April 26, 1966 H. L. BOCHMAN, JR 3,248,032

CARTRIDGE POWERED FASTENER DRIVER

Filed Jan. 6, 1964 2 Sheets-Sheet 1

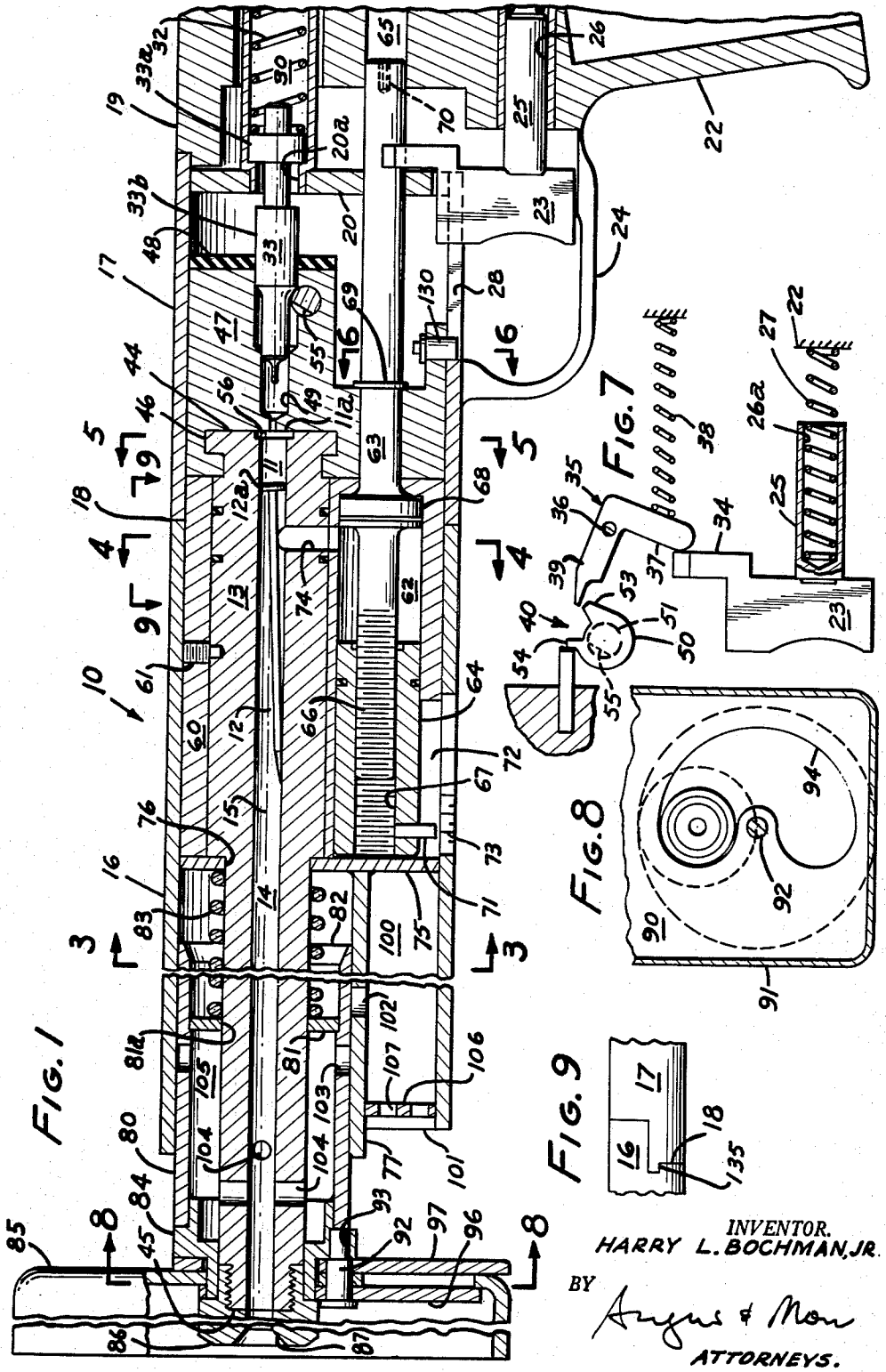

FIG. 1

FIG. 7

FIG. 8

FIG. 9

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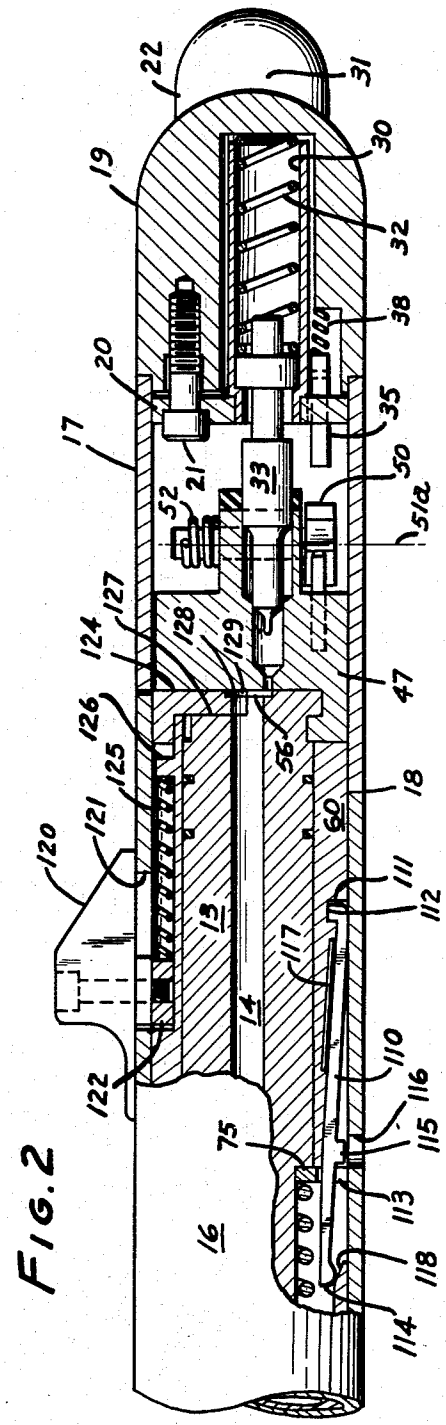

FIG. 2

