Nov. 27, 1951 C. W. MEYERS 2,576,473

METHOD OF SECURING A FASTENING ELEMENT IN CONCRETE

Filed Feb. 1, 1950 2 SHEETS—SHEET 1

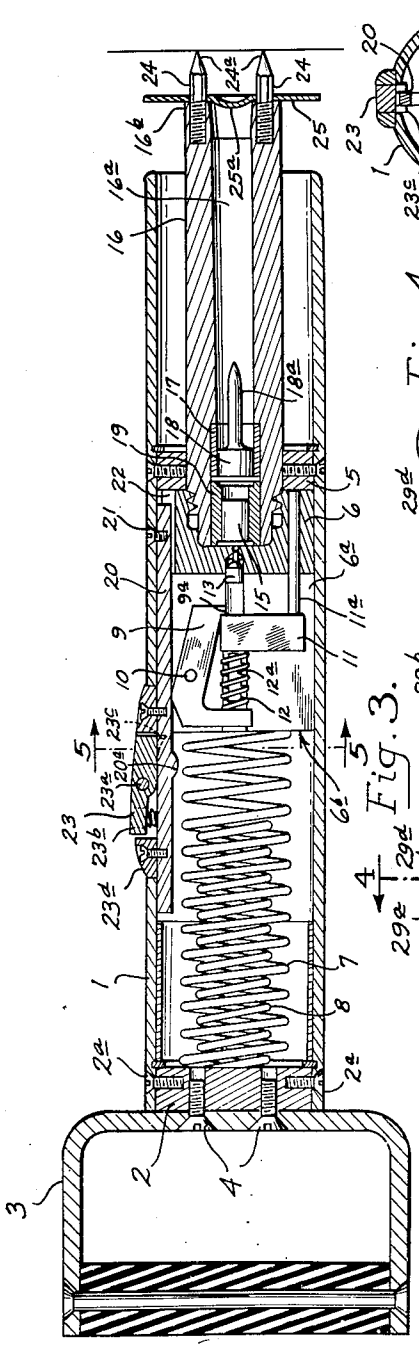


Fig. 1.

