This invention relates to a powder actuated tool, and more particularly to a powder actuated tool with a recoil absorber.

Powder actuated tools have an important role, particularly in the construction industry, to secure fasteners in walls, floors and the like, and are very extensively used. However, the powder actuated tools known hitherto and used up to several years ago, have been of the high velocity type. Within the last few years a low velocity powder actuated tool providing greater safety has been developed and used quite extensively. This type of tool minimizes the possibility of accidents, but due to the mass of the captive piston, results in much higher recoil than the high velocity tools. The extremely high recoil of this type of tool has limited its use to light duty fasteners. It would be desirable to provide a low velocity captive piston tool which is capable of driving medium and heavy duty fasteners with larger diameter and longer shanks than has hitherto been possible in this type of tool. A further problem has been present in powder actuated tools of the captive piston type which have a captive piston provided with a large piston portion, which tapers in a transition portion to a smaller diameter ram portion adapted to enter a bore of a muzzle of the barrel of the powder actuated tool, and in which the barrel has a tapered portion complementary to the transition portion to effectuate drawing of the transition portion. When the tool is fired without sufficient resistance encountered by the captive piston, the barrel portion often is damaged by such accidental firing of the tool and has to be replaced. The main portion of the barrel usually is undamaged and it would be desirable to be able to replace just the damaged muzzle portion of the barrel. It would also be desirable to provide a captive piston powder actuated tool in which a power plug assembly including a piston cage is provided with a tapered portion adapted to receive a threaded power plug, the plug being interchangeable with plugs adapted to hold different size cartridges.

An object of the invention is to provide a new and improved powder actuated tool.

Another object of the invention is to provide a powder actuated tool with a recoil absorber.

A further object of the invention is to provide a powder actuated tool having a pad of resilient, compressible material adapted to resist recoil movement of a firing mechanism of the tool to dissipate the recoil forces.

Yet another object of the invention is to provide a powder actuated tool having a recoil pad of foam-like, resilient plastic material having the characteristic of high energy shock during compression and also having a slow recovery characteristic.

A still further object of the invention is to provide a powder actuated tool in which a recoil absorber is positioned between a free floating firing mechanism and a handle.

A still further object of the invention is to provide a powder actuated tool having a trigger mechanism which cannot be fired from shock, such as that occurring, for example, in dropping the tool.

Another object of the invention is to provide a powder actuated tool having a power plug assembly including a captive piston and a collet-like piston cage together with a removable cartridge carrying plug mounted in the sleeve.

Yet another object of the invention is to provide a powder actuated tool including a barrel provided with a separable muzzle portion.

The invention provides a powder actuated tool preferably having a pad of resilient, compressible material compressed by recoil of a breech block subsequent to firing the tool to absorb and dissipate the energy of recoil. The pad preferably is a partially precompressed, elongated mass of foam-like plastic material having high energy absorption and a slow recovery characteristic. The tool also is preferably provided with a novel firing mechanism including a lightweight hammer and firing pin actuated by a light spring action so that accidental firing from shock occurring as, for example, in dropping the tool is prevented. Another feature preferably included in the tool is that of a power plug assembly having a compressible pad provided with collet-like gripping fingers and along which is slidable a captive piston having an elongated, smaller ram portion with a cartridge-holding power plug threaded into a tapped end portion of the piston cage. Preferably there also is provided a muzzle portion having a bore slidably receiving a fastener and adapted to slidably receive the ram portion, and also having a tapered end adapted to receive a soft, drawable, tapered transition portion of the captive piston to draw down the transition portion wherein there is no opposition to movement of the piston. The muzzle portion preferably is detachably secured to the barrel.