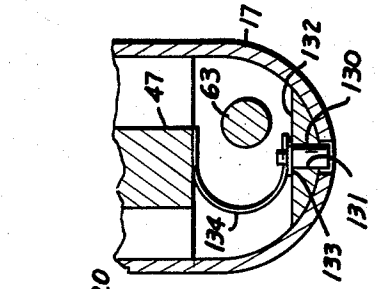

FIG. 6

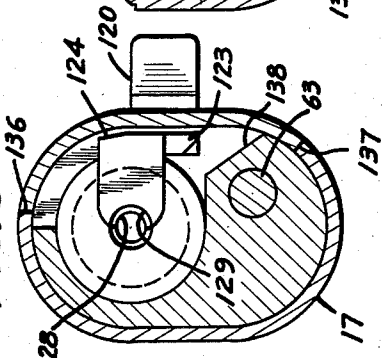

FIG. 5

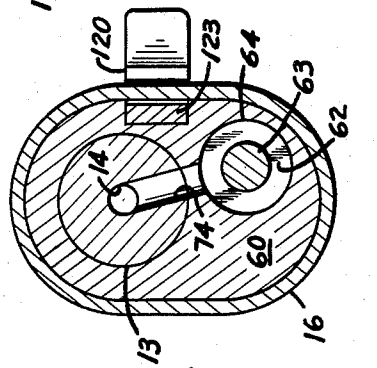

FIG. 4

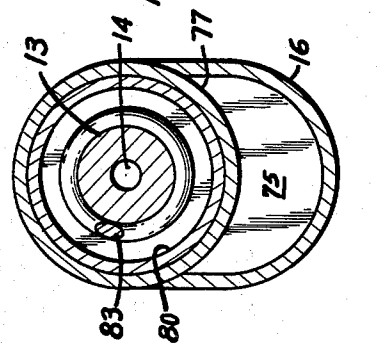

FIG. 3

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CARTRIDGE POWERED FASTENER DRIVER