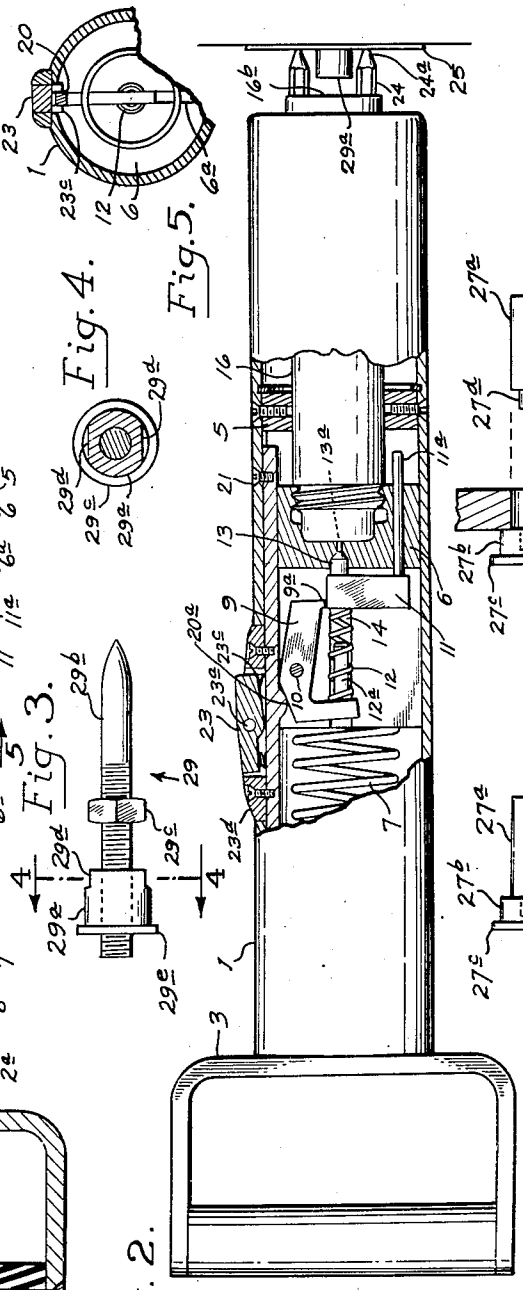


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

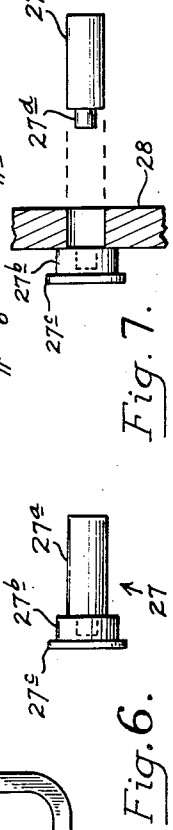


Fig. 6.

Fig. 7.

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Fig. 8.

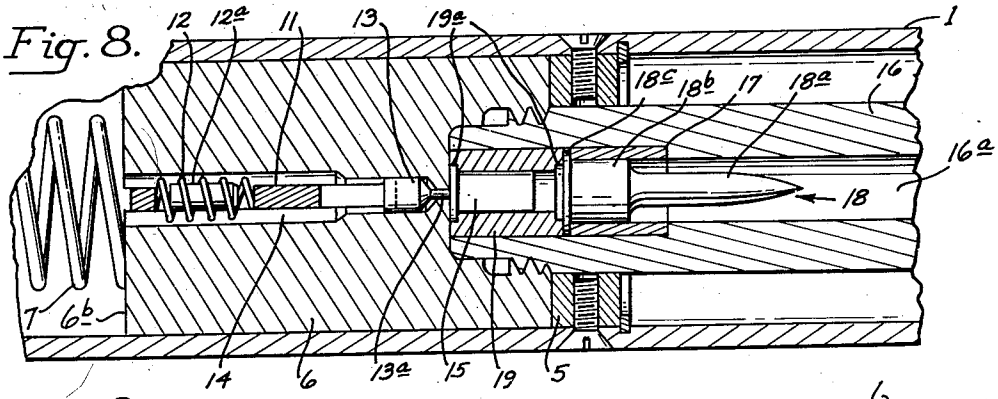


Fig. 9.

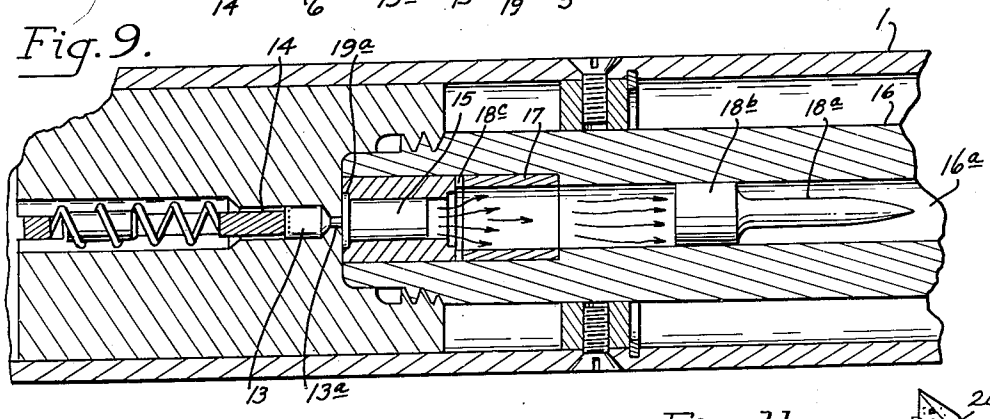


Fig. 10.

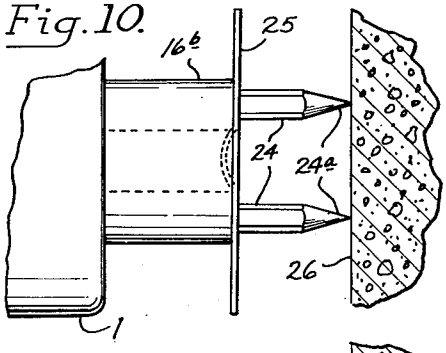


Fig. 11.