A complete understanding of the invention may be obtained from the following detailed description of a powder actuated tool forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

FIG. 1 is a vertical sectional view of a powder actuated tool forming one embodiment of the invention;

FIGS. 2 to 5 are enlarged, vertical sectional views taken respectively along lines 2-2, 3-3, 4-4 and 5-5 of FIG. 1;

FIG. 6 is an enlarged, vertical sectional view of a portion of the powder actuated tool of FIG. 1, with parts thereof in different positions from those in which they are shown in FIG. 1; and

FIG. 7 is a view similar to FIG. 6, with the parts of the tool in different positions from those in which they are shown in FIGS. 1 and 6.

Referring now in detail to the drawings, there is shown therein a powder actuated tool forming one embodiment of the invention and including a barrel housing 10 of tough plastic material and a breech housing 12 also of tough plastic material and having a tubular portion 13 and a hollow handle portion 14 integral therewith. The tool includes a simple, very effective recoil absorber 15 adapted to remove about 95% of the force of recoil when a cartridge 17 is fired to drive a fastener 18. The recoil absorber includes a piston-like cup 19 having a flat base 20 and an externally cylindrical, internally tapered rim 21, and also includes an elongated, plug-like pad 22 of resilient, compressible material. The cup 19 fits onto a tapered forward end 23 and annular shoulder 26 of the pad 22. The pad and cup are slidable along a liner 23 positioned in counterbore 24 in the breech housing, and the cup normally is urged against the end of the counterbore 24 by the pad. The pad is highly compressible and preferably is composed of foam plastic material capable of high energy absorption when compressed and also having a relatively slow recovery characteristic. One very excellent material for the pad 22 is an expanded, foam-like polyurethane material sold under the mark "Profoam"
9389" by the Xenon Corporation. The cup 20 preferably is composed of tough, substantially rigid nylon and acts to hold the pad under an initial longitudinal compression along with a cap 29 screwed onto threaded portion 30 of the breech housing 12. Preferably the pad when in its normal position, as shown in FIG. 1, completely fills the space between the breech housing and the retaining cup 19 and end cap 29, and is precompressed to a length only about 90% of its normal, unrestrained length. The pad 22 preferably has a smooth, molded cylindrical surface 31 fitting closely and slidably in the liner 23. A lubricant of, for example, silicone grease 50 is placed between the liner and the cup 19 and the pad 22. Preferably the pad 22 has a slow recovery time of at least a large fraction of a second, so that its rebound force is negligible. The pad has a large number of small air cells therein, preferably being of a density of approximately 15 pounds per cubic foot.

A guard 36 is carried by the barrel housing 10. A barrel sleeve 38 is connected to a headed, barrel or muzzle portion 40 by an internally flanged coupling ring 42, which is threaded internally. The barrel sleeve 38 is adapted to receive reduced, sleeve portion 44 of a piston cage 46 forming a portion of a power plug assembly 49. The piston cage 46 has a head 48. A cartridge-holding power plug 50 having an enlarged head portion 51 and a threaded shank portion 52 is screwed into an internally threaded portion 54 in the piston cage 46. The cartridge-holding power plug 50 is adapted to carry the cartridge 17.

The sleeve portion 44 also includes collet-like fingers 56 defined by longitudinal slots 58 positioned therebetween and serving to frictionally engage a captive piston 60. The piston has a ram portion 61, an enlarged piston portion 63 and a frustoconical transition portion 65. A spring 62 is seated between the an upper shoulder 66 of the barrel housing 10 and a spring 68 and extends between the sleeves 64 and the guard 36 of the breech housing 10. A compression spring 68 seats on the internal shoulder 66 of the barrel housing 10 at one end and seats against an annular shoulder 70 of the ring 42 at the other end. The spring 68 is positioned coaxially with and inside of the spring 62 and extends into the sleeve 64 of the guard 36, which is splined to the barrel sleeve 38 by means of a pin 74 fixed in bore 76 in the barrel housing 10 and a slot 78 formed in and extending along the sleeve 64. While the slot 78 is shown in elevation 80 from a slot 245 in the sleeve 64, the slot 78 and pin 74 preferably are positioned at 245° from the slot 125° to ensure proper insertion of the guard 36 into the barrel housing.

