

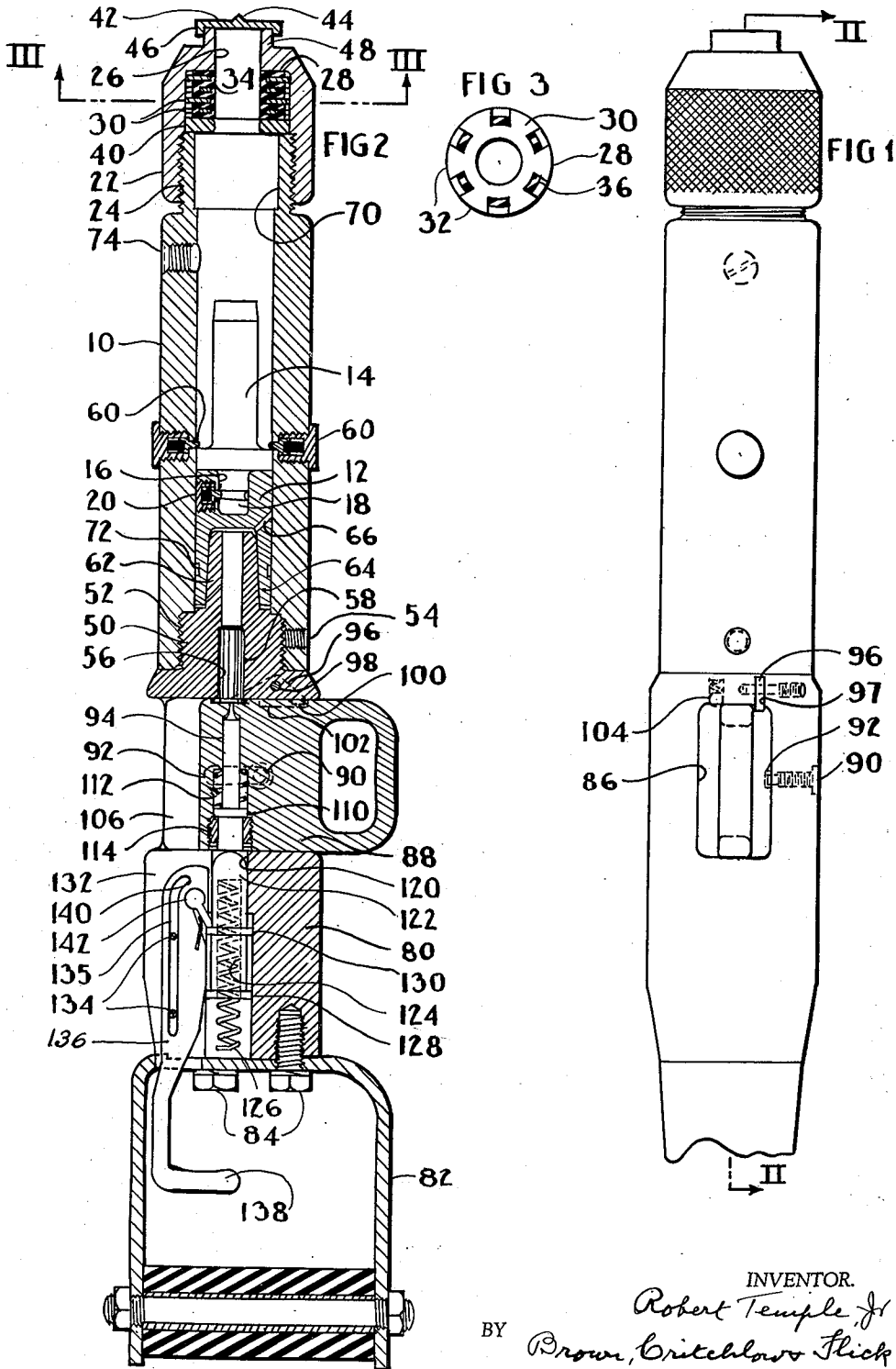
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RIVET REMOVER

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RIVET REMOVER

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This invention relates to methods and apparatus for removing confined rivets or other similarly headed members, and more particular is concerned with methods for employing the force of a detonated explosive charge and with apparatus operated thereby for performing the stated operation.