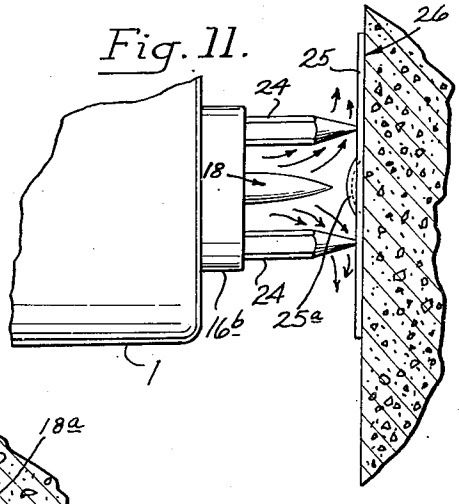
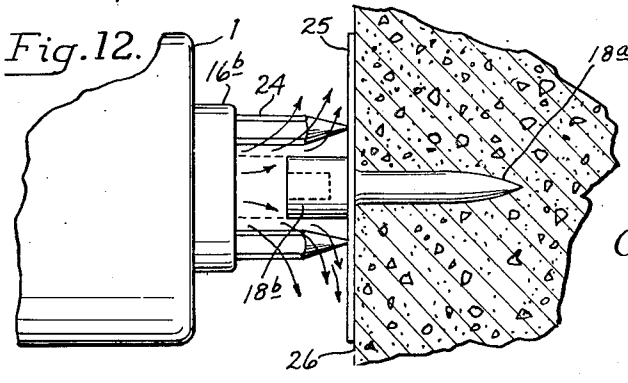


Fig. 12.



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METHOD OF SECURING A FASTENING ELEMENT IN CONCRETE

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Application February 1, 1950, Serial No. 141,763

5 Claims. (Cl. 1—1)

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My invention relates generally to an impact tool which utilizes the explosive discharge of gas from a highly combustible material to drive a fastening or material piercing element into and through two overlapped sections of metal, or to drive such a projectile-like device into a solid mass of concrete or masonry.

One of the principal objects of my invention is to provide an effective method of embedding a pointed fastening member into a solid mass of concrete or masonry without rupturing and dislodging substantial portions of concrete from the surface thereof adjacent the point of entry.

As a supplementary feature of the foregoing object, a further feature of my invention is to provide a dome-shaped disc, through which said piercing or fastening member is projected when it is shot into concrete.

A further and more specific object of my invention is to provide an impact tool for use with said thin metallic disc which will support the disc in place; will locate said too correcty over the point of entry for a piercing or fastening member discharged from said tool; will hold said disc tightly in place by the displaced air ahead of the projectile until it is pierced by said projectile; will direct the discharged gases from behind said projectile over said disc, to hold it tightly in place to shield said point of entry; and will prevent said high velocity gases from entering small crevices and "blowing out" chunks of concrete. That is to say, said impact tool is adapted to locate a disc correctly over the point of entry so that it will shield said point from the destructive force of said high velocity gases, and will use said high velocity of said gases beneficially to produce an area of high pressure immediately adjacent the point of entry. Said area of high pressure tends to counteract the destructive forces generated by the sudden entry of said projectile into a solid mass of concrete, and tends to hold said parts together adjacent said point of entry somewhat in proportion to the disrupting forces generated by the entry of said member.

A further object of my invention is to provide a projectile to serve as said piercing or fastening member, which has a head which constitutes a piston while said projectile is traversing the length of the bore of the barrel of said machine. Said projectile is thus directed into or through a mass of overlying members to be pinned together.

Said projectile also has utility in connection with a device to be used purely as a punching or shearing member, rather than a fastening member. In the latter case, it is desirable that said

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punch be permitted to pass completely through a sheet of material. This would be prevented if the shank of the device were provided with a large integral head serving as a piston. To this end, I make said head and said shank in separate pieces and bind them together by some adhesive or by a press fit so that when the shank passes through the plate, the head is released and a smooth hole is formed by said punch without substantial marking or indentation produced by said larger head.

If said connection has shanks which are threaded, such as studs, which are to be embedded in a mass of concrete with a portion extending substantially from the surface thereof, the removable head may be threaded to said stud. Said head may be used as a piston to guide it centrally, that is axially, of the bore of the barrel, and when said stud is lodged in material, said head either may be used as a depth gauge, to limit the entry of said stud into said material, or may be used as a nut or fastening device, which can thereafter be used to fasten something to the stud. In the latter case, I deem it preferable to provide two non-circular faces or a plurality of non-circular faces on a minor portion of said head so that said faces may be engaged by a wrench to apply force thereto in seating said nut-like head upon the threaded stem.

