EXPLOSIVE-ACTUATED TOOLS FOR DRIVING NAILS, STUDS, OR OTHER ANCHORING MEMBERS INTO HARD MATERIALS

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EXPLOSIVE-ACTUATED TOOLS FOR DRIVING NAILS, STUDS, OR OTHER ANCHORING MEMBERS INTO HARD MATERIALS

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6 Claims

ABSTRACT OF THE DISCLOSURE

An explosive-actuated tool having a barrel-mounted piston element which is seated against the head of a nail or other anchoring element and which is driven forwardly to drive the nail into a relatively hard surface by gases resulting from the explosion of a cartridge. A cartridge reloading device comprising a magazine contains a plurality of cartridges arranged in end-to-end relationship and axially urged one at a time into a cartridge recess which is formed in the barrel of the tool along an axis extending transversely of the bore of the barrel.

RELATED APPLICATION

This application is a continuation-in-part of my co-pending application Ser. No. 457,391 filed May 20, 1965, of Explosive-Actuated Tools for Driving Nails, Studs, or Other Anchoring Members Into Hard Materials, now abandoned.

FIELD OF INVENTION

This invention relates to explosive-actuated tools for driving studs, nails or other anchoring members into hard materials and is concerned more particularly with means for reloading cartridges into explosive-actuated tools of the kind having a barrel in which is mounted a piston element, which piston element is adapted to be driven by the gases resulting from the explosion of a cartridge mounted in a recess in the barrel.

SUMMARY OF THE INVENTION

According to the present invention a reloading device for explosive-actuated tools of the kind referred to comprises a hollow member movably mounted on the barrel of the tool adjacent to the cartridge recess, the hollow member being adapted to control a plurality of cartridges arranged in end to end relationship, and to urge the cartridges axially towards one end of the hollow member in such a manner that a cartridge is fed into the cartridge recess in the barrel when the cartridge recess is brought into axial alignment with the hollow member.

The hollow member is preferably a magazine movably mounted in the handle of the tool which is movable relative to the barrel.

The end of the magazine is preferably shaped so as to retain a cartridge with its nose portion protruding beyond the end of the magazine and to allow the cartridge to be removed substantially perpendicularly to the axis of the magazine.

The magazine may be made of any suitable material, but is preferably moulded in a synthetic resinous material.

DESCRIPTION OF DRAWINGS

FIGURE 1 is a front end view of an explosive-actuated tool incorporating a reloading device according to this invention;

FIGURE 2 is a longitudinal section taken substantially along lines 2—2 of FIGURE 1 and showing the components of the tool in firing position;

FIGURE 3 is a fragmentary section taken substantially along lines 3—3 of FIGURE 1 and illustrating the tool components in loading position;

FIGURE 4 is a fragmentary section taken substantially along lines 4—4 of FIGURE 1 and showing the components of the tool in firing position;

FIGURE 5 is a cross sectional view of the cartridge magazine filled with a number of cartridges;

FIGURE 6 is a view of the cartridge magazine as seen from the arrow A on FIGURE 5; and

FIGURE 7 is a fragmentary view in section showing the barrel and other components of the tool in loading position with the cartridge magazine aligned with the cartridge receiving recess in the barrel.

The explosive-actuated tool comprises basically a barrel 1 in which is mounted a cylindrical piston 2, and a handle portion 3 slidably mounted on the barrel at 21. The handle portion 3 is provided with a cylindrical-shaped aperture 4 adapted to receive the cartridge magazine 5.

The cartridge magazine, as shown in FIGURES 5 and 6, comprises a hollow cylinder, closed at one end 6 and having a substantially semi-circular intumetion portion 7 at its other end which is adapted to engage the rim 8 of a cartridge 9 and retain it axially whilst allowing the nose 10 of the cartridge to protrude from the end of the magazine. A semi-circular cutaway portion 11 is provided at this end of the magazine so that the cartridge 9 protruding from the end may be withdrawn sidewardly from the magazine.

A plurality of cartridges are contained in the magazine and are urged towards the open end by means of a spring 12. Thus if one cartridge is removed from the magazine a further cartridge is urged towards the end by the spring until it is stopped by the inturned portion 7 engaging the rim of the cartridge.

A sleeve 13, slidably mounted on the outside of the magazine is adapted to cover the cutaway portion 11 when the magazine is not in use, and so prevent the cartridges from being accidentally withdrawn from or knocked out of the end of the magazine. Two positions of the sleeve are illustrated in FIGURE 5, the position of the sleeve when the magazine is not in use being illustrated by chain-dotted lines 14.

When the cartridge magazine is inserted into the aperture 4 in the handle portion 3 of the explosive-actuated tool the sleeve 13 may be removed completely, or it may be retracted by contacting a shoulder or projection in the aperture 4.

