July 21, 1953 M. H. WALKER 2,645,772

STUD DRIVING TOOL

Filed May 8, 1951 2 Sheets-Sheet 1

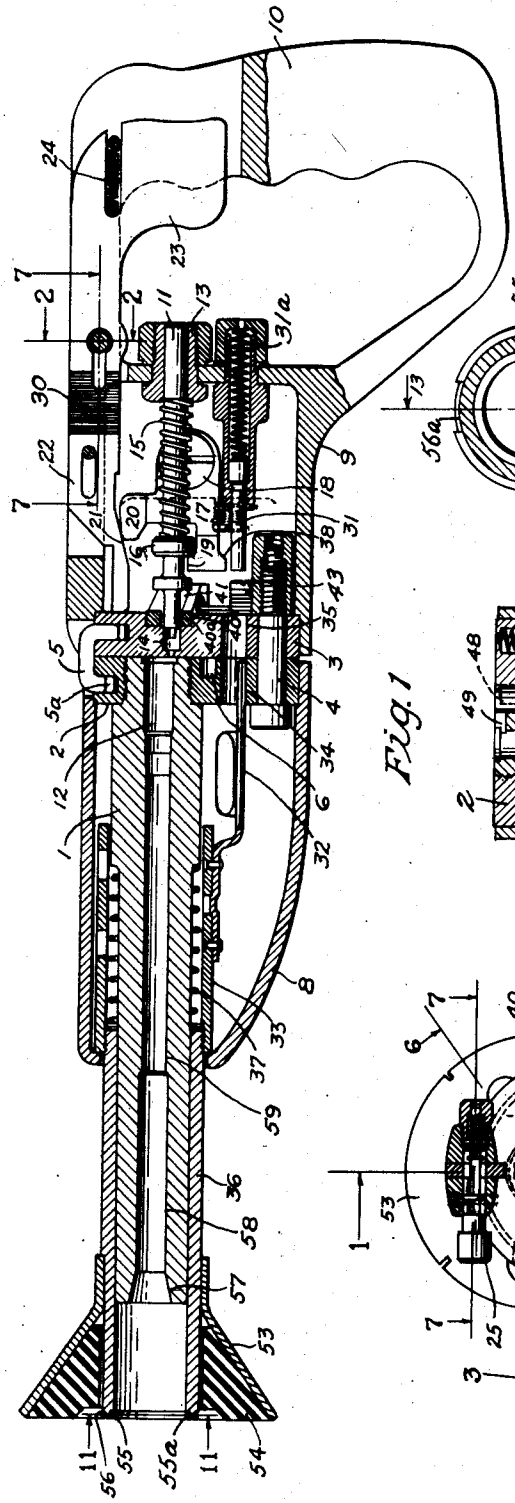

Fig. 1

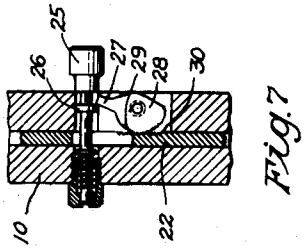

Fig. 7

Fig. 11

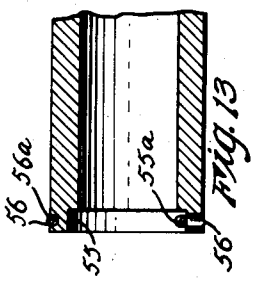

Fig. 13

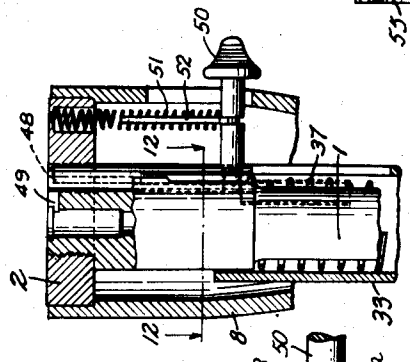

Fig. 6

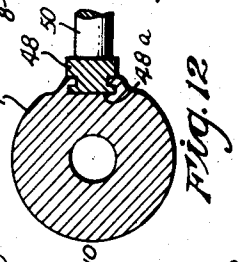

Fig. 12

Fig. 2

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July 21, 1953 M. H. WALKER 2,645,772