A further and more specific object of my invention is to provide an impact tool of this character in which the barrel is smooth-bored and uninterrupted, and is spaced a substantial distance from a surface to be entered. This is accomplished by the use of extension pins. Thus the area surrounding said pins may serve as a passageway through which exhaust gases may be discharged. Said barrel thus arranged also permits the gases to actually impinge against the surface to be entered. In this latter case, I preferably shoot said projectiles through discs and utilize said continuing blast of exhausting gases to hold said disc tightly about the point of entry, as has previously been commented upon.

A further object of my invention is to provide an impact tool which can not be discharged inadvertently. To this end, I provide a safety device which has an external trigger which must be depressed in order to permit the parts of said tool to move into operative position. Further details of said impact tool concern the manner in which the charge of combustible material may be ignited and burned by the detonating action of a spring-actuated firing pin, which is set so that a projectile will be discharged from the barrel

of said tool when the parts are arranged in appropriate firing positions and will not discharge said projectile except when said parts are thus arranged.

Further and other details of my invention are hereinafter described with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section through an impact tool embodying my invention, showing the parts as they are arranged before an explosive charge is ignited and burned;

Fig. 2 is a side elevation of said tool with portions shown broken away to illustrate the relation of the parts as they exist when the projecile has been discharged, immediately prior to recoil of the devices;

Fig. 3 is an elevation of a fastening device with removable piston-like head, which may serve as a threaded nut upon a stud used in concrete work, with a second nut shown thereon to serve as a depth gauge to limit the penetration of said stud into a mass of concrete or masonry;

Fig. 4 is a cross sectional view taken on the line 4—4 in Fig. 3 through the removable piston-like head for said projectile, illustrating the manner in which minor portions of said head are flattened so as to provide gripping surfaces;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 in Fig. 1 through the barrel of the gun, illustrating the manner in which the safety catch engages the firing pin carrier body to prevent inadvertent discharge of a cartridge carrying an explosive charge;

Fig. 6 is a side elevation of a piercing member used in connection with my invention, said piercing member being provided with a detachable head loosely secured to the shank;

Fig. 7 is a more or less diagrammatic illustration, showing the manner in which said head becomes detached from the shank when the latter is used as a punch to form a hole in a plate or other member;

Fig. 8 is an enlarged fragmentary longitudinal sectional view through the carrier body for the firing pin, showing the devices as they are arranged prior to discharge;

Fig. 9 is a view similar to Fig. 8, showing the parts when said firing pin is actuated to ignite the explosive charge, the projectile being shown on its way axially of the bore of the gun barrel;

Fig. 10 is a fragmentary view showing the end of an impact tool with extension pins bearing upon a concrete mass into which a projectile is to be embedded and with a disc arranged over the muzzle of said barrel;

Fig. 11 is a view similar to Fig. 10, showing the manner in which the air ahead of said projectile is displaced to move the disc against the surface of the mass of concrete to be pierced, and with the sharp end of the projectile approaching the dome-shaped center of said disc which it is to pierce and to flatten; and

Fig. 12 is a similar view showing said projectile fully embedded in said mass of concrete, having flattened said disc, and shows the manner in which the discharged gases continue to act upon the head of said projectile and to be forced downwardly and outwardly over said disc, which shields the surface of the mass of concrete adjacent the point of entry of said projectile.

An impact tool embodying my invention comprises a frame made up of a sleeve 1, closed at one end by a disc 2, to which a handle member 3 is secured by screws 4. Said disc is secured to the sleeve by screws 2a. Intermediate the ends of said sleeve is an annular stop collar 5. A firing pin carrier body 6 is resiliently held against the stop collar by a recoil spring 7. Said recoil spring is quite heavy and exerts a substantial pressure against said carrier body. It is also initially compressed or loaded so that substantial pressure is exerted against the carrier body even when the parts are at rest. A sectional recoil spring 8 lies within the recoil spring 7 and is spaced from the upper face 6b of the firing pin carrier body a substantial distance. Said springs 7 and 8 together form a compound recoil spring, which is cumulative as said carrier body is moved backward by the reaction of the explosive charge, tending to drive the projectile from the muzzle of the barrel.