A breech block 80 having arms 81 and 82 is mounted pivotally on the barrel sleeve 38 by a pin 83 positioned offset from the axis of the sleeve 38 and the longitudinal axis or centerline of the breech block 80. A set screw 85 (FIG. 3) screwed into a tapped bore 79 in the barrel sleeve 38 holds the pin rigidly to the barrel sleeve and the pin has a groove 89 to provide clearance for the sleeve portion 44 of the piston cage 46. This hinging structure permitting opening or "breaking" of the tool is substantially like that disclosed and claimed in Patent 2,977,508.

When the powder actuated tool is in its normal position, as shown in FIG. 1, the barrel housing 10, being urged by the springs 62 and 68, extends over the breech block 80 and engages the forward end of the breech block housing 12. The powder actuated tool when in its normal or cocked position and in FIG. 1, may not be able to remove the piston cage 46 with the captive piston from the tool. Opening or "breaking" of the tool may be effected by first sliding the barrel housing 10 to the left against the action of the spring 65 until the right-hand end of the barrel housing 10 is to the left of the pin 83, and then the breech block 80 with the breech housing 12 may be pivoted on the pin 83 away from the plug 50, and the piston cage 46 with the captive piston 60 may be withdrawn from the barrel sleeve 38 to eject the cartridge 17 and also slide the captive piston 60 back into its normal starting position in the piston cage 46, in which position it is shown in FIG. 1, and insert a loaded cartridge. Such sliding of the captive piston 60 serves to eject the cartridge 17 from a chamber 84 in the plug 50. A reduced end portion of a screw 91 (FIG. 1) screwed into tapped bore 93 in 12, breech housing 12 projects into slot 95 in the breech block 80. Shoulder 97 at the end of the slot 95 limits movement of the breech block to the left relative to the breech housing.

The captive piston 60 is provided with a combined gauge and ejector 85. After the piston cage 46 is placed, with a first firing, against the breech housing 12, the breech block 80 is swayed back into alignment with the barrel sleeve 38. The barrel housing 10 then is released and is moved back over the breech block 80 by the spring 68 to the normal position thereof shown in FIG. 1.

The fastener 18 has a reduced pointed shank portion 86, a larger shank portion 87 and an enlarged head 88. The fastener is inserted manually into the muzzle portion 40 until the head 88 engages an inner, annular shoulder 90 in the muzzle portion 48, which prevents insertion into the tool of excessive length fasteners which would cause premature engagement of the breech block 57 and prevent the head being placed against a surface into which the fastener is to be driven and then the breech housing 12 and the barrel housing 10 are pushed forwardly relative to the barrel sleeve 38, the muzzle portion 40 and the breech block 80, which is slidable in a lining sleeve 94. The breech housing 10 moves along the breech block 80 until the arm 19 engages end plate 96 carried by the breech block. The partial precompression of the pad 22 is several times greater than the combined forces of the springs 62 and 68 when the tool is in the cocked or firing condition thereof shown in FIG. 6 so that, to the user who has pushed the handle 14 to bring the tool to its cocked condition, the increased resistance of the pad to further forward movement of the handle and breech housing appears to be a positive stop, whereby the user readily senses that the tool is in its cocked condition and is ready to fire. This partial precompression of the pad prior to any movement of the cup 19 away from the stop shoulder at the end of the counterbore 24 also provides a substantial initial resistance to recoil movement of the floating firing mechanism, which includes the breech block 80, the barrel sleeve 38, the muzzle portion 40 and the elements carried with these elements about the breech block which makes optimum the recoil resisting action of the pad 22.