STUD DRIVING TOOL

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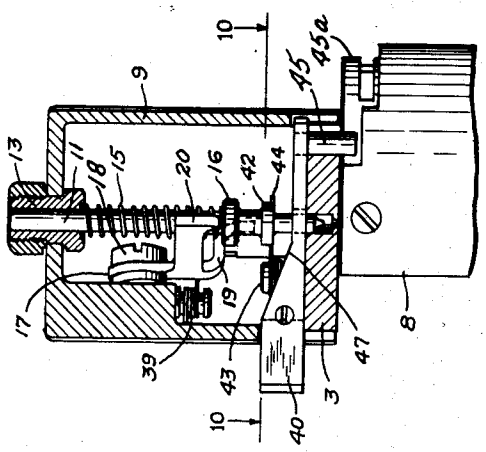

Fig. 5

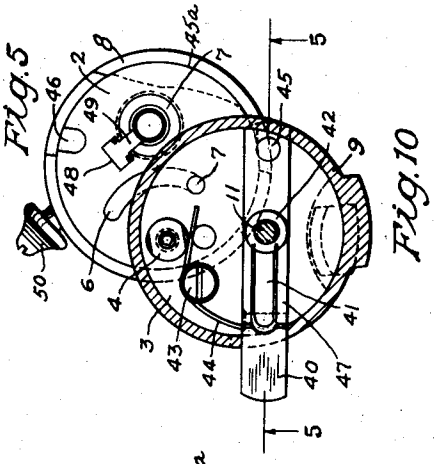

Fig. 10

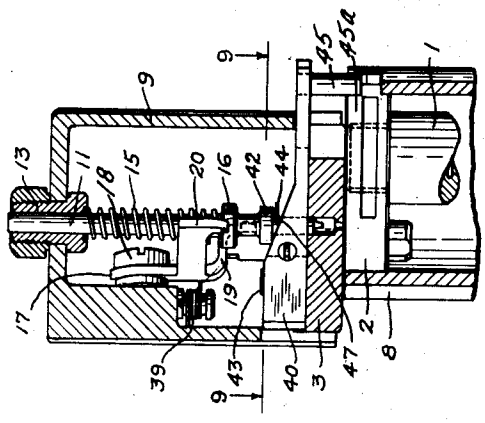

Fig. 4

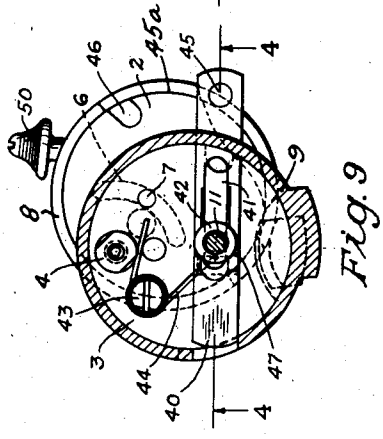

Fig. 9

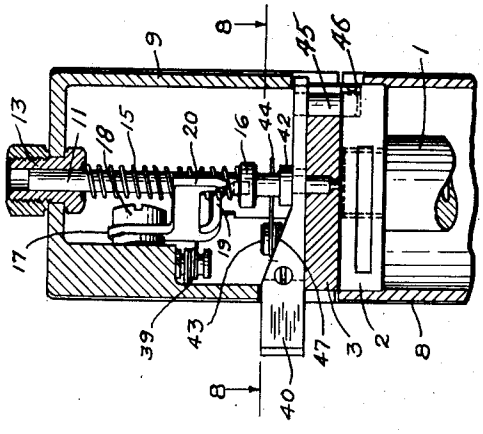

Fig. 3

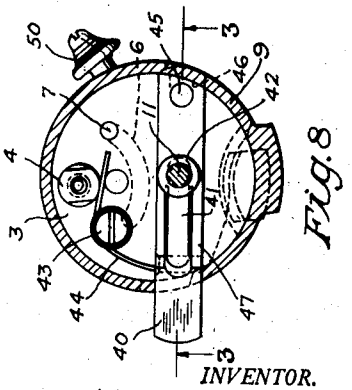

Fig. 8

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2,645,772

STUD DRIVING TOOL

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Application May 8, 1951, Serial No. 225,146

16 Claims. (Cl. 1—44.5)

1

This invention relates to an industrial tool which utilizes the power from an explosive cartridge to drive studs or fasteners through or into steel, concrete, brick, wood or other structural material either for joining these materials or for attaching fixtures to the surface of these materials.

