyed to the firing pin housing.

Alternatively the magazine may be keyed to a separate insert in front of the firing pin housing this insert being itself keyed to the main integral housing.

A powder actuated tool incorporating the invention described herein may be made in various ways but one specific embodiment and one modification will be described with reference to the accompanying drawings in which:

FIG. 1 is a partial longitudinal cross section of one form of the tool, with only part of the handle shown and the full length of the barrel not shown, and showing the tool just at the beginning of the ejection of the spent cartridge,

FIG. 2 is a section similar to FIG. 1 showing the tool in the fully cocked position,

FIG. 3 is a section similar to FIG. 1 immediately after firing before the tool is removed from the wall,

FIG. 4 is a plan view of the tool showing in partial cross section the ejector mechanism and the method by which the barrel is retained,

FIG. 5 is a side elevation of the tool,

FIG. 6 is a perspective view of the magazine shown in FIGS. 1 to 5,

FIG. 7 is a partial view similar to FIG. 5 showing a modified form of magazine, and

FIG. 8 is a partial view similar to FIG. 3 showing a cross section of the modified form of magazine shown in FIG. 7.

FIGS. 1, 4 and 5 all show the tool in the same state.

The tool has a generally cylindrical body housing **10** to which a trigger and handle housing **11** is attached by means of two bolts **12** and **13** passing through holes in the handle housing and screw threaded in the underside of the body housing.

The body housing contains at its front end (the right-hand end of FIG. 1) a slidable barrel assembly **20** and contains at its rear end a fixed cartridge holding and firing assembly **21.**

The slidable barrel assembly **20** comprises a cylindrical slide **25** having shoulders **26** on its top and bottom edges by which the assembly **20** is removeably secured within the body housing **10** by means of a knurled nut **27** screw threaded on the outside of the front end of the body housing **10.** The barrel slide **25** also has flats **171** on its sides (FIG. 5).

A work face engaging barrel **30** having a workface engaging flange **29** has its rear end **31** slidably mounted in the front end of the slide **25.** The front end of the slide **25** is sealed around the barrel by means of a knurled nut **32** screw threaded on the outside of the slide **25** which engages a hardened steel washer **33** which at the sides of the tool extends inwardly of the rear end **31** of the barrel so as to engage the shoulder **34** (FIG. 4) formed by flats **35** in the sides of the barrel and thus holds the barrel within the slide **25.**

At the rear end of the slide **25** there is an insert **37** defining an expansion chamber which is a push fit inside the end of the slide **25** and is secured therein by three equidistantly spaced radial dowels only one **40** of which is shown. Alternatively the expansion chamber can be screw threaded into the barrel slide **25.** The expansion chamber **37** has at its rearward end an annular flange **38** which abuts against the rearward end of the slide **25.** The interior of the expansion chamber has three sections each of larger diameter going from back to front end separated by two shoulders **41** and **42** respectively. A plunger **45** is located with its rear end **50** snugly slidable within the middle section of the expansion chamber **37** and its front end **46** slidable in the barrel **30.**

The barrel slide has four gas venting ports **170** on each side (the rearmost of which are shown in FIG. 4) communicating with the rear end of the flats **171.** Thus once the head **57** of tge plunger has passed the ports **170** gas can escape from the interior of the barrel slide to atmosphere via the flats **171.** Alternatively the flats could be formed in the top and bottom of the barrel side **25** to ensure that gas escapes forwardly and not outside ways through the ejection mechanism.

The edges of the nut **27** opposite the flats **171** can be fluted to assist gas escape.

The rear end **50** of the plunger is wider than the rest of the plunger and carries curved buffering shoulders **51** which are arranged to co-operate with metal buffers **52,** spaced from the rear end of the barrel **30** by a large rubber washer **53,** so as to limit forward movement of the plunger relative to the barrel **30** and slide **25.**

The front end **46** of the plunger has a longitudinal hole **47** bored in it to receive the heads of small diameter fixing devices.

A spring **55** (in a compressed state in FIG. 1) is located between a shoulder **56** on the buffer **52** and a shoulder **54** on the outside of the expansion chamber **37.**

The lower edge of the flange **39** of the expansion chamber fits into a transverse slot **60** in a sear **61.** The sear is semi cylindrical and at its front end fits into a recess **62** in the bottom of the rear end of the slide **25.** The sear has a flat top **63** and at its rear end is provided with a chamber **64** and a notch **65.** The sear **61** fits into a slot **195** in the bottom of the firing pin housing **70** (described below).