As the breech housing 12 is moved forwardly relative to the breech block 80 to bring the tool to its cocked condition, a safety hook portion 110 of a trigger 112 mounted pivotally in slot 114 in the handle 14 by a pin 116 moves forwardly and is secured in aligned bores on the opposite sides of a longitudinal slot 120 in the breech block 80. This permits the trigger 112 to be moved manually from the position thereof shown in FIG. 6 to that shown in FIG. 7. The pin 116 is secured in aligned bores in the handle 14. A hammer 124 having a rounded end 122 is mounted pivotally on a pin 126 fitting into bores in semi-cylindrical projecting portions 128 of the breech block 80 and extending across a slot formed between the members 128. During such movement, the end 122 engages an L-shaped ear 130 mounted pivotally on a pin 132 seated in aligned bores in the barrel housing 12 so as to prevent movement of the lower end 122 of the hammer 124. A spring 129 urges the ear toward its latching position. This pivots the hammer 124 clockwise as viewed in FIG. 1 against the action of a pair of springs 139 positioned in bores 134 in the members 128 and bearing against the plate 96 and spring seat 136 formed on the ends of pin 138. The plate 96 is secured by screws 139 to the members 128. The pin 138 extends through parallel, laterally aligned slots 140 and is movable along the slots 140. When the plate 96 reaches the cup 19, the hammer 124 is in the cocked position thereof shown in its...
FIG. 6. Then, when the trigger 112 is pivoted counter-clockwise as viewed in FIG. 6 to the position thereof shown in FIG. 7, the end of the shaft 130 engaging the rounded end 122 of the hammer 124 moves downwardly out of engagement with the hammer 124 and the springs 133 and pin 138 move the hammer 124 rapidly in a counterclockwise direction to cause hammer portion 146 of the hammer 124 to strike firing pin 152. This drives reduced end portion 152 of the firing pin into firing engagement with the cartridge 17. The firing pin 150 is mounted slidably in a bushing 153 mounted in recess 154, the bushing 153 being hollow and containing a compression spring (not shown) engaging a shoulder on the firing pin and urging the firing pin 150 toward the rign as viewed in FIG. 6 to normally keep the firing pin from projecting to the left beyond the end wall of the breech block to prevent damage to the point of the firing pin by the power plug when the tool is being opened and closed. The springs 133, when in the positions thereof shown in FIG. 1, are substantially fully extended so that no appreciable force is applied thereby to the hammer 124 and the hammer, being stationary at this time, applies no appreciable force to the firing pin. A port 159 is connected by a passage (not shown) in the bushing 153 and by clearance around the portion 152 of the firing pin to permit gases to escape from the cartridge 17 into the space between the members 128 in the even of puncture of the cartridge by the firing pin. This prevents build up of excessive pressure in the recess 154.

Upon triggering, the cartridge 17 is fired and gases are emitted from the left end thereof as viewed in FIG. 1 to drive the captive piston 60 to the left, at a relatively low velocity with a high momentum, because of the mass thereof, into engagement with fastener 18. This drives the fastener 18 fully up to the portion 87 into the surface engaged by the tool. Full force of the explosion is applied to the captive piston 60 during the main portion of the travel of the captive piston. Then, as the right-hand end of the piston as viewed in FIG. 1 arrives at the slots 58, the gases are ported through the slots 58 and a port 155 in the barrel sleeve 38 to rapidly relieve the force of the explosion from the captive piston. That is, the pressure of the gases of explosion are vented before the fastener is driven the desired distance, and the energy in the moving captive piston completes the driving of the fastener the distance desired.

The breech block 80, the barrel sleeve 38, the muzzle portion 40, the ring 42, the piston cage 46, the power plug 50, the firing pin 150, the hammer 124, the springs 133, the pin 138 and plate 96 comprise a floating firing mechanism. The firing mechanism is freely slidable along the barrel housing 10 and breech housing 12 to the right, as viewed in FIG. 1, except for the restraining actions of the spring 68 and the recoil absorber 18, which absorb the forces of recoil on the firing mechanism, these forces being absorbed primarily by the recoil absorber. The firing mechanism also floats freely relative to the guard 36 so that, during recoil, the guard remains in guarding position against the work. Since, forewseise, the recoil absorber is positioned between the handle 18 and the firing mechanism, all but a negligible portion of the shock or recoil is isolated from the handle.