Heretofore, in maintenance or disassembly work it has often been necessary to remove a rivet or other headed member from a hole or other position in which it is secured. This has always entailed considerable work and is usually performed on button-headed rivets by cutting off the head of the rivet or other member with a cold chisel or a saw which is a time-consuming and laborious operation which, furthermore, often has the disadvantage of enlarging the hole or bending or distorting the members to which the rivet is secured. As obnoxious as button-head rivets are to remove, this is relatively simple when compared to removing countersunk rivets. These must be burned out with a cutting torch, which often so injures the hole that it must be redrilled and recountersunk.

It is the general object of my invention to avoid and overcome the foregoing and other objections to known methods and apparatus, as just stated, by the provision of improved means and methods for utilizing the force of a detonated explosive charge to remove a rivet or other headed member from the bodies to which it is secured.

Another object of my invention is the provision of apparatus operated by a blank cartridge or other explosive charge for driving a punch with high force and velocity through the head of a rivet to punch the body or stem portion thereof out of a hole in which it is secured.

Another object of my invention is the provision of explosively actuated apparatus for punching out or removing rivets or similarly headed members and characterized by the inclusion of a shock-absorbing member for cushioning the final punching movement of the apparatus.

Another object of my invention is to provide explosively actuated apparatus for driving a punch or similar member at high velocity into and through a rivet or the like, and which is characterized by being relatively light in weight, long wearing in use, easily operated by the ordinary workman, and which can be rapidly and safely reloaded in a minimum of time to be used over and over again without disassembly for cleaning or repairing.

Another object of my invention is the provision of an improved method for driving a rivet or

a similar member out of the body in which it is secured by the force of a detonated explosive charge, and which is characterized by relatively simple yet accurate aligning steps.

The foregoing and other objects of my invention are achieved by the provision of an apparatus comprising a barrel, a piston slidably mounted in the barrel, a punch carried by the piston, a piston-retaining means associated with the muzzle end of the barrel and having a central aperture therethrough to permit the passage of the punch. Completing the combination are resilient shock-absorbing and cushioning means for stopping the movement of the piston, a frangible aligning device carried by the retaining means, and means for detonating an explosive charge behind the piston to drive it and the punch toward the muzzle end of the barrel.

My improved method for removing rivets or the like includes the steps of centering a frangible member with the rivet, aligning the barrel with the frangible member, driving the punch out of the barrel and through the frangible member and rivet by the power of a detonated explosive charge, and cushioning the final movement of the punch in the barrel.

One embodiment of my invention is illustrated in the accompanying drawing wherein Fig. 1 is a plan view of the apparatus; Fig. 2 is a longitudinal cross-sectional view taken on the line II—II of Fig. 1; and Fig. 3 is a transverse cross-sectional view taken on line III—III of Fig. 2.

In the form of my invention specifically illustrated in the drawing the numeral 10 indicates generally a barrel which slidably receives a piston 12. The piston 12 is adapted to removably carry a punch 14 in axial alignment in the barrel 10, and to this end the piston 12 is formed with a socket 16 which receives a stud 18 formed on the end of the punch 14. A spring-pressed detent 20 having a compressible rubber plug therein serves to releasably hold the stud 18 in the socket 16 so that punches of different sizes can be used in conjunction with the apparatus, as will be understood.

Means are employed in conjunction with the apparatus for stopping the forward or outward movement of the piston 12 and these means may conveniently take the form of retaining nut 22, which has a threaded connection 24 with the muzzle end of the barrel 10 and which is provided with a central aperture 26 of a diameter slightly greater than the largest diameter of the punch 14. Associated with the retaining nut 22

is a shock-absorbing and cushioning unit indicated as a whole by the numeral 28. The shock-absorbing unit 28 is an important part of my apparatus inasmuch as it prevents breakage of any of the parts thereof and is particularly adapted to withstand the relatively heavy blows imparted to the retaining nut 22 by the piston 12 and its associated parts.