Said carrier body is a cylindrical member, having a diametric slot 6a formed therein, as is shown in Fig. 5. In said slot lies a trigger 9, pivotally mounted on a pin 10. Said trigger is in the form of a bell-crank and has a protuberant lip 9a, which underlies and engages a contact hammer 11 when the parts are arranged as is shown in Fig. 1. A coiled trigger spring 12 lies between the opposed faces of the hammer 11 and the projecting arm of the trigger and tends to hold said parts spaced. Separation is prevented by the engagement of the lip 9a, with the under surface of said contact hammer when the firing pin mechanism is cocked. Within the trigger spring 12 is a plug 12a, whose function it is to prevent the recoil of the parts from breaking said trigger spring. That is, when said trigger spring is compressed upon recoil, the spacing of the contact hammer with the trigger is limited by the presence of said plug. A firing pin 13 is slidably mounted in an axial passageway 14 in the carrier body, and when the trigger is cocked, as is shown in Fig. 1, said firing pin is free to move slightly in said passageway with the firing extremity 13a in floating engagement with the cap of a cartridge 15.

A barrel 16 is screw-threaded in the end of the carrier body 6 and slidably engages the bore of the annular stop collar 5. The sleeve 1 overlies the greater portion of the length of the barrel, extending to a point where only clearance is provided when the parts are in firing position, as is shown in Fig. 2. In the bore 16a of said barrel is a liner 17. The upper portion of said barrel is cut away so that the liner may be recessed therein and may have substantially the same diameter bore as that of said barrel 16. Within said liner, a projectile 18, constituting a fastening or piercing element, is lodged, as is shown in Fig. 1. Said projectile 18 has a shank 18a, a piston-like head 18b, and a projecting flange 18c. When I speak of the head as being piston-like, I mean that it slidably engages the bore of said liner and the bore 16a of said barrel. Thus it holds the shank in axial alinement with the axis of said bore and causes it to be directed, point first, from said barrel when thus axially alined. The projecting flange overlies the top of the liner 17 and is shearable. That is, when the explosive charge in the cartridge is ignited and expands and generates an explosive gas of predetermined compression, it will cause said projecting flange to be sheared off and will drive the projectile, point first, down the barrel. When I speak of upwardly and downwardly, I am referring to the relation of the parts as they stand when driving into a floor. Above said projectile is a breech plug 19 of tubular section. The ends 19a of said breech

plug are counter-bored to receive the rim portion of the cartridge 15. Both ends are counter-bored so that the breech plug is interchangeable, and thus care does not have to be exercised to see that the right end is up to receive said cartridge. The lower end of the breech plug bears against the upper surface of the projecting flange of the projectile, and the adjacent ends of said breech plug and liner, respectively, clamp said flange between them. Thus, when the buring gases from a combustible charge within the cartridge drives the projectile along the bore of the barrel, said flange is sheared off and is retained between the adjacent ends of the breech plug and the liner in the manner illustrated in Fig. 9, and the projectile utilizes the piston-like head to maintain it in alinement, as has been described.

Fixed to the interior of the sleeve 1 is a longitudinally extending guide key 20, secured to the sleeve by screws 21. A guideway 22 in the carrier body 6 engages said key and prevents relative rotation of said body in said sleeve. A pivoted safety button 23 is rotatably mounted upon a pin 23*a* carried by a housing 23*d* secured to the guide key and projecting through a slot in said sleeve, and said safety button rocks about the axis thereof. It is arranged so that it tends to rotate clockwise, as viewed in Fig. 1, about said pin under the influence of a coil spring 23*b*. A pair of latching points 23*c* formed on the bottom lie at the lateral side of the guide key 20 and overlie and engage the face 6*b* of the carrier body 6, as is shown in Figs. 1 and 5. Thus, when the safety button is in normal position, it prevents the parts from moving into firing position. To permit it to be fired, the safety button must be pressed, rocking it counter-clockwise to lift said latching points out of engagement until they have passed beyond the face 6*b* of the carrier body.