More specifically, this invention relates to and has as its principal objects the development of an explosively operated tool which can be operated with greater convenience, efficiency and safety than any prior explosively operated tool and which can be operated at rates from ten to one hundred times as great as can be achieved with electric, pneumatic, or hand-operated tools.

Although not necessarily limited thereto, this tool may be operated with the greatest convenience and safety with ammunition of the type disclosed in the copending application of Robert T. Catlin et al., Serial No. 217,086, filed March 23, 1951, entitled "Ammunition."

The tools most widely used at the present time are all characterized by inconvenience and difficulty in use. Generally, it is necessary to unscrew and remove the barrel for reloading and frequently the operation of the safety devices is so difficult as to make it almost impossible to maintain the accurate alignment necessary to drive a fastener in a predetermined location.

The exact nature of the invention as well as other objects and advantages thereof will become more apparent from consideration of the following specification referring to the attached drawings in which:

Fig. 1 is a longitudinal sectional view through my improved tool, the firing pin being shown in cocked position.

Fig. 2 is an end elevational view partially in section on the line 2—2 of Fig. 1.

Fig. 3 is a partial sectional view on the plane indicated as 3—3 in Fig. 2, the firing pin being shown in the position it would occupy after firing.

Fig. 4 is a view similar to Fig. 3 in which the frame has been rotated relative to the breech block and housing to retract the firing pin slightly beyond the normal cocked position.

Fig. 5 is a view similar to Fig. 3 in which the frame has been rotated relative to the breech block and housing to completely cock the firing pin and to expose the breech end of the barrel for loading or extraction of a fired shell.

Fig. 6 is a partial sectional view on the plane indicated as 6—6 in Fig. 2, showing the ejector assembly.

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Fig. 7 is a partial sectional view on the plane 7—7 indicated on Figs. 1 and 2, showing details of the manually operated safety.

Fig. 8 is a cross-sectional view on the plane shown by the line 8—8 in Fig. 3.

Fig. 9 is a cross-sectional view on the plane shown by the line 9—9 in Fig. 4.

Fig. 10 is a cross-sectional view on the plane shown by the line 10—10 in Fig. 5.

Fig. 11 is a partial cross-sectional view on the line 11—11 of Fig. 1.

Fig. 12 is a partial cross-sectional view on the line 12—12 of Fig. 6.

Fig. 13 is an enlarged view of a portion of Fig. 1.

Referring to the drawings by characters of reference, it will be noted that the tool comprises a barrel 1 threadably or otherwise secured at its breech end to a frame plate 2. A breech block 3 is hinged to the frame plate 2 by a hinge bolt 4 passing through both block and plate axially parallel to the barrel on which the breech block and frame plate are capable of relative rotation far enough to expose the breech end of the barrel. When the breech block is in alignment with the frame and closing the breech of the barrel, a breech hook 5 engaged in a closely fitting groove in the breech block 3 and secured to the breech block 3 by any convenient means such as a furnace brazing operation is slidably engageable in a groove 5a in the frame plate. Thus, the hinge pin 4 and the breech hook 5 provide substantially diametrically opposed members resisting axial separation of the breech block and frame plate and having ample strength to withstand the forces of discharge of any cartridge which may be used. An arcuate slot 6, Figs. 8, 9 and 10, in the frame plate receives a breech stop pin 7 mounted in the breech block which limits the swinging movement of the breech block.

Secured to the frame plate 2 by radially extending screws or other convenient means is an action tube cover 8 which houses and protects certain elements of an automatic safety device and of the cartridge ejecting system, both to be later described in detail. A somewhat similar housing 9 is similarly secured to and extends rearwardly from the breech block forming an enclosure for the firing mechanism and the remainder of the safety mechanism. A handle grip 10 is preferably formed integrally with the housing 9.

As illustrated, my tool is arranged for use with the familiar and inexpensive rimfire type of cartridge, conveniently that known as .32 Long rim-

fire, although obviously centerfire types and other calibers of rimfire types may be used without departing from the invention. The firing pin 11 is therefore supported in alignment with one edge of the barrel chamber 12. Guidance and support for the firing pin is provided by a bushing 13 supported in the rear wall of the housing and by a bore 14 in the breech block 3, while a coil spring 15 engaged between the bushing 13 and a flange 16 on the firing pin provides the driving force for the firing pin. As may be seen by comparing Figs. 1, 4, and 5 with Fig. 3, the end of the firing pin is exposed, when cocked, providing for an instantaneous visual check on the readiness of the tool for firing. If desired, the end of the firing pin may be coated or inlaid with red or other distinctive color to provide a more obvious warning.