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Filed Jan. 6, 1964, Ser. No. 335,933
2 Claims. (Cl. 227—8)

This invention relates to power actuated drivers for driving elongated objects such as nails.

It is an object of this invention to provide a gun to drive nails which gun has a variable power control, even when the source of energy is at a constant level, whereby the operator may vary the driving force on the nail in accordance with the needs of an individual job.

A related object of the invention is to provide a means to shield the operator of the device from detritus which may be scattered by impact of the nail with the material into which it is driven.

Another related object is to provide a means to lock the device so that a nail cannot be driven when the safety shield is removed, nor when the discharge end of the device is not forced against the material to be fastened.

Frequently in the use of power drivers for fasteners, such as a driver to drive nails to attach two pieces of material together, the driver has a force unsuitable for the material being fastened. If the nail is to be driven through plasterboard, a relatively light force is desirable, while a relatively large force is needed to drive the nail into hardwood. The force on the nail may be too great tending to damage the material, or the force may be so small on the nail that it will not enter into the material. Also, when the driver is driven by trigger-actuated means, it is necessary to be sure that the nail cannot be shot freely through the air but only into an intended surface which is to receive and stop.

A nail driver in accordance with this invention is a gun adapted to accept an explosive charge which when detonated will fire a nail into a piece of material. By providing an adjustable expansion chamber, tapped off the bore through which the nail is fired, the energy of the fastener may be adjusted.

According to a preferred but optional feature of this invention, a cup-like guard is placed over the discharge end of the barrel to shield the operator from any flying detritus. To fire the gun the discharge end of the device must bear against the material to be fastened with sufficient force to move the spring-loaded barrel towards the handle of the gun. Only when the barrel is in such a position may the gun be cocked and the trigger caused to actuate the firing pin and explode the charge.

The above and other features of this invention will be more completely understood in the following detailed description and accompanying drawings of which:

FIG. 1 is a front view in cross-section of a power actuated driver in accordance with this invention;

FIG. 2 is a top view of part of the device shown in FIG. 1 partially in cross-section;

FIG. 3 is a cross-section view of the device taken at line 3—3 of FIG. 1;

FIG. 4 is a cross-section view of the device taken at line 4—4 of FIG. 1;

FIG. 5 is a cross-section view of the device taken at line 5—5 of FIG. 1;

FIG. 6 is a cross-section view of the device taken at line 6—6 of FIG. 1;

FIG. 7 is a side view of the trigger mechanism when the device is in a cocked position;

FIG. 8 is a cross-section view of the device taken at line 8—8 of FIG. 1; and

FIG. 9 is a view taken at line 9—9 of FIG. 1.

The drawings show a gun 10 operable to detonate an explosive charge 11 in order to drive a nail 12 into a surface. The driver comprises a barrel 13 which has a circular bore 14 centrally disposed and of the same diameter as the size of the nail head 12*a* along a longitudinal axis 15. Barrel 13 is eccentrically enveloped within a front case 16 and a rear case 17 as shown in FIGS. 1 and 3. Front case 16 and rear case 17 are substantially eliptical in cross-section and join together at joint 18. A handle is attached to the rear case 17 such as by welding at the end opposite joint 18 and the barrel is slidably engaged within the front and rear case to move relative to the handle. Handle 19 has an end plate 20 attached by a screw 21 shown in FIG. 2 on the side facing the barrel 11. The handle has a hand grip 22 with a trigger 23 attached thereon with a trigger guard 24 connected between the hand grip 22 and rear case 17. A circular shaft 25 is attached to the trigger 23 and is slidable within a bore hole 26 in the handle 19 along an axis parallel to longitudinal axis 15 at a position directly above hand grip 22. Shaft 25 has a cavity 26*a* shown in FIG. 7 adapted to accept a compression spring 27 disposed in bore hole 26. Spring 27 tends to force trigger 23 away from hand grip 22 in the conventional manner. Trigger 23 is slidable in a longitudinal slot 28 in the end of rear case 17.