The forces of recoil from the explosion of the cartridge 17 applied through the cartridge and the cartridge holding housing power plug 50 to the breech block 80 drive the breech block 80 to the right as viewed in FIGS. 6 and 7 from the firing position thereof shown in FIG. 6 to the fully recoiled position shown approximately in FIG. 7. This compresses the pad 22, to be described, which occupies almost half of the volume normally occupied thereby in the breech housing 12, and the pad absorbs most of the force of recoil, in a tool forming one of the invention the pad absorbing about 90% of the force of recoil. Then, the spring 68 which has been compressed during the recoil returns the barrel sleeve 38, muzzle portion 40 and breech block 80 to the initial, firing positions thereof. The pad 22 has a slow recovery time so that it does not exert any appreciable rebound force on the breech block 80 during or after the recoil. While the recovery is slow, it is effected within a few seconds after the return of the barrel sleeve 38, the muzzle portion 40 and breech block 80.

After the breech block 80 returns to its firing position, it, of course, carries the hammer 124 back to the left as viewed in FIG. 7. If the trigger 112 is still held by the user in its firing position, the sear 130 is held down out of the path of the hammer 124 and the hammer 124 remains in an uncocked position. This is true when the trigger 112 has been released because the rounded end 122 of the hammer will depress and pass over the left-hand end of the sear 130. Then the user relases the forward pressure on the handle 14 and the breech housing 12 and the barrel housing 10 are both moved back to the right to the positions thereof shown in FIG. 1, and the firing mechanism including the breech block 80, the barrel housing 58, the muzzle portion 40 and the power plug carried by the barrel sleeve 38 all remain stationary while the breech housing 12, barrel housing 10 and the handle 14 move to the right. During this latter movement the pin 118 moves under the hook 110 of the trigger 112 if the trigger 112 has been released by the user. If the trigger 112 has not been released by the user, the pin 118 moves under the hook 110 and returns the trigger to its normal position against all but a very strong force holding the trigger in its firing position. The hook 110 is sufficiently long and pivotal movement of the trigger 112 to effect firing is sufficiently short, being limited by stop portion 141, that the free end of the hook 110 is never out of the slot 120. Hence, the pin 118 can never go on past the hook 110.

The ram portion 61 of the captive piston 60 is joined to the enlarged piston portion 63 thereof by the transition portion 65 which is flared inwards and which is of reduced hardness so that it is extrudable. The transition portion 65 is complementary in shape to a frustoconical portion 151 leading to a counterbore 149 in the muzzle portion 40 which counterbore 149 is of larger diameter than the ram portion 61 and of lesser diameter than the piston portion 63, so that, if the tool is inadvertently fired with insufficient resistance to movement of the fastener or with no fastener therein, the frustoconical portion 151 will draw the transition portion 65 of the captive piston 60 to dissipate the kinetic energy of piston 60 and prevent the danger. However, when this happens, it sometimes damages the muzzle portion 40, as would be expected, and the muzzle portion 40 may be replaced with an undamaged muzzle portion merely by removing the guard 36 and turning the muzzle portion 40 to turn ring 42 through a keying pin 170 and then sliding the muzzle portion 40 out of the ring 42 and placing a new muzzle portion in the ring. The pin 170 fits over a flat 171 at the end of an enlarged head 172 of the muzzle portion 49 and also fits into a bore 174 in the ring 42 to rigidly key the muzzle portion to the ring 42.

The sleeve 64 of the guard 36 has a reduced muzzle end 178 fitting into a bore 180 positioned eccentrically in a cylindrical disc 182 and fixed thereto against rotation. The outer periphery of the disc 182 has a flange 184 on which is rotatably positioned a cup-shaped shield member 186 having a bore 188 eccentric to the periphery of the fitting rotatably on the disc 182 and held between the flange 184 and a disc 190 secured to the disc 182 by rivets 192. The disc 190 has an eccentric bore 194 therein aligned with the bore 180 in the disc 182. By rotating the shield member 186 relative to the disc 182 and 196, the eccentricity of the member 186 relative to the muzzle portion 40 may be adjusted as desired by the user.