The firing pin may be retained in a cocked position by a sear 17 (Figs. 1, 3, 4, and 5) swingably supported by a sear screw 18 in the housing and provided with a finger 19 engageable with the forward face of the flange 16 on the firing pin 11 (Figs. 1, 3, 4, and 5). An arm 20 on the sear is extended laterally into a position opposing a cam 21 formed on a slidable trigger bar 22. The trigger bar is provided with a finger piece 23 positioned in the grip 10 and is normally urged forwardly by a spring 24. Obviously, when the trigger is pulled rearwardly, the cam 21 will urge the sear toward firing pin releasing position.

Unintentional operation of the trigger is prevented by manually operable safety means which include a safety plunger 25 spring-urged to project from one side of the handle 10 near its intersection with the housing 9. Preferably, this safety plunger should be so located relative to the handle and trigger finger piece as to require that one hand be used to operate the trigger and the other hand to depress the safety plunger.

The safety plunger is provided with a flange 26 spaced from the head to provide a section of reduced diameter in which there may be received the tail 27 of a safety cam 28, best seen in Fig. 7. The safety cam is provided with an eccentric and serrated, knurled, or toothed surface 29 which is opposed to a similarly roughened surface 30 on the trigger bar. When the safety button is depressed the eccentric safety cam is rotated to a point such that the roughened surfaces are out of engagement. Whenever the safety button is released, the surfaces 29 and 30 are in engagement and any slight rearward movement of the trigger rotates the cam into closer engagement and positively locks the trigger bar. This locking action is independent of the position of the trigger bar and will lock the bar if the safety button is released after the trigger has been pulled almost to the releasing point or at any intermediate point.

A further safety feature is provided by the sear lock 31 reciprocably mounted in the housing and urged by a spring 31*a* to project into a position where it extends across and obstructs the path of firing pin releasing movement of the sear. Unless the sear lock is moved rearwardly from its position in Fig. 1, the sear cannot be moved far enough to be disengaged from the firing pin. Means to so move the sear lock is provided by a finger 32 mounted on an action tube 33 which is slidably mounted on the barrel within the action tube cover 8. With the breech in closed and locked position corresponding to Figs. 1, 3, and 8, aligned holes 34 and 35, respectively in frame and breech block permit the projection of the finger 32 into operative engagement with the sear lock. Unless the breech is properly locked, the holes are out of alignment and the sear lock may not be operated by any means. Obviously, the thickness of the action tube finger must be less than the diameter of the sear lock and the finger must be appropriately positioned or the finger will itself act as a sear lock.

Operation of the action tube is by means of an action tube extension 36 slidable on the barrel and threadably engaged with the action tube. A spring 37, engaged between a shoulder on the barrel and the action tube extension, normally maintains the action tube in a forward position in which the end of the action tube projects beyond the muzzle of the barrel. When the tool is pressed firmly against the surface of a workpiece, the action tube extension will be telescoped into the cover until the muzzle of the barrel comes into contact with or, if desired, approaches contact with the work. This telescoping movement is adequate to bring the finger on the action tube into engagement with the sear lock and to move the sear lock out of opposition to the sear. Should the pressure of the tool against the work surface be relaxed prior to firing, the sear lock will return to a safe position even though the trigger is partially pulled at the time. The sear lock spring 31*a* is of substantial force and with a partially pulled trigger the sear lock returns to engagement with the sear on the angling surface 38 of the sear, either camming the sear back to full engagement or at least blocking further movement of the sear in firing pin releasing direction. It will be noted that the application of force by the operator to disengage the sear lock is in the opposite direction to the force necessary to pull the trigger, thus minimizing the possibility of inadvertent firing.

When the sear 17 is operated, the firing pin is propelled into engagement with the cartridge primer but the relationship of the sear 17 and firing pin flange 16 is such that the edge of the firing pin flange 16 keeps the sear spring 39 from returning the sear to its former position. Under these conditions, the sear holds the sear lock 31 retracted and when the firing pin is again cocked both the sear lock spring 31*a* and the sear spring 39 urge the sear into holding engagement with the front face of the firing pin flange 16.