A spring chamber 30 is centrally disposed parallel to axis 15. It is shown in FIG. 2 in the handle and houses a firing pin power spring 32 in compression operable to actuate a firing pin 33. Longitudinal axis 31 is parallel to and spaced from axis 15 in a horizontal plane as shown in FIGS. 1 and 2. Pin 33 has a retaining sleeve 33*a* fixed to the non-detonating end and disposed to slide within chamber 30. Spring 32 bears against sleeve 33*a* on pin 33 biasing the pin to move through end plate 20. End plate 20 has a circular hole 20*a* centrally located on axis 31 having a size which allows pin 33 to pass therethrough but which restricts sleeve 33*a*. FIG. 7 shows trigger 23 to have an upwardly extending arm 34 adapted to strike a pawl 35 which is pivoted about a pin 36. Pawl 35 is an elbow shaped member having an arm 37 spring-loaded by compression spring 38 to bear against arm 34 of trigger 23. Pawl 35 has a second arm 39 which is operable to rotate a sear mechanism 40 to release firing pin 33.

Barrel 13 has a breech end 44 and a discharge end 45. Breech end 44 has shoulders 46 which interlock with a firing pin block 47. Firing pin block 47 is disposed in the rear case of 17 and has a resilient pad 48 attached at the end adjacent the handle. Block 47 has an elongated cavity 49 disposed to allow the firing pin to move therein. Sear 40 comprises a wheel 50 attached to a shaft 51 disposed along an axis 51*a* passing perpendicular to axis 31 through block 47 and is rotatable by pawl 35. Shaft 51 is biased to rotate in a counterclockwise direction as shown in FIG. 7 by a spring 52 shown in FIG. 2. Firing pin 33 has a rearward section 33*b* of larger diameter than its forward section. Section 33*b* bears against shaft 51 when the pin is cocked and the device is ready to fire.

FIG. 2 shows wheel 50 offset from longitudinal axis 31 and spaced from arm 39 of pawl 35. Block 47 is slidable in rear case 17 to a position wherein pad 48 abuts plate 20 so that arm 39 of pawl 35 will strike a protruding lug 53 on wheel 50 when pawl 35 is rotated about pivot pin 36 by trigger 23. The positioning of lug 53 and arm 39 is described in the operation of the device. Wheel 50 has a restraining lug 54 operable to abut against a restraining pin attached to block 47 to stop shaft 51 from unwinding the tension of spring 52. Shaft 51 has

a flat land 55 which, upon rotation of shaft 51, will release the large diameter rear section 33*b* of spring biased firing pin 33 to allow it to move along axis 31 toward a firing chamber 56 located at the breech end 44 of barrel 13. Firing chamber 56 is concentrically located on the end of bore 14 and has a circular hole extending into the breech end 44 of barrel 13. Chamber 56 has a larger diameter than bore 14 with a periphery which encircles axis 31 as shown in FIG. 2 so that firing pin 33 may detonate the head 11*a* of explosive charge 11 disposed therein.