The muzzle end 16*b* of the barrel carries a plurality of extension pins 24. I have illustrated two of said pins which aid in centering the impact tool with regard to a point of entry. This permits rocking about a line extending through said pins, and if it is desirable to have a more firm support, three or four of said pins may be provided. I have found it desirable, however, to have either two or four of said extension pins, because this arrangement permits the use of guide lines, or center punch marks on guide lines, to locate the impact tool with regard to the point of entry of a projectile. Said extension pins preferably have sharpened points 24*a* to seat in counter-punch marks useful in connection with the original location of the muzzle end of said barrel. I preferably make said extension pins of smaller diameter so as to maintain the spacing of said pins at the muzzle to maximum distance to permit the rapid escape of gases following the discharge of a projectile. This will be described in greater detail.

I also use said extension pins as guides upon which a metallic disc 25 may be supported. That is, holes are provided in said disc so that said pins may extend therethrough. The holes are sufficiently large in diameter to permit a sliding fit upon said pins, but are not too large in diameter to remove too much of said disc. This is for the reason that said disc plays a rather important function when projectiles are used to pierce and to become imbedded in a mass of concrete. Said metallic disc has a dome-shaped central portion 25*a*, whose diameter is substantially

that of the bore so that it cups into the muzzle of the barrel, as is shown in Fig. 1. When a projectile is discharged, there is a large amount of air entrapped in the bore of the muzzle, as is shown in Fig. 1, which must be swept out by the projectile, because the piston-like head fills the entire cross-sectional area of the bore. Said entrapped air in advance of the projectile tends to drive the metallic disc against the surface 26 of the mass of concrete. All of the actions hereinafter described happen so quickly that it is difficult to state what happens with great particularity. Apparently, however, said metallic disc strikes said surface 26 slightly ahead of the projectile, but before it may rebound, it is pinned by the pointed end of the shank of the projectile and pierced thereby. As is shown in Fig. 1, the bore of the barrel adjacent the muzzle end 16*b* thereof flares slightly, and thus when the head reaches the point of flare, it permits gases to escape around the marginal edges. Thus there is formed an annular envelope of gases about the projectile, which sweep downwardly and outwardly about said metallic disc 25. Said gas velocities, as well as the muzzle velocity of the projectile, are high, and the pressures generated by said gases and by said projectile are of high order. It is obvious that, as the pointed end of the shank of the projectile enters a mass of concrete, it tends to produce displacement and fracture if the cohesion of the concrete is less than the disrupting forces produced by entry of said projectile. The cohesion of the concrete, of course, is less at the surface than at points lying below the surface. Thus, in the absence of such metallic disc, said cohesive forces are exceeded and fissures and "blowouts" of sections of concrete result. The pressure of said disc tends to increase the pressure area adjacent the point of entry and tends to minimize said fracturing. Said disc also tends to shield the area adjacent the point of entry against the terrific blast of the escaping gases which would tend to enter any slight fissures to "blowout" any dislodged portions. As a matter of fact, the velocity of said gases is sufficient to overcome the cohesive forces of the concrete, the gases are directed into a fissure, tending to dislodge any adjacent particles of concrete. I have found that, when said annular discs are used, fracture is maintained to a minimum. Even if slight fractures do exist, said disc tends to overlie them and to cover them, and thus said disc surrounding the head of a projectile tends to constitute a shield over said area. Said disc does not merely cover a fractured section of concrete, but actually limits fracturing at this point to a substantial degree. The dome-shaped center 25*a* also provides a factor of substantial importance, in my opinion, because the marginal edges thereof are held tightly about the point of entry, but spaced substantially therefrom. When the projectile pierces said dome and flattens it, it exerts substantial pressure over an area spaced from the point of entry. I preferably make said dome of a span comparable to the diameter of the head of the projectile, because it is in this area that fractures are initiated and portions are blown out, if the gases strike the surface of the mass of concrete being penetrated.