With the tool in the loading position (i.e. when a cartridge recess 16 is in alignment with the cartridge magazine as shown in FIGURE 7) the nose 10 of the
end cartridge enters the cartridge recess. Such alignment of the cartridge recess with the cartridge magazine is obtained by slidable displacement of barrel 1 to the left in FIGURE 2 to locate the rear end of the barrel as shown in FIGURE 7. Then, as the handle portion 3 is moved relative to the barrel 1 (that is, to the left from the position shown in FIGURE 7) the cartridge is sidewardly withdrawn from the magazine. A ramp or cam 17 on the handle portion 3 adjacent to the end of the magazine guides the cartridge further into the recess 16. A further cartridge 15, then moves to the end of the magazine ready for the next loading operation.

As shown in FIGURE 2, pistol 2 is slidably received in a guide sleeve 25 which, in turn, is slidably received in the bore 26 of barrel 1. Bore 26 is formed at its inner end with a reduced diametered bore section 27 which is adapted to slidably receive an enlarged head 28 of piston 2. Forward displacement of piston 2 is limited by engagement with the inner end of reduced bore section 27 as shown in FIGURE 2. Rearward displacement of piston 2 is limited by engagement with the inner end of a conical surface 30 joining bore section 27 with a diametrically enlarged bore section 31. Forward displacement of sleeve 25 is limited by engagement of an external shoulder 32 with a stop ring 33. Stop ring 33 engages the forward end of barrel 1 at the forward end of sleeve 25. Sleeve 25 and piston 2 are coaxial and are axially displaceable relative to each other. When the subassembly of barrel 1, sleeve 25 and piston 2 is in its firing position shown in FIGURE 2 for driving a fixing pin 36 or other anchoring member into the surface of relatively hard material indicated at 37, piston head 28 is seated against the inner end wall of reduced bore section 27 and is axially spaced by a distance L from end face 29 on sleeve 25. The inner end of sleeve 25 in its firing position is seated against the junction of bore section 31 and surface 30.

The axial lengths of piston 2, sleeve 25 and barrel 1 are dimensioned such that when they are in their firing positions shown in FIGURE 2, the forward end of piston 2 projects axially beyond the forward end of the barrel, and the forward end of sleeve 25 extends axially beyond piston 2 by a distance L'. The head of fixing pin 36 is seated in a suitably contoured recess which is formed in the forward end of piston 2, and the pin extends through and axially beyond the forward end of sleeve 25 by a short distance. By making the axial distance L' slightly shorter than the distance L, the forward end of piston 2 is axially advanceable relative to the forward end of sleeve 25 to drive fixing pin 36 and a washer 38 below the relatively hard surface of material 37. The distance L' shown in FIGURE 2 is for the shortest pin or anchoring element to be driven with the tool. This axial distance increases when longer pins or nails are used. Still referring to FIGURE 2, the forward end of sleeve 25 is internally formed with a diametrically enlarged, outwardly diverging conical surface 40. Washer 38, which is concentrically mounted on fixing pin 36, is received in the forward end of sleeve 26 and wedged against surface 40 at a position where it is axially between the forward end of sleeve 25 and the head of fixing pin 36 in the recessed, forward end of piston 2.

As shown in FIGURES 2 and 7, barrel 1 is biased axially forwardly by a helically coiled spring 42. Spring 42 peripherally surrounds a cylindrical guide element 43 which is fixed to handle portion 3 and which axially extends into a blind bore 44. Bore 44 is formed in the side wall of barrel 1 and coaxially receives spring 42. Spring 42 is seated at its forward end against the inner end wall of bore 44 and reacts against a surface on handle portion 3 to resiliently bias barrel 1 forwardly to its loading position shown in FIGURE 7.

Forward displacement of barrel 1 under the bias exerted by spring 42 is limited by a catch 46 (see FIGURE 4) which is retained by the free end of a cantilever leaf spring 47. The opposite end of spring 47 is suitably secured to the barrel receiving housing section 21 which, as previously described, is part of the barrel 1.

When barrel 1 is allowed to shift axially forwardly under the bias exerted by spring 42, spring 47 biases catch 46 inwardly into an outwardly opening recess 48 formed in the side of barrel 1. Recess 48 is formed with a forwardly facing shoulder 49 which engages a rearwardly facing surface 50 on catch 46 when barrel 1 is advanced by spring 42 to its loading position illustrated in FIGURE 7. Further forward displacement of barrel 1 is thus prevented.