The barrel assembly **20** comprising the slide **25** the chamber **37** plunger **45** barrel **30** and sear **61** can be easily removed from the housing **10** for cleaning or repair merely by undoing the nut **27** and sliding the assembly out of the housing. Once out of the housing the sear **61** will drop away from the flange **38.** The rest of the assembly can be disassembled by undoing the nut **32** and sliding out the barrel **30** from the slide **25.** The buffer **52, 53** and spring **55** can then be removed as can the plunger **45** through the front end of the slide **25.** The expansion chamber **37** can be removed from the slide **25** by undoing the dowels **40** and pulling it out since it is only a push fit. Reassembly of the barrel assembly **20** and reinsertion into the housing **10** is merely the reverse operation.

The firing assembly **21** as mentioned above is housed at the rear of the tool. It comprises a firing pin housing **70** having an annular shoulder **71** (shown in FIGS. **1** to **3** at its upper edge) which abuts a corresponding annular shoulder ring **72** formed on the inside of the housing **10.** This ring extends around the entire inside circumference of the housing **10** except for a gap in its bottom edge (opposite the groove **195** in the housing **70**) through which the sear **61** passes. The front end of the firing pin housing **70** has a transverse square sectioned cavity **73** formed in it which houses the magazine **74.** The magazine slides transversely through the cavity **73** and extends out through windows **14** formed in each side of the body housing **10.**

The magazine is a solid block **77** of metal and has two cartridge chambers **75** and **76** formed as male inserts which are push fits in the block **77.**

Slots **69** are formed in the top and bottom faces of the magazine and co-operate with square ribs **68** (FIG. **5**) formed in the firing pin housing **70.** The magazine thus has an H-shaped cross section.

The slots **69** key the magazine to the firing pin housing whilst allowing it to be slid easily from side to side without jamming.

In addition it ensures that the cartridge will not burst on firing since the magazine is held by the grooves tight against the front of the firing pin housing. Without this keying the barrel assembly would have to be relied upon to ensure that the magazine was held against the firing pin housing.

The rear wall of the cavity **73** has a hole **79** through which a firing pin **82** (see FIG. **2**) can pass. A bolt **83** passes through a hole **89** in the top of the housing **10** and is screw threaded in the firing pin housing **70** and extends down into a wide slot **78** in the top of the magazine **74.** The center of the bolt **83** is diametrically above the firing pin hole **79.** The slot **78** as shown in FIG. **6** is formed by cutting away the metal at the top front side of the magazine. The length of the slot is equal to the distance between the centers of the chambers **75** and **76** plus the diameter of the bolt **83.** Thus when the bolt **83** engages either end of the slot **78** the longitudinal axis of the respective chamber is in register with the firing pin hole **79.**

In addition there may be a spring loaded ball supported in a bore in the middle of the lower portion of th magazine and arranged to engage semi-circular holes (not shown) in the front face of the firing pin housing so as to hold the magazine in the inregister positions once these have been reached. Clearly alternative forms of indexing means could also be used.

FIGS. **7** and **8** show an alternative form of magazine with a modified arrangement for securing the chambers.

The magazine **274** is rectangular in cross section and has a slot **278** cut in its top face which is engaged by the screw **183** as in the arrangement described above.

The chambers **276** are push fits into through-bores in the block **277.** The outside faces of the chambers have annular flanges **200** which engage the front face of the block **277** and stop it passing right through the bore. This simplifies production of the block **277** and the chambers.

It will be appreciated that the relative positions of the hole **79** and the chambers **75** and **76** are arranged for rim firing cartridges but clearly the tool could readily be modified to take other cartridges such as center firing cartridges by changing the position of the chambers **75** and **76** in the block **77** of the magazine.

Similarly the dimensions of the cartridge chambers could be varied to suit a wide range of cartridges if so desired and the present arrangement would make this very easy to achieve.

All that is required to remove the magazine is to unscrew the bolt **83** until it clears the slot **78.** The magazine can then be slid out of the cavity **73** and through the window **14.**

The rear portion of the firing pin housing houses the firing pin **82** and its integral hammer **87.** The firing pin has conical sloping shoulders **88** broadening out from the pin to the hammer. The hole **79** also broadens out into a conical cavity **89** but the cavity **89** diverges more rapidly than the shoulders **88.** The hammer **87** at its rear end has a shoulder **90** engaged by a steel washer **92.** This washer is loaded by a powerful spring **93** which itself engages a plug **94** which is screw threaded into the end of the firing pin housing **70.** The internal cavity of the firing pin housing is of greater diameter at the rear than the hammer **87** but is stepped down via a shoulder **96** to a sliding fit with the hammer at the front end of this cavity. Thus the hammer can be forced back against the spring **93** by means of the washer **92** and the shoulder **90.** When released the spring will drive the hammer forwards again via the washer **92** and shoulder **90** until the washer engages the shoulder **96.** The hammer **87** has a vertical transverse hole bored in it extending out through its bottom edge. A weak spring **97** in this cavity biases a firing pin release pin **98** outwardly through a slot **100** in the bottom of the housing **70.**