A spacing block 60 envelopes a barrel 13 within the front case and is attached by a set screw 61 to the barrel adjacent firing pin block 47. Spacing block 60 is substantially elliptical in cross-section as shown in FIG. 4 and barrel 13 is eccentrically disposed therein. An expansion chamber 62 is aligned parallel to longitudinal axis 15 in block 60 opposite barrel 13. A pivot shaft 63 attached to a piston 64 in the expansion chamber extends parallel to axis 15 through the block 47 and into a circular hole 65 extending through handle 19. Shaft 63 has external threads 66 adapted to thread into internal threads cut into a central hole 67 in piston 64. A pressure sealing sleeve 68 disposed in the expansion chamber 62 and a retainer sleeve 69 disposed adjacent block 47 are rigidly attached to shaft 63 and serve to hold spacing block 60 to block 47. Shaft 63 is rotatable through blocks 47 and 60 and is slidable within a hole 65. An Allen-head socket hole 70 is disposed in the end of shaft 63 opposite the piston 64. A key 71 is attached to the piston and extends radially outward into a longitudinally extending keyway 72 disposed in the block 60 and front case 16. By proper rotation of an Allen head wrench (not shown) in socket hole 70 in the end of shaft 63, shaft 63 may be rotated. Piston 64 will be restrained from rotating by key 71 in keyway 72 and will be caused to move along shaft 63 in a direction parallel with longitudinal axis 15 in the expansion chamber 62. As the piston moves along the shaft, the volume of the expansion chamber varies accordingly. Notches 73 may be scratched on keyway 72 to serve as a gauge to indicate the position of piston 64 on shaft 63. Chamber 62 is substantially airtight except for passage 74 which extends radially from bore 14 through the barrel 13 and block 60 and into chamber 62 between piston 64 and sleeve 68. A radial plate 75 is disposed in a plane perpendicular to longitudinal axis 15 and is attached around the inside wall of front case 16 as by welding. Plate 75 has a circular hole 76 of the same size as the outside diameter of barrel 13 to allow the barrel to pass therethrough. Plate 75 is disposed from the end of front case 16 opposite joint 18 and adjacent piston 64 on the side opposite expansion chamber 62. A tubular sleeve 77 having an inside diameter greater than the outside diameter of barrel 13 is attached concentrically around longitudinal axis 15 to the plate 75 and extends toward the discharge end 45 of barrel 13.

A tubular guard sleeve 80 has an outside diameter of substantially the same size as the inside diameter of sleeve 77 and is adapted to slide therein. A spring restraining plate 81 is attached around the inner periphery of sleeve 80 at a distance from an end 82 in a plane parallel to plate 75. Plate 81 has a circular hole 81*a* to envelope barrel 13 and slide thereon. A compression spring 83 bears against plates 75 and 81 to provide a spacing between end 82 of sleeve 80 and plate 75. An adapting ring 84 is attached to the end of sleeve 80 opposite end 82 as by welding. The inside periphery of ring 84 slides against the outside periphery of barrel 13 adjacent the discharge end 45 and a safety guard 85 is mounted on the outside periphery of ring 84. A nut 86 threaded onto the discharge end 45 of barrel 13 serves to attach the safety guard 85 to sleeve 80. Nut 86 has a central opening 87 to allow the nail 12 to pass from the barrel.

Safety guard 85 has a rectangular back 90 as shown in FIG. 8 with a flanged edge 91 around its periphery extending over nut 86 to bear against the surface of the material to be fastened. Should it be desired to drive a nail at a corner, which will obstruct the proper position of the guard, the safety guard may be shifted with respect to the barrel 13 so that the barrel is disposed adjacent an end of the guard. The edge of the guard closest to the barrel is then placed into the corner and the nail is driven. A pivot pin 92 inserted through the guard at an eccentrically located position from the center point on the back 90 as shown in FIG. 8. Pin 92 is attached to adapting ring 84 such as by threading it into a hole 93.