The firing pin is cocked each time the breech is opened by a slide 40 which also has the function of a breech block latch. The operation of the slide is best understood by reference to Figs. 3 to 5, and 8 to 10. Referring to these figures and to Fig. 1, it will be seen that the slide is arranged for sliding movement in a groove 40*a* in the back face of the breech block and is slotted at 41 to straddle the firing pin in a location forward of a cocking flange 42 formed thereon. Pin 43 in the breech block supports a torsion spring 44 engaged with the slide and urging it continually toward an extreme left hand position which it occupies as viewed in Figs. 3, 5, 8 and 10. In the Fig. 1 and Fig. 3 positions the breech block and frame plate are in alignment and in breech closing relationship. In this position a cam pin 45 mounted on the slide is received in a notch 46 in the frame plate 2 to latch breech block and frame plate 2 in alignment. When the projecting end of the slide is forced inwardly by thumb pressure, the cam pin is disengaged from the notch 46 and the frame plate 2 may be turned on the hinge bolt 4 relative to the breech block 3. At the same time, the cam 47 formed on the rear

face of the slide engages the forward face of the firing pin flange **42** and starts the retracting of the firing pin so that its tip is behind the front face of the breech block and may not interfere as the frame plate **2** is swung on the hinge bolt.

During the swinging movement, as shown in Figs. 4 and 9, the cam pin **45** rides on the outer periphery **45***a* of the frame plate and the frame plate acts as a cocking cam to force the slide to move to the right and wedge the firing pin back slightly beyond cocked position, whereupon the sear snaps in front of the flange **16**. Further swinging movement of the frame plate exposes the breech end of the barrel and the cam pin **45**, engaging a portion of the periphery **45***a* which is progressively less remote from the axis of the hinge bolt **4**, returns to the extreme left hand position, as shown in Figs. 5 and 10, to serve as a detent releasably holding the breech in open position.

With the breech in open position, a fired cartridge may be ejected by means best illustrated in Figs. 6, 10, and 12. The ejector **48** is slidably mounted in an undercut groove **48***a* in the side of the barrel (Fig. 12) and passes rearwardly through the frame plate, where it is provided with a claw **49** forming a movable part of the rim of the chamber and extending beneath the normal position of the cartridge rim. An ejector handle **50** is threadably or otherwise attached to the ejector and projects laterally through a slot in the action tube cover. Within the cover a spring **51** and spring guide rod **52** engage the ejector handle to urge the ejector into its normal forward position in the direction of the nozzle of the barrel. A rearward movement of the handle **50** carries with it the ejector and the claw **49** withdraws a cartridge from the chamber. It will be noted that both the breech face of the barrel and the extractor claw are counterbored to provided a recess completely enclosing and supporting the head of the cartridge to prevent case casualties with high operating pressures.

Particularly for use with ammunition in which the fasteners are equipped with gas check sabots or heel caps, such as the ammunition shown in the copending application of Catlin et al., previously referred to, I prefer to counterbore the muzzle section of the barrel as shown in Fig. 1.

Obviously, if a sabot is to fulfill its function as a gas check, it must fit tightly in the bore and since tools of this type are designed to be fired with the muzzle practically in contact with the workpiece, the heel of the fastener and the sabot thereon will usually remain within the muzzle section of the barrel after firing. If the snug fit between sabot and barrel is retained all the way to the muzzle, it may be difficult to remove the tool from a driven fastener or the sabot may pull off the fastener and remain in the barrel, neither condition being desirable.

Occasionally a fastener will be driven so deep that the forward end of the sabot contacts the workpiece and may be deformed thereby almost to the point of complete flattening. If this action takes place within a snug fitting muzzle section, the sabot will be forced and thermoplastically molded into intimate contact with the barrel and may be difficult to remove therefrom.

Accordingly, I form the counterbored muzzle in two sections consisting of an outer flared section **57** having a depth about equal to the length of the usual sabot and a width about equal to the diameter of a sabot flattened under pressure. The remainder of the counterbore is cylindrical

as at **58**, of a diameter somewhat larger than that of the major part of the bore **59**, and of a depth adequate to receive the undriven portion of the fastener designed to project from the face of the workpiece the greatest amount after being driven into the work. Such a fastener is usually one which has a relatively long, e. g., 2½ inch, threaded shank designed to be left exposed after the pointed portion has been driven into the work. With ammunition of the type shown in the copending application, frequently referred to herein, I have found that an increase in diameter of about .013" is adequate to prevent the sabot from sticking in the barrel. With a soft metal sabot a lesser degree of enlargement would probably be adequate and with wound paper or similar material a greater degree of enlargement would probably be required. After the sabot enters the counterbored section, gas escapes by it under high pressure. The violence of the report obtained on firing is one of the limiting factors influencing the choice of the diameter of the counterbore **58**.