If projectiles are to be used merely for forming a hole, that is to punch a hole through a sheet of material, I preferably provide one of the type shown in Figs. 6 and 7. Such projectile 27 has a shank 27*a* and a piston-like head 27*b*, having a

shearable lateral flange 27c at the end thereof. Said shank and said head are separable and are only joined together sufficiently to prevent inadvertent separation. To minimize the point of contact, I preferably reduce the diameter of the end 27d of the shank, as is shown in Fig. 7, and arrange it in a cavity of complementary size in the head. Said end is either press-fitted into its cavity or is bonded therein by an adhesive or membrane. The friction, adhesive, or other bond between said parts is so slight that the shank will separate from the head quite easily. Thus, when a shank has penetrated a plate 28, as is shown in Fig. 7, the head will become separated and will not cause a large deformation or indentation as would result if the head and shank were integral. Also, if said parts were integral, I find it difficult to back out such a punch, because the plate is torn and shreaded by the shank passing therethrough and it can be dislodged only with great difficulty. By permitting separation, however, a sharp edged punch hole will result and little deformation of the plate 28.

If I were to embed a stud 29 in concrete or masonry, it is frequently desirable that said stud be threaded so that a nut can be secured thereto. Another factor which is frequently met with is that penetration of said stud should be limited within close bounds, so that a predetermined portion of said stud will stand free of the surface of said mass of concrete or masonry. To accomplish both of said ends, I provide a piston-like head 29a on the threaded shank 29b, and provide an auxiliary nut 29c to limit penetration of the pointed end of the shank in concrete or masonry. The head 29a may be flattened slightly, as at 29d, so as to provide gripping faces, if said head is to be used as a nut. Preferably, in the latter case, said nut is turned end-for-end after the stud is embedded, so that the flattened surface will be outermost and may thus be more easily gripped. As in the use of the other fastening or piercing elements, a lateral shearable flange 29e is provided for the head 29a, for the purpose previously expressed in connection with the other type of projectiles defining fastening or piercing elements.

In loading the impact tool preparatory to use, the barrel 16 is removed from the gun by unscrewing it from the carrier body 6. The breech plug 19 is removed from the rearward end of the barrel, permitting the sheared flange 18c of a projectile 18 previously driven from the gun to be expelled. A new projectile is inserted point first into the breech, the flange 18c resting upon the edge of the liner 17. The breech plug is then inserted in back of the projectile and the cartridge 15 arranged in the end of the plug. The barrel is then treaded into position within the sleeve, and the gun is thus made ready for use.

The metallic disc 25 is now arranged upon the extension pins 24 with the dome-shaped central portion 25a protruding into the muzzle of the barrel 16. The points 24a of the extension pins are then arranged symmetrically about a point in the concrete into which the projectile is to be driven. In this position the gun is ready for firing, with the exception that the safety button is yet unreleased as shown in Fig. 1 of the drawings. By pressing downwardly upon the rearward end of the safety button 23, the forward end thereof is rotated upwardly about the pivot pin 23a, thereby removing the latch points 23c from engagement with the rear face 6b of the carrier body.

In firing the gun, pressure exerted forwardly upon the handle 3 sufficiently to overcome the force of spring 7 causes the barrel 16 to telescope rearwardly in relation to the forward movement of the sleeve 1. As the barrel and the carrier body 6 attached thereto attain a rearward position in the sleeve, the trigger 9 slides along the guide key 20 and engages the rounded cam projection 20a formed on the latter. As the barrel takes a further rearward position the engagement of the trigger with the cam projection 20a causes the trigger to pivot in a counterclockwise direction as viewed in Figs. 1 and 2, releasing the lip 9a from engagement with the contact hammer 11. As illustrated in Fig. 2, the tension of trigger spring 12 then causes the hammer to move forward with great force, and the extremity 13a of the firing pin 13 strikes the cartridge 15.

Referring now to Figs. 9 through 12, the gases developed by the ignition of the cartridge charge causes the projectile 18 to be shot forwardly through the barrel 16. The high velocity air passing out of the barrel ahead of the onrushing projectile is sufficient to drive the metallic disc 25 against the concrete surface 26 and to hold it thereagainst until the projectile is driven through it and is embedded in the concrete. As the projectile emerges from the barrel, the propellant gases are directed onto the marginal edges of the disc 25 to continue to hold the latter in place, as described hereinbefore.

When the gun has been fired the release of pressure on the handle by the operator results in the trigger automatically becoming cocked again and ready for a second firing. Thus it will be apparent from Fig. 2 that when the pressure on the handle 3 is released by the operator the force of the spring 7 will cause the sleeve 1 and the carrier body 6 to move relatively in opposite directions with respect to each other until the carrier body 6 and the annular collar 5 come into abutment. When this happens the latch points 23c will again engage the rearward end 6b of the carrier body 6. Meanwhile the engagement of the pin 11a with the annular collar 5 will cause the hammer 11 and trigger 9 to be moved closer together until the trigger lip 9a has again engaged the hammer 11.