A semicircular slot 94 having a width equal to the outside diameter of adapting ring 84 at the position where the guard is mounted to the ring, is disposed in back 90 of guard 85 and extends therethrough. Slot 94 is disposed concentrically around pin 92 and terminates with one end adjacent an edge of guard 85 and the other terminating end being located substantially at the center of back 90. Two circular plates 96 and 97 are concentrically attached on opposite sides of back 90 by pin 92. Plates 96 and 97 each extend radially outward beyond slot 94 and serve to cover up semicircular slot 94 as the guard is shifted on the barrel. It is found that two plates will cover the slot with a high degree of safety for the operator to protect him from flying detritus.

Front case 16 extends eccentrically around sleeve 77 to provide a muffler chamber 100 therebetween longitudinally defined between plate 75 and the end 101 of the front case. An exhaust port 102 extends through sleeve 77 as shown in FIG. 1 and a similar shaped port 103 extends through sleeve 80. Barrel 13 has relief passages 104 disposed adjacent discharge end 45 to allow gas pressure generated by the explosive charge to be dissipated from the bore after the nail has been actuated. Passages 104 allow the gas to escape into an intermediate chamber 105 between barrel 13 and sleeve 80. When guard 85 is pressed against a piece of material, ports 102 and 103 are aligned to allow the gas to pass into the muffler chamber 100. By providing chambers 100 and 105, the sound emitted by the explosive charge will be baffled as it passes through the relief passages 104 and ports 102 and 103. Additional baffling of the noise is provided by attaching a plate 106 perforated with holes 107 on end 101 between front case 16 and sleeve 77.

A latch arm 110 shown in FIG. 2 is operable to hold spacing block 60 in a fixed longitudinal position away from the handle when the guard is not attached to the barrel. In such a position, the barrel and firing pin block are also held stationary in a position away from the handle. Since the sear mechanism 50 is fixed to the firing pin block 47 and the pawl 35 is attached to the handle 19, arm 39 of the pawl cannot engage with lug 53 of sear 50 and the gun cannot be fired when latch arm 110 is in a latched position. The latch arm 110 is disposed in a longitudinal groove in block 60 and has a hook 111 at one end engaged to block 60. Hook 111 is inserted into a hole 112 in the block and held therein by front case 16. Latch arm 110 extends through a hole 113 in plate 75 and has a finger 114 at the end opposite the hook bearing on the inner wall of sleeve 77 when guard 85 and sleeve 80 are removed. A latch tang 115 protrudes radially outward from latch arm 110 through a hole 116 in front case by a leaf spring 117. End 82 of sleeve 80 is flared to serve as a cam 118 so that finger 114 will be moved radially toward the barrel 13 when sleeve 80 of the guard is inserted properly into sleeve 77, thus causing latch tang 115 to clear hole 116. Once the latch tang is clear of the hole the spacing block and barrel assembly may be slid in the front and rear case toward the trigger to cock the firing pin.

A cartridge extractor lever 120 shown in FIGS. 2, 4, and 5 is attached through a longitudinal slot 121 passing through front case 16 into spacing block 60 to a lug 122.

Lug 122 is attached to one end of an extraction arm 123 which is disposed longitudinally along the side of the device and terminated at an extraction element 124. A compression spring 125 disposed between a spring retainer 126 fixed to spacing block 60 and lug 122. Spring 125 forces extraction arm 123 toward the discharge end of barrel 13 so that the end of extraction element 124 lies in a notch 127 in barrel 13 and is flush with breech end 44. Element 124 extends radially inward toward the bore 14 and has a concave circular slot 128 in its end. Slot 128 has the same size diameter as bore 14 and is aligned to serve as a portion of the bore while element 124 is in notch 127. Element 124 has a groove 129 in slot 128 of larger diameter than slot 128 to serve as part of the firing chamber 56. Lever 110 is slidable in slot 111 to move element 124 longitudinally away from barrel 13 to force cartridge 11 to be pulled out of bore 14 by head 11*a*.

A knockout pin 130 shown in FIGS. 1 and 6 is inserted into a hole 131 in a leg 132 on firing pin block 47 disposed adjacent trigger guard 24. Pin 130 extends radially into slot 28 and has a head 133 which is forced by a spring 134 to bear against leg 132. By pushing pin 130 radially inward against spring 134 to clear slot 28, the entire barrel assembly including the firing pin block and front case may be removed from the handle assembly and rear case.