The barrel housing 10 near the forward end thereof has a thickened portion 200 provided with a slot 202.
therein in which is fitted tightly a channel-like insert member 204 mounting a latching dog 206. Whenever the sleeve 64 of the guard 36 is pulled out of the barrel housing 10, the dog 208 enters an annular, undercut groove 210 in the coupling ring 42 to hold the barrel sleeve 38 against movement to the right relative to the barrel housing. Cap-shaped inserts 220 and 222 secured in holes in the barrel housing carry pivot pins 224 and 226, respectively. Latching dogs 228 and 230 are mounted pivotally on the pins 224 and 226, respectively. The dog 228 is urged counterclockwise into slot 232 in the guard sleeve 64 to prevent removal of the guard sleeve from the barrel housing 10 unless the dog 228 is pressed manually out of the slot 232. When the muzzle portion 40 is replaced with a longer muzzle portion where desired for certain uses, the shield can still be held in the position shown in Fig. 1 by the dog 228 or the shield can be held in a second position to the left of that shown, in which second position the dog 228 projects into a slot 236 in the shield sleeve to limit movement of the shield to the left relative to the barrel housing 10. The dog 228 is urged by a torsion spring (not shown) in a counterclockwise direction, as viewed in Fig. 1, into the slot 232 and designed to engage web 241 to limit movement of the guard sleeve 64 to the left. The dog 230 is urged clockwise by a torsion spring (not shown) into the slot 236, and is designed to be engaged by the web 241 to limit movement of the guard sleeve 64 to the right. The sleeve 64 is shown in a retracted or shortened position in Fig. 1, and, when desired, may be adjusted to an extended position in which the dog 228 projects into the slot 236 and engages web 243 and the dog 230 projects into slot 245, to limit movement of the sleeve 64 to the right. The dogs 228 and 230 can be pressed manually to retract them from the slots in the sleeve 64 to adjust the sleeve 64 along the barrel housing 10 or to remove or insert the sleeve 64 into or out of the barrel housing.

Since the recoil absorber 15 is positioned between the handle 14 and the free floating firing mechanism, the force of recoil is dissipated before reaching the user except for the negligible, slight residue which is a small fraction of the total force of recoil. Hence, the user has no unpleasant or dangerous kick imparted to him. The trigger mechanism will not fire on accidental dropping of the tool. Also, the power plug 50 being replaceable, the tool can be readily adapted to cartridges of different sizes. Since the cap 29 is removable from the breech housing, the pad 22 and cup 19 can be easily extracted for purposes of maintenance or replacement. It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and full within the spirit and scope thereof.

What is claimed is:

1. In a powder actuated tool, a breech housing, a pad means of resilient, compressible material mounted in the breech housing and maintaining normally in a partially precompressed condition, breech means adapted to carry a cartridge and slideable along the breech housing from a forwardly located normal position out of engagement with the pad means into engagement with the pad means at a rearwardly located firing position and also movable rearwardly from the firing position to a recoil position, and firing means adapted when the breech means is in the firing position thereof to fire a cartridge carried by the breech means.

2. In a powder actuated tool, a generally tubular breech housing closed at the rear end thereof, a pad of resilient foam material mounted in the rear end portion of the breech housing and compressible rearwardly in the breech housing, a retaining member engaging the forward end of the pad and slideable rearwardly along the breech housing from a forward position, and breech means slideable rearwardly in the breech housing from a firing position in engagement with the retaining member.

3. The powder actuated tool of claim 2 wherein the retaining member when in its forward position holds the pad under compression.