When the gun has become cocked in this manner the barrel is removed and a new projectile and cartridge may be inserted in the barrel as previously described.

I claim:

1. The method of embedding a fastening member having an enlarged head into a solid mass of concrete comprising, providing a device for driving said member by means of an explosive charge, directing said device toward the area to be penetrated but spaced a distance therefrom, arranging a shield having a dome-shaped center between said device and said area, and driving said member through the center of said shield and into said concrete until the enlarged head has flattened said dome-shaped center and is seated against said shield, said shield functioning to create a high pressure area on said concrete surface adjacent the point of entry of said member and to prevent high velocity gases developed from said explosive charge from impinging on the concrete surface surrounding the area entered by said member and blasting concrete therefrom, whereby a bond between said member and said concrete is formed.

2. The method of embedding a fastening mem-

ber having an enlarged head into a solid mass of concrete by means of an explosive charge comprising, preliminarily arranging a shield havng a dome-shaped center between said fastening member and said concrete, and driving said member through the center of said shield and into said concrete until the enlarged head has flattened said dome-shaped center and is seated against said shield, said shield functioning to prevent high velocity gases developed from said explosive charge from inpinging on the concrete surface surrounding the area entered by said member and blasting concrete therefrom, whereby a bond between said member and said concrete is formed.

3. The method of securing a fastening element with an enlarged head in a solid mass of a fracturable substance such as concrete and the like, which method consists in employing a device having a gun-like barrel for driving said element part way into the fracturable substance by means of an explosive charge, providing spaced members secured to and extending from the muzzle end of said barrel, placing a shield between said fracturable substance and said muzzle end of said barrel, holding said device with said members pressed against the face of said shield with said shield covering and surrounding the area over the spot on the fracturable substance to be penetrated by said element, and driving said element through said shield and into said fracturable substance, whereby the high velocity air forced out from said barrel ahead of said driven element will force said shield tightly against the face of said fracturable substance until said element is driven through said shield and into place in said fracturable substance and whereby said shield will function to prevent the high velocity air and other gases produced by the driving of said element from being impinged on the face of said fracturable substance while said spaced members will provide escape outlets between said muzzle end of said barrel and said shield for the velocity gases.

4. The method of securing a fastening element with an enlarged head in a solid mass of a fracturable substance such as concrete and the like, which method consists in employing a device having a gun-like barrel for driving said element part way into the fracturable substance by means of an explosive charge, providing spaced members secured to and extending from the muzzle end of said barrel, placing a shield having holes for said spaced members between said fracturable substance and said muzzle end of said barrel on the face of said fracturable

substance, and inserting said members in said holes, holding said device with said members pressed against the face of said fracturable substance with said shield covering and surrounding the area over the spot on the fracturable substance to be penetrated by said element, and driving said element through said shield and into said fracturable substance, whereby the high velocity air forced out from said barrel ahead of said driven element will force said shield tightly against the face of said fracturable substance until said element is driven through said shield and into place in said fracturable substance and whereby said shield will function to prevent the high velocity air and other gases produced by the driving of said element from being impinged on the face of said fracturable substance while said spaced members will provide escape outlets between said muzzle end of said barrel and said shield for the velocity gases.

5. The method of securing a fastening element with an enlarged head in a solid mass of concrete, which method comprises, employing a device having a gun-like barrel for driving said element part way into the concrete by means of an explosive charge, providing spaced members secured to and extending from the muzzle end of said barrel, placing a shield having holes for said spaced members over the muzzle end of said barrel with said members extending through said holes, holding said device with said members pressed against the face of said concrete, and driving said element through said shield and into said concrete, whereby the high velocity air forced out from said barrel ahead of said driven element will force said shield tightly against the face of said concrete until said element is driven through said shield and into place in said concrete and whereby said shield will function to prevent the high velocity air and other gases produced by the driving of said element from being impinged on the face of said concrete while said spaced members will provide escape outlets between said muzzle end of said barrel and said shield for the velocity gases.

CORNELIUS W. MEYERS.

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