FIG. 9 shows joint 18 with rear case 17 having a dog leg 135 of a configuration to engage snugly with front case 16. The irregularity at dog leg 135 of joint 18 shown in FIG. 9 continues around the periphery of the cases to the limits 136 and 137 shown in FIG. 5. The front case 16 may be pushed longitudinally away from the handle 19 to move the entire barrel assembly toward discharge end 44 until knockout pin 130 strikes the end of slot 28 adjacent the trigger guard. At this position, dog leg 135 will be clear of the front case. It is desired that the longitudinal distance which the front case must be moved is about one-eighth (⅛) inch to clear the dog leg. Firing pin block has an accessary 138 so that shoulders 46 of barrel 13 will clear the firing pin block and the front case so that the front case, spacing sleeve, and barrel may be rotated clockwise about shaft 63 as shown in FIG. 5. When the front case is rotated from the rear case, easy access to the bore is provided to load the gun with a nail 12 and a cartridge 11. The guard 85 and sleeve 80 assembly are attached to barrel 13 by nut 86 so that the latch tang 115 will clear hole 116 as previously described.

When the device is to be operated, the size of the expansion chamber 62 must be adjusted in order to develop the required driving force. The driving force on the nail 12 can be adjusted in accordance with the type of material into which the nail is to be driven. Some of the gas liberated from the explosion of the charge 11 will flow into the chamber to consume some of the gas which would normally act upon the nail head. Decreasing the size of chamber 62 will increase the driving force on the nail because a smaller amount of gas will flow into the chamber and a larger amount of gas will force the nail to move longitudinally toward the discharge end of the device. Similarly, increasing the size of the chamber will decrease the force on the nail. An Allen head wrench is inserted into socket 70 to rotate shaft 63. Rotating shaft 63 in a clockwise manner as shown in FIG. 5 will cause piston 64 to move toward the handle and thereby decrease the size of the expansion chamber 62. Similarly, rotating shaft 63 in a counterclockwise direction will increase the size of the expansion chamber 62. Key 71 serves as an indicator to point to the gauge made by notches 73 in keyway 72 so that the operator may visually determine the proper setting of piston 64.

The front case 16 is pulled longitudinally away from the handle until pin 130 strikes the end of slot 28 as previously described. The front case is then pivoted clockwise on shaft 63 to expose bore 14 and a nail such as nail 12 is inserted into the bore with the head 12*a* of the nail closest to the handle. The explosive cartridge 11 having head 11*a* to fit into groove 129 of firing chamber 56 is inserted into the bore such that the head is flush with breech end 44. The drawings show the nail head 12*a* disposed between the passage 74 and the cartridge. Since passage 74 is in the vicinity of the firing chamber 56, there is no difference which side of passage 74 the head of the nail is disposed. Once the nail head passes passage 74 the force on the head will be adjusted by the expansion chamber. Once the nail and cartridge are inserted into the bore, the front case 16 is pivoted counterclockwise and then pushed back against the rear case so that dog leg 135 engages properly with the front case. Firing pin 33 is disposed on axis 31 which is spaced from axis 15 so that pin 33 will strike cartridge 11 eccentrically as shown in FIG. 2. The advantage to this eccentric spacing is that pin 33 will miss the firing chamber and will not strike the cartridge until the dog leg 135 is properly engaged with the front case.

After the front and rear cases are connected at joint 18, a substantial spacing exists between end plate 20 of the handle and resilient pad 48 on firing pin block 47. Pin 33 will be in an uncocked position disposed toward the discharge end of the gun. The pin will be restrained from moving with the firing pin block 47 by the retaining sleeve 33*a* when the front and rear cases are pulled apart. The shaft 51 will move past rearward section 33*b* to the region of the front section of the pin 33 where the shaft will be free to rotate to its counterclockwise position by spring 52.