Specifically, the shock-absorbing unit 28 includes a plurality, such as four, of metal discs marked 30 which are in the nature of flat washer-like members formed with a plurality of radially directed tabs 32. The discs 30 are formed of a metal, such as steel, which has little or no affinity for rubber. In other words, when rubber is vulcanized in contact with the steel surfaces there will be no adhesion between the surface and the rubber. However, the discs 30 are embedded in a cylindrical block of resilient rubber marked 34 which, as clearly shown in Figs. 2 and 3, is of smaller diameter than the over-all diameter of the discs 30, including the tabs 32, but which is of greater diameter than the diameter of the discs without including the tabs 32. Thus the shock-absorbing unit comprises a plurality of steel discs positioned in spaced parallel relation to each other and separated by resilient rubber which is in the form of a plurality of separate layers connected by integral stud or finger portions 36. The tabs 32 of the individual discs 30 are not positioned in opposed relation but are staggered circumferentially relative to each other so that the stud or finger portions 36 are scattered more or less uniformly throughout the entire shock-absorbing unit. Terminating the resilient member body at a point radially within the outer periphery of the tabs 32 provides a space into which the rubber body may flow when the shock-absorbing unit is subjected to high axial force, as is the case when the piston is driven against it. The fact that the rubber is not vulcanized to the metal discs permits the flowing displacement of the rubber, as just described, without any tearing action on the rubber.

I employ a relatively heavy steel washer 40 between the end of the barrel 10 and the shock-absorbing unit 28, which washer functions to uniformly apply the force of the piston over the entire surface of the shock-absorbing unit 28. The retaining nut 22 not only serves to carry the shock-absorbing unit 28, as just described, but also is adapted to carry aligning means which take the form of a frangible metal disc 42 formed with an axially positioned outwardly directed pointed stud 44 which is adapted to be received in a center punched hole in the rivet or other member to be removed. The frangible disc 42 is conveniently connected to the retaining nut 22 by the provision of an integral flange 46 on the disc which fits snugly over a circular flange 48 formed on the end of the retaining nut 22. It should be understood that button-head rivets or the like can be properly aligned with the apparatus without the use of the frangible disc since the curved head of the rivet aligns itself with the round opening in the retaining nut 22. Thus, the center punching and frangible disc need only be used with a countersunk rivet or similar member.

The breech end of the barrel 10 is adapted to removably receive a breech member marked 50, and this may be achieved by the provision of a threaded connection 52 therebetween. A set-screw 54 serves to lock the breech member 50 in

place at the breech end of the barrel 10. The breech member 50 is formed with an axial chamber 56 adapted to removably receive an explosive charge which is conveniently made in the form of a blank cartridge 58.

Means are preferably provided for holding the piston 12 against movement in the barrel 10 until substantially the greatest energy is developed from the detonated explosive charge. These means may take the form of one or more spring-pressed detents 60 carried by the barrel 10 and engaging with the outer end of the punch 14. Instead of a metal compression spring I employ a compressible rubber plug in the detent 60 which I have found has increased life and is less subject to breakage. Further, I may form the breech member 50 with a tapered extension 62 which extends into a skirt 64 formed on the piston 12 and having a complementary taper. The tapers between the extension 62 and the piston skirt 64 are at a relatively small angle to the axis of the barrel, and there is a definite wedging action between these parts. While I preferably employ both the wedging action just described and the spring-pressed detents 60 for holding the piston 12 against movement, it should be understood that either of the stated means could be used alone and that furthermore at least certain of the advantages of my invention are retained even when both retarding means are eliminated.