Sleeve 25 is resiliently biased to its extended loading position shown in FIGURE 7 by a helically coiled spring 52 (see FIGURE 3) which is received in a blind bore 53 and which peripherally surrounds a cylindrical spring follower 54. Bore 53 is formed in the side wall of barrel 1 and has a longitudinal slot 55 which opens into bore 26. A pin 56 extending through slot 55 and transversely into bore 26 is fixed to the forward end of follower 54. Spring 52 acts against the end wall of bore 53 to urge pin 56 into engagement with the inner end face 29 of sleeve 25 with the result that sleeve 25 is biased forwardly to its loading position shown in FIGURE 3 where shoulder 52 seats against stop ring 33 to prevent further displacement. Bore 53 and 44 are parallel with bore 26 as shown.

If a cartridge has been previously fired, piston 2 will be in its forwardly extended, loading position shown in FIGURE 7. If it is not, it may be shifted axially forwardly by tilting the tool downwardly, allowing the piston to slide forwardly through sleeve 25 and to its position where its forward end protrudes beyond the forward end of the sleeve. With the parts of the tool in their loading positions shown in FIGURE 7, the tool is ready for loading and use providing that any previously fired cartridge has been ejected. Cartridge ejection will be explained later on.

To drive an anchoring element such as fixing pin 36 into a relatively hard material, magazine 5 is inserted into aperture 4 in the previously described manner so that the protruding nose of the foremost cartridge 9 extends into recess 16. Fixing pin 36 with washer 38 mounted thereon is then inserted into sleeve 25, and washer 38 is wedged in place against surface 40 with the head of pin 36 in axial alignment with the recess in the forward end of piston 2, and the head of the piston 2 is now spaced distance L from face 29 of the sleeve 25. With the assembly of fixing pin 36 and washer 38 mounted in place, handle portion 3 is manually gripped and the pointed end of pin 36, which is protruding axially beyond sleeve 25 is pressed against the surface of material 37. Forward manual pressure applied through handle portion 3 axially displaces housing section 21 and barrel 1 towards the surface of the material and relative to the sub-assembly of piston 2, and sleeve 25. Axial displacement of handle portion 3 together with barrel 1 compresses spring 52 until the piston head 28 contacts the inner end of reduced bore section 27.

As housing section 21 is further axially displaced in a forward direction (i.e., towards the surface of material 37) shoulder 50 (FIGURE 4) separates from engagement with shoulder 49, as the housing section 21 from further forward movement by the piston which itself is supported by the fixing pin resting against the surface of the relatively hard material 37. This relative movement is resisted by the spring 42, the spring 47 biasing catch 46 to a position where a forwardly facing shoulder 60 (see FIGURE 4) on catch 46 aligns with a rearwardly facing shoulder 61 formed on the barrel 1, and defines a side wall of recess 48. Shoulder 49 defines
the opposing side of recess 48, until shoulder 61 engages shoulder 60.

As previously explained, the foremost cartridge 9, with its nose in recess 16, is sidewardly withdrawn from magazine 5 and cammed into recess 16 as handle portion 3 is forwardly advanced relative to barrel 1 from the loading position shown in FIGURE 7 towards the firing position shown in FIGURE 1, where the manual pressure applied through handle portion 3 holds fixed pin 36 against the surface of material 37; it is the only means by which barrel 1 and sleeve 25 are held in their firing positions against the bias of springs 42 and 52 respectively. It is to be noted that when the tool is in its firing position shown in FIGURE 2, surface 48 of the forward end of sleeve 25 seats against washer 38, and the forward end face of sleeve 25 is spaced from the surface of material 37 owing to the axial dimensions of pins 36 and piston 2 relative to the axial dimension of sleeve 25.

The cartridge 9, now in recess 16, is exploded by squeezing a spring biased trigger 63 which forms a part of the revolver type firing mechanism 64. Mechanism 64, as best shown in FIGURE 2, further comprises an arm 65 and a plate type, spring biased firing pin 66 which is slidably mounted in handle portion 3. Arm 65 has a cam portion 67 and is pivoted on trigger 63 for engaging firing pin 66. When trigger 63 is squeezed, arm 65 retracts firing pin 66 by a short distance and then disengages from pin 66 by engagement of cam portion 67 with a fixed pin 68. As a result, firing pin 66 is biased upwardly by its compressed spring to engage and fire the cartridge in recess 16.

The expanding gases generated by exploding the cartridge in recess 16 pass into the inner end of bore 26 to propel piston 2 forwardly for driving fixing pin 36 and washer 38 into material 37.

Barrel 1 has an outwardly opening recess 70 (see FIGURE 2) which allows trigger 63 to be pulled out when barrel 1 is in its firing position. In all other positions of barrel 1, a projection on trigger 63 engages the periphery of barrel 1 at regions spaced from recess 70 to prevent trigger 63 from being pivoted to its cartridge-firing position.

Owing to the previously described difference between distances L and L', piston head 28 engages the inner end face of fixing pin 36 only when fixing pin 36 and washer 38 have been driven into material 37. Barrel 1 and sleeve 25 will be returned by springs 42 and 52 to their loading positions shown in FIGURE 7 when the tool is removed from contact with the surface of material 37.