The guard 85 is pressed against the material to be fastened, to force sleeve 80 to slide into sleeve 77. Adapting ring 84 will slide on barrel 13 until the end of nut 86 bears against the material. The barrel assembly including the spacing block and firing pin block will then slide toward end plate 20 on the handle. As block 47 moves towards the handle, shaft 51 of sear 50 will bear against section 33*b* of firing pin 33 to move the pin into the chamber 30 and compress spring 32. The firing pin block 47 will move toward the end plate 20 until resilient pad 48 bears against the end plate causing the block to stop. When pad 48 strikes plate 20 the sear 50 will be in an operable position with trigger 23 shown in FIG. 7 and ports 102 and 103 will be aligned to allow gas to pass from chamber 105 to chamber 100. The positional relationship between the sear and the trigger is such that the trigger mechanism is ineffective until the pad 48 bears against end plate 20. When the trigger is pulled arm 34 will strike arm 37 of pawl 35 causing arm 39 to strike lug 53 of sear 50 and rotate shaft 51 clockwise.

When shaft 51 is rotated clockwise the firing pin is released by flat land 55 and strikes the head 11*a* of cartridge 11 thereby causing detonation.

The gas produced by detonation of the charge will force the nail 12 toward the discharge end 45. After the head of the nail passes passageway 74 the gas enters into chamber 62 to relieve some of the gas pressure on nail head 12*a*. The nail continues to move along the bore by the force from the gas pressure and after the head of the nail passes relief passages 104 and the gas is discharged therethrough. The noise of the discharged gasses is attenuated by the chambers 105 and 100. The nail will move into the material by its own inertia until the head 12*a* strikes the surface of the material.

After the nail is driven, the firing pin is in the uncocked position with the flat land 55 bearing against rearward portion 33*b* of the firing pin. The pressure of the gun on the material is released and compression spring 83 forces the guard 85 and barrel assembly away from the handle. Front case 16 may then be manually pulled longitudinally from the rear case as previously described and rotated clockwise about shaft 63. Cartridge ejector lever 120 is pulled toward the handle which causes

ejector element **124** to move longitudinally toward the handle to eject the used cartridge **11** from the bore by its head. Compression spring **125** will return the lever **120** and the gun may again be loaded and fired as herein described.

This invention is not to be limited to the specific embodiment shown and illustrated herein, which is given by way of illustration rather than of limitation; and the invention is not limited except by the scope of the appended claims.

What is claimed is:

1. A cartridge powered gun for actuating a projectile, comprising a barrel having a bore disposed along a longitudinal axis and having a breech end and a discharge end, a spacing block embracing said barrel at said breech end and a firing pin block attached to said breech end, a firing chamber in gaseous communication with said bore to house said cartridge, a firing pin passage disposed in said firing pin block and terminating at an edge of said firing chamber, a firing pin slidably engaged in said firing pin passage to move toward said firing chamber for a fixed distance, said cartridge disposed in the path of travel of said firing pin, said barrel and firing pin block being longitudinally retractable to a retracted position from said firing pin such that said firing pin will terminate at the end of said fixed distance before striking said cartridge, a rotatable threaded pivot shaft extending through said firing pin block and said spacing block in a direction parallel with said longitudinal axis, said barrel being rotatable on said pivot shaft in a direction away from said firing pin passage termination when said barrel and firing pin block are in said retracted position; an expansion chamber in fluid communication with the barrel, and a piston threadedly engaged to the pivot shaft and axially movable in said expansion chamber by turning the pivot shaft for varying the volume of said expansion chamber.

2. A cartridge powered gun in accordance with claim **1** wherein said breech end has shoulders adapted to engage with an end of said firing pin block, an accessway disposed on said end of said firing pin block adapted to release said shoulders as said barrel rotates away from said termination of said firing pin passage.

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