In order to relieve the pressure of the expanded gases of the detonated explosive charge once the piston 12 has moved to perform the desired work, I preferably incorporate one or more bleeder vents 66 between the inside of the skirt 64 on the piston and the outer circumference of the piston. I also provide a slightly enlarged bore 70 at the muzzle end of the barrel 10, which cooperates with the vent or vents 66 when the piston 12 is at the most outward movement of its travel to thereby exhaust the gases behind the piston to the front end of the piston and eventually to the atmosphere with a comparatively slow bleeding action. Further, I preferably provide circumferential grooves 72 on the piston 12 or on its skirts, which grooves are adapted to receive a suitable lubricant which can be introduced into the barrel through a pressure gun fitting 74.

The breech member 50 is preferably formed integral with a stock 80, usually made of a substantially cylindrical shape in cross section, and to which is secured a handle 82 as by cap screws 84. The stock 80 is provided with a transverse opening 86 which is substantially rectangular in cross section and which slidably receives a breech-block 88 for limited lateral movement, as controlled, for example, by a screw 90 carried in the stock and having an end extending into a relatively short groove 92 formed in the side face of the breech-block 88. The breech-block 88 carries a firing pin 94 so that in one lateral position of the breech-block 88 the firing pin 94 is in alignment with the blank cartridge 58 carried in the chamber 56 of the breech member 50. In the other lateral position of the breech-block 88 the firing pin 94 is moved out of alignment with the blank cartridge 58 to permit the ejecting of the detonated shell and the introduction of a new cartridge into the breech member.

The ejecting of the fired cartridge shell is effected by the lateral movement of the breech-block 88. Specifically, an ejector finger in the form of a triangular plate 96 is received in a

suitable slot 97 and is pivotally mounted near its center on a pin 98 carried by the breech member 50. The one end of the finger plate 96 is formed with an extension 100 which is slidably received in a slot 102 cut in the opposed face of the breech-block 88. The length of the slot 102 is such that when the breech-block 88 is near the end of its travel to expose the breech chamber the end of the slot 102 engages with the extension 100 on the finger plate 96 to tilt the plate about the pivot pin 98 and eject the blank cartridge 58. It will be seen from Fig. 1 that the finger plate 96 is positioned off center of the breech chamber 56 so that the end of the finger plate 96 remote from the extension 100 engages behind the flange on the blank cartridge 58, as will be understood.

A spring-pressed ball detent 104 serves to lock the breech-block 88 in either the firing or loading position. To facilitate the loading operation and to provide the necessary strength while reducing the lateral travel of the breech-block 88 to a minimum, its one end is formed with a U-shaped opening or slot marked 106 which is sufficiently wide to receive a blank cartridge.

The firing pin 94 is adapted to be held by suitable means in a retarded or non-operating position, and to this end the firing pin is formed or provided with a flange 110 which is received slidably in an enlarged aperture formed in the breech-block 88. A coiled compression spring 112 carried in the enlarged bore engages with the flange 110 and forces the firing pin against a retaining collar 114 which is locked in threaded relation with the breech-block 88. The stock portion 80 of the apparatus is formed with an axial bore 120 which slidably receives a hammer 122. The hammer 122 is in turn provided with an axial pocket 124 which receives a coiled compression spring 126 so that the hammer 122 is normally urged toward the firing pin 94. The hammer 122 carries spaced shoulders 128 and 130 which are engaged by a simplified trigger mechanism which will now be described.

A circumferentially narrow, longitudinally extending and radially directed slot 132 is formed in the stock 80 so that the slot runs into communication with the bore 120 receiving the hammer 122. A pair of pins 134 is positioned perpendicular to the faces of the slot 132 and at equal distances from the bore 120, and these pins, which are carried by the stock 80, are slidably received in a cam slot 135 formed in the flat plate 136 which is extended to form a trigger 138 in proximity to the handle portion 82 of the apparatus. The cam slot 135 in the plate 136 is formed with a downwardly curved end 140 so that when the trigger 138 is pulled the flat plate 136 is moved toward the handle to bring one of the pins 134 into the curved portion 140 of the cam slot 135. This tilts the plate 136 away from the axial bore 120 so that a spring-pressed pawl 142 carried by the plate slides out from engagement behind the collar 130. This causes the hammer 122 to be driven forward under the energy stored in the compression spring 126 to thereby strike the firing pin 94 a blow sufficient to overcome the pressure of the spring 112 and detonate the blank cartridge 58. The trigger 138 is now pushed back to the full-line position shown in Fig. 2, at which time the spring-pressed pawl 142 rides over the collar 130 to again position the trigger mechanism ready for the pulling and firing operations.