The rear end of the housing **10** is closed by a cap **99** screw threaded on the outside of the housing **10.**

The trigger and handle assembly (only part of the handle **15** is shown) contains a trigger lever **17** pivoted at **16** and biased to the safe position by a leaf spring **18** engaging a detent **19.**

The trigger is basically a right angle triangle pivoted adjacent the right angle, with the detent in the hypotenuse. A firing pin release peg **22** extends up through a slot **24** in the bottom of the housing **10** and the top of the housing **11.** In its normal fully biased position the top of the peg **22** is just at the same level as the bottom of the firing pin release pin **98** when it is in its fully biased position.

The firing pin and cartridge holding assembly **21** can be disassembled by unscrewing the bolt **83** as described above then releasing and removing the magazine **74.**

The cap **99** is now removed. This enables the whole firing pin housing to be removed as a unit from the rear of the housing **10.** This assembly can be stripped down by unscrewing the plug **94** withdrawing the spring **93** and washer **92** and then the hammer **87** and release pin **98.**

Assembly is merely the reverse operation.

The tool also contains an axial spent cartridge ejection system with ejection means located on each side of the body housing just in front of the windows **14.**

The body housing (as shown in FIG. **4**) has an ejector housing **102** as an integral part of the housing **10.** To the rear of the windows **14** and level with the tops and bottoms of the windows **14** there are a pair of wings or guards **103** located on each side of the housing **10.**

As shown in FIG. **4** the sides of the slide **25** and the annular flange **38** of the expansion chamber have a groove of a flat **104** formed in or on them which provides a rearwardly facing shoulder **110.** The housing **102** has a slot **105** formed through it so as to coincide with the groove or flat **104.** Coaxial with this slot is a longitudinal bore **106** which is coaxial with the chamber **76** when the chamber is fully displaced away from the firing pin housing.

An ejector **107** having a wide head **108** is located in the bore **106** with the wide head at the front end of the housing **102.** The ejector has a narrower stem **109** which passes out of the housing **102** via a narrower bore **112.** The ejector is biased by a spring **113** towards the front end of the housing **102.** The wide head **108** has a hole **114** bored through it transversely. A pin **115** is located in this hole extending through the slot **105** in the housing **10** so as to engage the shoulder **110.** The pin **115** is held releasably in position in the hole **114** by means of a grub screw **116** threaded axially in the end of the wide head of the ejector which engages a waist **117** in the pin **115.**

The ejector can be disassembled by unscrewing the grub screw until the pin **115** can be dropped out. Then the ejector **107** and spring **113** can be withdrawn from the bore **106** through the front of the housing **102.**

Assembly is merely the reverse operation. Operation of the tool will now be described.

FIGS. 1, 4 and 5 all show the tool in the same condition, namely with a nail 120 loaded into the barrel and the tool pressed against the work face 121 only sufficiently for the nail to engage both the work face and the front end of the plunger. This stage is just immediately prior to commencement of ejection of a spent cartridge from the chamber 76 (see FIG. 4).

The nail has forced the barrel inwardly into the slide 25 compressing the spring 55 and has also pushed the plunger 45 into the central chamber of the expansion chamber 37. Thus the barrel 30 the plunger 45 and nail 120 and slide and expansion chamber now act as a single unit and on further pressing of the tool by the operator against the work face the whole barrel assembly will slide back into the housing 10. Prior to this stage pressing the tool against the work face would merely press the barrel back into the tool and the plunger would not be forced into the expansion chamber until its end 46 actually contacted the work face 121.

Once the stage shown in FIG. 1 is reached further pressure against the work face first causes ejection of the spent cartridge to occur. As shown in FIG. 4 the shoulder 110 engages the pin 115 and pushes the ejector rearwardly through the chamber 76. Consideration of the drawings makes it clear that the ejector will have passed right through the chamber 76 before the expansion chamber 37 contacts the chamber 75. Further pressure brings the tool to the state shown in FIG. 2 which is the fully cocked fully ejected state.

In moving from the end of the ejection to the FIG. 2 state the sear 61 slides up to the end of the pin 98 which is engaged in the notch 65 and is forced with the hammer 87 and firing pin 82 back against the action of the spring 93, until it comes up against the end of the slot 100 in the bottom of the firing pin housing 70. At this position the pin 98 is positioned above the peg 22 of the trigger lever 17. Also the chamber 75 is snugly located in the first section of the expansion chamber 37 tightly up against the end of the plunger 45. The end face of the chamber 37 is also tight up against the magazine 74.