4. In a powder actuated tool, a hollow breech housing, a cushioning member of resilient compressible foam material positioned in the breech housing, breech means slideable rearwardly along the breech housing from a forward position out of engagement with the cushioning member to a firing position in which the cushioning member first resists rearward movement of said breech means and also being slideable rearwardly along the housing from the firing position during recoil, and trigger means cockable by relative movement of the move to engage from its forward position to its firing position.

5. In a powder actuated tool, a generally tubular breech housing closed at the rear end thereof, pad means of resilient, foam material mounted in the rear end portion of the breech housing, breech block means slideable relatively rearwardly in the breech housing from a forwardly located normal position out of engagement with the pad means to an intermediate firing position in which the pad means first resists rearward movement of said breech block means and slideable rearwardly in the housing from the firing position thereof during recoil to further compress the pad means, whereby the pad means absorbs the energy of recoil, rear means carried by the breech housing, hammer means carried by the breech block and engaging the rear means and being cocked thereby as the breech block means is moved from its normal position relative to the breech housing to its firing position, and trigger means carried by the breech housing for actuating the rear means to release the hammer means.

6. In a powder actuated tool, a breech housing having an open front end thereof and a closed rear end, a breech block slideable in the breech housing toward the rear end thereof during recoil, and pad means of resilient, compressible, foam material positioned in a chamber within the breech housing between the breech block and the closed rear end of the breech housing, said pad means substantially completely filling said chamber and adapted to be compressed by the breech block during recoil of the breech block.

7. In a powder actuated tool, a breech housing having an open front end thereof and a closed rear end, a breech block slideable in the breech housing toward the rear end thereof during recoil, a pad means of resilient, compressible, foam material positioned in the breech housing between the breech block and the closed rear end of the breech housing, and a rigid member slideable in the breech housing, engaging the forward end of the pad and adapted to be engaged and pressed against the pad by the breech block during recoil of the breech block.

8. In a powder actuated tool, a breech housing having a forwardly positioned cylindrical bore and also having a rearwardly positioned
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counterbore aligned with the bore and having a predetermined diameter and a predetermined length, an elongated, cylindrical pad of resilient, compressible material having a diameter substantially the same as said predetermined diameter and having a length substantially greater than said predetermined length, restraining means positioned in the counterbore and engaging the front end of the pad, a cap secured to the rear end of the breech housing and holding the pad under longitudinal compression in the counterbore, and a breech block slideable in the bore and counterbore and adapted to engage the cup and compress the pad during recoil.

9. In a powder actuated tool, a breech housing having a forwardly positioned cylindrical bore and also having a rearwardly positioned counterbore aligned with the bore and having a predetermined diameter and a predetermined length, an elongated, cylindrical pad of resilient, compressible material having a diameter substantially the same as said predetermined diameter and having a length substantially greater than said predetermined length, a piston-like cup of tough plastic material fitting slidably in the counterbore and on the forward end of the pad, a cap secured to the rear end of the breech housing and holding the pad under longitudinal compression in the counterbore, and a breech block slideable in the bore and counterbore and adapted to engage the cup and compress the pad during recoil.

10. In a powder actuated tool, a firing pin, a breech block having a centrally positioned slot in the rear end thereof extending transverse to the longitudinal axis of the breech block and also having a firing pin bore extending forwardly from the slot and in which the firing pin is slidably mounted, a hammer lever having a hammer end and a second end, a pivot pin mounting the hammer lever pivotally in the slot in a position in which the hammer end is adapted to engage the firing pin, the breech being provided with a pair of longitudinal bores positioned at opposite sides of the slot and also having a pair of guideways extending along the bores and entering into the bores and the slots, a pin extending across the slot and through the guideways and having a pair of cupped spring seats positioned in the bores, a pair of compression springs mounted in the bores and pressing the pin forwardly against the hammer to urge the hammer forwardly relative to the breech block, a breech housing mounting the breech block slidably therein, a sear carried by the breech block housing and movable between a cocking position in the path of the second end of the hammer when the breech block housing is moved forwardly relative to the breech block and a firing position releasing the hammer, and trigger means for moving the sear between the cocking and firing positions thereof.