It is believed that the operation of my im-

proved apparatus will be understood from the detailed explanation given above. Suffice it to say here that in accordance with my improved method and in an operation on a countersunk rivet the rivet to be removed is first centered punched, and then the frangible member 42 is aligned with the rivet by positioning the pointed stud 44 in the center punch on the rivet. This aligns the barrel of the apparatus with the rivet, whereupon the trigger 138 is pulled to first move the hammer 122 back to compress the spring 126 with the subsequent release of the hammer to strike the firing pin and detonate the blank cartridge 58. The forward movement of the piston 12 and the punch 14 is retarded by the spring-pressed detents 60 and by the tapered and wedged fit between the extension 62 on the breech member 50 and the skirt 64 on the piston until substantially the maximum power of the detonated blank cartridge has been realized.

Thereupon, the frictional retarding means yield to the full pressure of the expanded gases, and the piston 12 and the punch 14 are driven toward the muzzle end of the barrel with tremendous pressure and velocity. The end of the punch 14 shears the frangible member 42 and punches through the head of the rivet and into the stem thereof to punch it out of the hole in which it was fixed. I have found that certain rivets yield very easily without absorbing the full force of the piston and punch. The surplus force is absorbed by the shock-absorbing cushion 28 wherein the rubber 34 is free to flow without tearing. The shock-absorbing unit is also important for the reason that often a rivet may be merely loosened by the first operation of my improved apparatus with a second shot being required. Usually when this is the case the force required in the second shot is relatively low, and if a standard powder charge is employed a very considerable energy will have to be absorbed by the shock-absorbing unit 28. Without the use of the shock-absorbing unit there is a metal-to-metal impact of the parts which I have found results in considerable breakage of the parts, due to the very high forces created by the detonated explosive charge.

It is believed that the objects of my invention have been achieved by the apparatus and method described. The apparatus is relatively light in weight and can be readily operated by the ordinary workman to almost instantly remove a rivet or other headed member from a body substantially without distortion. I believe that distortion is largely eliminated because of the suddenness of the blow. The apparatus is readily adapted to perform punching operations on rivets of different diameter by merely changing the size of the punch carried by the piston. This can be accomplished either by removing the retaining nut 22 from the end of the barrel 10 or by removing the barrel 10 from the breech-member 50, as will be understood. The exhaust gases or any corrosive condensation thereof are bled out from behind the piston to the front of the piston and gradually out to the atmosphere after each operation of the apparatus and relatively simple lubricating means are employed. The breech-block is quickly operable to permit rapid and facile reloading of the apparatus, and the trigger and firing pin mechanisms are relatively simple and rugged in design and are substantially fool-proof.

Throughout the specification and claims reference has been made to rivet punching and re-

moving. It will be appreciated that my improved method and apparatus are broadly applicable to other punching operations, although they are particularly adapted to operations on rivets or other headed members.

While in accordance with the patent statutes I have specifically illustrated and described one embodiment of my improved apparatus and have given one specific way of practicing my improved method, it will be understood that my invention is not limited thereto or thereby but is defined in the appended claims.

I claim:

1. Apparatus for punching comprising a barrel, a piston slidably mounted in the barrel, a punch carried by the piston, piston-retaining means associated with the muzzle end of the barrel and having an aperture therethrough to permit the passage of the punch, means carried by the retaining means and resiliently cushioning the stopping movement of the piston, a frangible aligning device carried by the retaining means, and means for detonating an explosive charge behind the piston to drive it and the punch towards the muzzle end of the barrel.