To eject the fired cartridge shell from recess 16, the tail 72 of catch 46 is depressed inwardly with barrel 1 in its loading position shown in FIGURE 7. This pivot catch 46 in a direction to lift the nose 73 of catch 46 out of engagement with the barrel, allowing shoulder 61 to pass under shoulder 60 when sleeve 25 is manually pushed inwardly to urge barrel 1 in a corresponding direction.

Since shoulder 60 rides over shoulder 61 when tail 72 is depressed, barrel 1 is axially displaced rearwardly beyond its firing position by continuing to manually push sleeve 25 into housing section 21. As barrel 1 passes its firing position shown in FIGURE 2, the foremost cartridge in magazine 5 will not enter recess 16 owing to the presence of the empty cartridge shell.

The cartridge ejection position of barrel 1 is displaced axially rearwardly of the barrel firing position, and as the barrel approaches the cartridge ejection position, an arm 76, pivotally mounted on the rearward end of barrel 1, engages an abutment 77 which is fixed in the rearward end of housing section 21 above the handle portion of the tool. Arm 76 is seated on a cartridge ejector 78 which is slidably mounted on the rearward end of barrel 1 for reciprocable movement along a path extending transversely of the longitudinal axis of bore 26. When barrel 1 is disposed axially forwardly of its cartridge ejection position, ejector 78 is slidably seated on a fixed horizontal surface 79 which is formed at its rearward end by a member 80. Ejector 78 is maintained in its illustrated raised position by engagement with surface 79 and has a projection 81 which retains the cartridge in recess 16 and which slides along surface 79.

When barrel 1 is shifted rearwardly beyond its firing position, arm 76 is urged downwardly by engagement with abutment 77. At the same time, projection 81 rides off the rearward end of surface 79 and downwardly along a sloped camming surface 82 on member 80. Arm 76 thus urges ejector 78 downwardly from recess 16, allowing the empty cartridge shell to drop out through a handle space 83. Rearward displacement of barrel 1 beyond its cartridge ejection position is prevented by engagement of shoulder 60 with a shoulder 86 on the barrel. When sleeve 25 is released, it and barrel 1 are biased forwardly by springs 42 and 52. As barrel 1 is moved forwardly, ejector 78 is cammed upwardly by engagement of projection 81 with surfaces 82. When catch 46 is released, it is biased into recess 48 again as barrel 1 is urged forwardly to its loading position for re-loading and driving another anchoring member.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. An explosively actuated tool for driving anchoring members into relatively hard materials and comprising a barrel, a piston element slidably mounted for limited axial movement in the bore of said barrel for propelling anchoring members therewithfrom, a cartridge recess adapted to axially receive a cartridge to be fired and being formed in a said barrel along an axis extending transversely of said bore, passage means formed in said barrel and providing fluid communication between said bore and said recess for transmitting the expanding gases of a cartridge fired in said recess to act on said piston element in said bore, a structure slidably receiving said barrel and having a handle portion extending transversely of said barrel, a hollow, cylindrical magazine detachably mounted within said handle portion and being retained in a stationary position along an axis extending transversely of said bore, said magazine having an open end adjacent to the rearward end of said bore and a closed end at the heel of said handle portion, said magazine being adapted to coaxially receive a plurality of cartridges in axially aligned, abutting end-to-end relation, with the noses of said cartridges facing towards said open end, said barrel and said structure being relatively disposable to a loading position, said magazine end said recess being so relatively arranged that said open end engages said recess in said loading position, and spring means disposed in said magazine for axially biasing the cartridges therein towards said open end and for urging the foremost cartridge in said magazine through said open end and axially into said recess when said open end registers with said recess in said loading position.

2. The explosively actuated tool defined in claim 1 wherein said recess is disposed rearwardly.

3. The explosively actuated tool defined in claim 1 wherein said magazine is formed with an inwardly turned, radial lip at its open end, said lip being adapted to engage the rim of the foremost cartridge in said magazine to axially retain it therein with its nose protruding beyond said open end.

4. The explosively actuated tool defined in claim 3 wherein said magazine is formed with a cut-away portion
at its open end to provide for the withdrawal of the foremost cartridge sidewardly from said magazine.

5. The explosively actuated tool defined in claim 4 comprising a collar mounted on magazine and being slidable to a position to cover said cut-away portion to contain with said lip for preventing the loss of cartridges from said magazines when said magazine is removed from said handle portion.

6. The explosively actuated tool defined in claim 5 wherein a guide surface is formed in said structure adjacent to the open end of said magazine for guiding each cartridge into said recess as said structure is displaced relative to said barrel toward said loading position.

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