It may also be noted that some plastic materials which may be used as sabots have a tendency to stick to and build up on the surface of the barrel. Difficulty from this source may be minimized by polishing both barrel and counterbores, particularly the latter where the condition is aggravated by the hot blast of escaping gas. Particular attention should be paid to the junction between the flared and cylindrical counterbores, it being desirable to blend these surfaces together and highly polish this region.

As a protection to the operator in case of fragmenting or spalling of the surface into which he inserts a fastener, the action tube extension **36** may be fitted with a conical guard **53** which may have an insert **54** of neoprene or other rubber-like material. Such a guard insures that fragments can only be projected laterally and, even in that direction, somewhat impedes their progress by the resistance of the insert. It will be noted that the guard is permanently fastened to the action tube extension and may not be removed without unscrewing the action tube extension from the action tube. This feature prevents the use of the tool without a guard and thus insures that a careless operator may not remove the guard and cause his own injury from spall fragments, ricochets, etc.

For special work in corners, electrical conduit boxes, adjacent to the flanges of angles or channels, and other locations which may not be readily reached with the standard guard illustrated, several additional action tube extensions, each furnished with a special guard adapted to the particular job, may be furnished as accessories. Such accessories are not shown in this application, since they function exactly as the standard guard here illustrated and differ only in the conformation of the work engaging portion of the guard.

The forward end of the action tube extension may conveniently be counterbored as at **55** to accept disks of metal or other material which can be temporarily retained therein by detents **55***a* formed integrally with and projecting inwardly from a spring **56** engaged in a groove **56***a* encircling the outside of the extension and best shown in Fig. 11. Such disks find a large use in many applications of these tools, as a fastener may be fired through the disk forming its own hole therein and making the disk serve as a washer on the shank of the fastener. Such a disk

covers the slight spalling produced at the point of penetration, aids in straight penetration of the fastener, and, by engagement with the enlarged head of a fastener, limits the depth of penetration thereof. They are particularly valuable in fastening wooden members such as furring strips to masonry walls.

In recapitulating, let us assume that with the frame plate 2 in the Figs. 5 and 10 position, a loaded cartridge consisting, for example, of a primed and powder charged case, a gas check sabot, and an appropriate type of industrial fastener as disclosed in the copending Catlin application above referred to is loaded into the chamber. The frame plate 2 and parts secured thereto (barrel 1, action tube cover 8, action tube 33, and extension 36) may then be turned about the bolt 4 as a pivot into alignment with the breech block 3, housing 9, and parts housed therein as shown in Fig. 1 and latched there by the inter-engagement of the cam pin 45 and notch 46, as shown in Figs. 3 and 8. The guard 53 may then be placed against the face of the work, where it may be accurately located by means of intersecting guide lines scribed on the work and by guide notches formed at 90° spacing on the rim of the guard. The tool may then be forced toward the work to bring the muzzle of the barrel into substantial contact therewith, thus releasing the sear lock 31. After depressing and holding the safety button 25 with one hand, the trigger may be pulled with the other hand and the fastener will be driven into the work. As explained in the copending Catlin et al. application, a variety of fasteners are usually stocked by a tool user and may be assembled on the job with factory loaded cartridges of appropriate power, each of which may be fitted with a gas check or sabot having a recess fitting the fastener or otherwise capable of releasably engaging same.

After firing, it will usually be found that the gas check remains on the end of the fastener within the counterbored muzzle section of the barrel.

To extract the fired cartridge, the breech of the barrel is first exposed by manual operation of the latch 40 which releases the cam pin 45 from the notch 46. The frame plate 2, cover 8, barrel 1, and parts 35 and 36, are interconnected as a unit, and as a unit they may then be pivoted about the bolt 4 to remove the breech block 3 from a position closing the chamber in the barrel. During this pivoting of the frame plate about the bolt 4, the surface 45a cams the latch further in to complete the retraction of the firing pin which is then held by the sear.

With the breech end of the barrel exposed, the ejector 48 may be operated by the handle 50 and the claw 49 will remove the fired cartridge from the chamber.