11. In a powder actuated tool, a breech housing having a longitudinally located position and a rearwardly located position, hammer means movable to a cocked position during relative movement of the housing and the block in which the block moves relatively to its rearwardly located position, sear means for releasing the hammer means from its cocked position, and pin means carried by the block and positioned in the hook when the block is not in its rearwardly located position to prevent movement of the trigger means and positioned out of the hook when the block is in its rearwardly located position to permit movement of the trigger means.

12. In a powder actuated tool, a breech block having a transverse slot in a predetermined plane at the rear portion thereof and also having a centrally located firing pin bore extending forwardly from the transverse slot, the breech block also having a longitudinal slot in the peripheral portion thereof and in said plane, a firing pin mounted in the bore and normally projecting into the transverse slot, a hammer mounted in the transverse slot for pivotal movement therein and having a hammer portion at one end for engaging the firing pin and also having a cocking portion at the other end thereof, a transverse pin carried by the breech block in a position extending across the rear end portion of the longitudinal slot, spring means urging the pin against the hammer to urge the hammer toward the firing pin, a breech housing mounting the breech block therein for relative movement between a normal position in which the breech block is forward of the housing and a firing position in which the breech block is positioned rearwardly in the breech housing, an L-shaped sear lever carried pivotally in the breech housing and movable between a cocking position in which one end thereof projects into the path of and behind the cocking portion of the hammer and a releasing position out of engagement with the hammer, trigger means urging the sear toward its cocking position, and a trigger carried by the breech housing and engaging sear, the trigger being urged by the sear toward a normal position and movable manually to move the sear from the cocking position thereof to the releasing position thereof, the trigger having a hook extending along the longitudinal slot and over the transverse pin when the block is in its normal position and being free of the pin when the breech block is in its firing position.

13. In a powder actuated tool, a barrel means having a muzzle portion provided with a bore and a stop portion projecting into the bore thereof to limit insertion of a fastener into the muzzle portion, and a captive piston of a diameter sufficiently small to move freely past the stop portion.

14. In a powder actuated tool, a generally tubular breech housing closed at the rear end thereof, breech means including a piston-like retaining member at the rear end thereof and slideable along the forward portion of the breech housing, and a mass of resilient foam material positioned in the breech housing behind said retaining member and substantially completely filling the space between the rear end of the housing and the retaining member.

15. In a powder actuated tool, a breech housing having a longitudinal bore closed at the rear end thereof and open at the front end thereof, breech means slideable rearwardly in the housing from a forward position to a firing position and also slideable rearwardly in the housing from the firing position to a recoil position, a cartridge firing mechanism within said housing which is prevented from firing a cartridge when the breech
means is in the forward position thereof and permitted to fire when the breech means is in the firing position thereof,
resilient means in the bore in the housing in the path of rearward movement of the breech means,
and means holding the resilient means in a precompressed position in which the resilient means first resists rearward movement of the breech means when the breech means arrives at the firing position thereof.

References Cited by the Examiner

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,518,395</td>
<td>8/1950</td>
<td>Sopris</td>
<td>227—9</td>
</tr>
<tr>
<td>2,966,683</td>
<td>1/1961</td>
<td>Schulz</td>
<td>227—8</td>
</tr>
<tr>
<td>3,074,071</td>
<td>1/1963</td>
<td>De Caro</td>
<td>227—10</td>
</tr>
<tr>
<td>3,126,630</td>
<td>3/1964</td>
<td>Catlin et al.</td>
<td>227—10</td>
</tr>
<tr>
<td>3,181,760</td>
<td>5/1965</td>
<td>Catlin et al.</td>
<td>227—10</td>
</tr>
<tr>
<td>3,239,121</td>
<td>3/1966</td>
<td>Kopf et al.</td>
<td>227—10</td>
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10 GRANVILLE Y. CUSTER, Jr., Primary Examiner.