The tool is now ready to fire. This is done by squeezing the trigger 17 so that it pivots the peg 22 upwardly this forces the pin 98 into its hole against its weak spring 97 out of the notch 65 until it can ride up the chamfer 64 with the hammer 87 under the action of the powerful spring 93. Once up the chamfer it rides along the flat top 63 of the sear until the pin 82 passes through the hole 79 and detonates the cartridge 122 at its rim. Shortly thereafter the washer 92 engages the shoulder 96 of the firing pin housing. The weak spring then halts the hammer and returns the pin after firing. The cartridge has ignited and the plunger moves away from the end of the chamber. The recess 57 in the outside of the rear end of the plunger 45 enable the gases to exert back pressure on the shoulder 41 to hold the expansion chamber 37 tight against the chamber 76 until the recess 57 has cleared the shoulder 42.

The plunger 45 is then driven out of the expansion chamber down the barrel, driving the nail 120 into the work face. At some state in this movement depending on the length of the nail the shoulders 51 on the plunger engage the buffers 52 thus driving the tool backwards slightly against the operator since the barrel is forced outwardly from the slide 25. FIG. 3 shows this condition just after the nail has been driven home.

The tool is now taken away from the wall and the springs 113 force the slide 25 sear 61 and chamber 37 back to the FIG. 1 point. A new cartridge is pushed by hand between the wings 103 into the chamber 76 and the magazine pushed by hand fully across to the other-side so that the chamber 76 is now in register with the hole 79 through which the firing pin moves. The spent cartridge 75 is now in register with the ejector on the other side of the tool ready for automatic ejection during the next cocking cycle.

It will already have been appreciated how simple the tool is to make, assemble and operate.

The tool is also extremely safe. Firstly the tool can only be cocked by being pressed against a work face since the pressure between the work face and the nail or other fixing device and the plunger is essential to cock the tool.

In addition the distance between the end of the nut 32 and the shoulder 26 is less than that through which the sear has to move in order to cock the device thus forcing the nut 32 against a hard edge would not achieve cocking of the device.

Also if the tool is removed from the work face after being cocked but before being fired the spring 55 (which is highly compressed in this stage) will force the barrel 30 forwards so that its shoulders 34 will strike the washer 33 located inside the nut 32. This will jerk the slide 25 and expansion chamber 37 and sear 61 forwards so that the chamber will no longer be closed but will be open to atmosphere via the windows 14 in the housing. The firing pin is no longer restrained by the sear. However the momentum is not likely to actually detonate the cartridge but should this happen the cartridge will dissipate its energy to atmosphere.

The springs 113 also act to force the slide 25 forwards when the tool is removed from the work face back to the FIG. 1 position.

What is claimed as my invention and desire to secure by Letters Patent is:

1. A powder actuated device comprising a body housing, a barrel assembly and a firing assembly secured to said body housing, and a magazine having at least two cartridge chambers spaced apart transversely of the device, means mounting said magazine between said firing assembly and said barrel assembly for movement transverse to the longitudinal axis of said device while preventing relative movement of said magazine parallel to said axis, said transverse movement of said magazine bringing the chamber containing the last-fired cartridge into an ejection position and simultaneously bringing another chamber into firing position, and ejection means mounted on said body housing for displacement to penetrate said chamber which is in the ejection position to clear said chamber without detaching the magazine or the ejection means from the device.

2. A powder actuated device which includes a housing having an opening therein, a magazine provided with at least two chambers, a barrel mounted in the housing and movable longitudinally of the housing from an extended position to a retracted position, in which the device is conditioned for firing, by urging the muzzle of the device against a surface, means mounting the said magazine in the said housing for reciprocating movement through said opening, while the barrel is in

the extended position, to bring one chamber to an ejection position while another chamber is simultaneously brought to a firing position, and ejection means mounted on the device for movement parallel to the longitudinal axis of the device for displacement through a chamber in the ejection psition to clear the chamber.

3. A device as claimed in claim **2** including means operatively connecting the barrel and ejection means whereby movement of the barrel from the extended position to the retracted position causes the ejection means to operate.

4. A device as claimed in claim **2** wherein the magazine moves in a direction transverse to the longitudinal axis of the device and the ejection means move in a direction parallel to the longitudinal axis of the tool.

5. A device as claimed in claim **3** including spring means opposing rearward movement of the ejection means, said spring means assisting the return of the barrel to the extended position.

6. A device as claimed in claim **3** in which the means operatively connecting the barrel and the ejection means comprise a barrel slide which is slidably located in the body housing, the barrel being slidably located in the barrel slide.

7. A device as claimed in claim **6** in which the return movement of the barrel slide to the extended position returns the ejection means to the forward position.

8. A device as claimed in claim **5** in which the spring means act directly on the ejection means.

9. A device as claimed in claim **6** in which the ejection means are located outside the barrel slide.

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