2. Apparatus for punching comprising a barrel, a piston slidably mounted in the barrel, a punch carried by the piston, piston-retaining means associated with the muzzle end of the barrel and having an aperture therethrough to permit the passage of the punch, means carried by the retaining means and resiliently cushioning the stopping movement of the piston, said means including a plurality of metal washers surrounding the aperture in the piston-retaining means, a body of rubber vulcanized around the washers but not thereto and holding the washers in spaced relation, integral rubber tabs connecting the layers of rubber between the washers, said body of rubber being of less effective circumferential area than the washers to provide spaces into which the rubber can be displaced, and means for detonating an explosive charge behind the piston to drive it and the punch towards the muzzle end of the barrel.

3. Apparatus for removing rivets or the like comprising a barrel, a piston slidably mounted in the barrel, a punch carried by the piston, piston-retaining means associated with the muzzle end of the barrel and having an aperture therethrough to permit the passage of the punch, a frangible aligning device carried by the retaining means, and means for detonating an explosive charge behind the piston to drive it and the punch towards the muzzle end of the barrel.

4. Apparatus for removing rivets or the like comprising a barrel, a piston slidably mounted in the barrel, a punch carried by the piston, piston-retaining means associated with the muzzle end of the barrel and having an aperture therethrough to permit the passage of the punch, a frangible aligning device carried by the retaining means, said device including a disc adapted to be sheared by the punch and having an outwardly extending pointed stud which is adapted to be placed in a center punch on the work, and means for detonating an explosive charge be-

hind the piston to drive it and the punch towards the muzzle end of the barrel.

5. In explosively actuated apparatus, a barrel, a piston slidably mounted in the barrel, said piston being formed with bleeder vents from its back surface to its cylindrical surface, the barrel being formed with cooperating bleeder vents near its muzzle end, the bleeder vents being adapted to be aligned near the end of the forward movement of the piston to exhaust the gas behind the piston to the atmosphere, and means for detonating an explosive charge behind the piston to drive it towards the muzzle end of the barrel.

6. In explosively actuated apparatus, a barrel, a piston slidably mounted in the barrel, said piston and barrel being formed with bleeder vents, the bleeder vents being adapted to be aligned near the end of the forward movement of the piston to exhaust the gas behind the piston to the atmosphere, and means for detonating an explosive charge behind the piston to drive it towards the muzzle end of the barrel.

7. In explosively actuated apparatus, a barrel, a piston slidably mounted in the barrel, a breech member and stock carried by one end of the barrel, a breech-block slidably mounted for limited lateral movement in an aperture in the stock and in one position exposing the breech member for the introduction or removal of an explosive charge and in the other position bringing a firing pin chamber into alignment with the breech member, a firing pin resiliently mounted in the chamber in the breech-block, a hammer slidably carried in the stock remote from the barrel, means for resiliently urging the hammer towards the firing pin, and trigger means for moving the hammer away from the firing pin and for releasing the hammer to detonate the explosive charge.

8. Explosively actuated apparatus comprising a barrel, a member slidably mounted in the barrel, means associated with the end of the barrel and adapted to resiliently stop the movement of the member through the barrel, said means including a plurality of metal plates, a body of rubber vulcanized around the plates but not thereto and serving to hold the plates in spaced relation, integral rubber tabs connecting the layers of rubber between the plates, said body of rubber being of less effective circumferential area than the metal to provide spaces into which the rubber can be displaced, and means at the other end of the barrel for detonating an explosive charge behind the member to drive it toward the first-named end of the barrel.

9. Explosively actuated apparatus comprising a barrel, a member slidably mounted in the barrel, a frangible aligning device carried at the muzzle end of the barrel, said device including a disc-like element having an outwardly extending pointed stud which is adapted to be placed in a center punch on the work, and means for detonating an explosive charge behind the member to drive it toward the muzzle end of the barrel.

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