Although a specific embodiment has been here illustrated and described, it should be understood that I consider the invention to extend to all equivalent devices and constructions falling within the terms of the claims appended hereto.

I claim:

1. An explosively operated tool comprising a barrel; an action tube including a work-engaging end slidable on said barrel; spring means tending to cause said end of said tube to project in advance of the muzzle of said barrel; firing means to discharge a cartridge chambered in said barrel; a safety lock engaging said firing means to block the operation thereof; and a member on said tube and movable therewith, whenever said end of the tube is forced back a predetermined distance toward the plane of the muzzle of the barrel against the urging of said spring means, into engagement with said safety lock to disengage same from blocking engagement with the firing means.

2. A tool as described in claim 1, said firing means comprising a firing pin and a movable sear to releasably restrain the firing pin, and said safety lock comprising a movable element removably projected across the path of movement of the sear to oppose movement of the sear to firing pin releasing position.

3. A tool as described in claim 1, in which said action tube comprises a rearward part to which said safety lock engaging member is joined and a forward part having permanently secured thereto a safety guard; an action tube cover fixedly mounted on said tool to enclose said rearward part of said action tube and at least a portion of the breech end of said barrel; and a separable connection between said parts of the action tube, said connection being located within said cover and rearward of the muzzle of said barrel so that in the absence of said forward part of the action tube and of the safety guard attached thereto said rearward part of the action tube is inaccessible and said safety lock engaging member cannot be displaced to disengage said safety lock.

4. In an explosively operated tool including a movable fire control trigger bar, an automatic safety device comprising an eccentric cam pivotally mounted on an axis generally transverse to the line of movement of the trigger bar, spring means tending to rotate the eccentric surface of said cam into frictional engagement with the trigger bar, and manually operable means to rotate said cam against the urging of said spring to a position out of engagement with the trigger bar.

5. An automatic safety device for an explosively operated tool as described in claim 4, said cam being so disposed that the portion thereof having the greatest radius is positioned relative to said axis in a direction substantially opposite to that in which the trigger bar must be pulled to fire said tool, whereby movement of the trigger bar in firing direction when said safety cam is in frictional engagement therewith will result in jamming said cam between the trigger bar and said axis.

6. An automatic safety device as described in claim 5, the eccentric surface of said cam and the surface of the trigger bar with which it engages being roughened for more positive frictional engagement.

7. An automatic safety device as described in claim 4, said trigger bar being formed to define a trigger portion engageable by an operator's finger and said manually operated cam rotating means being so positioned and so remote from said trigger portion as to require a normal operator to operate the trigger with one hand and said manually operable cam rotating means with another hand.

8. An automatic safety device as described in claim 4, said spring means and said manually operable means being combined in the form of a plunger, the spring urging said plunger to project outwardly from said cam and said trigger bar, and a tail on said cam engaged with said plunger to rotate the cam in response to projection or retraction of said plunger.

9. An explosively operated tool comprising a

breech block, a frame plate facially engaged with said breech block, a hinge bolt passing through both said breech block and said frame plate to retain said members in facial engagement but free to rotate relative to each other about the axis of said hinge bolt, a barrel supported by said frame plate in substantial parallelism with the axis of said hinge bolt, a latching notch on the frame plate, and a latch slidably mounted on said breech block and engageable between said breech block and said frame plate notch to releasably lock said members in such alignment that the breech block closes the breech end of the barrel supported by said frame plate, disengagement of said latch permitting said frame plate and breech block to be rotated relative to each other about the axis of said hinge bolt to expose the breech end of said barrel.

10. A tool as described in claim 9, including a spring-urged firing pin mounted for sliding movement in said breech block for operation on a cartridge in said barrel, an abutment on said firing pin, and a wedge-like cam on said latch engageable with said firing pin abutment as said latch is moved to disengage from the latching notch on the frame plate to at least partially retract said firing pin.

11. A tool as described in claim 10, said frame plate, after disengagement of the latch from the latching notch, being swingable about said hinge bolt to expose the breech end of said barrel, a cam pin on said latch, and a cam surface on said frame plate engageable with said pin during swinging movement of the frame plate to further slide said latch in the same direction as that disengaging the latch from the locking notch to completely cock the firing pin.

12. A tool as described in claim 9, said breech block being provided at a location remote from said hinge bolt with a breech hook, and said frame plate being provided with a recess in which said hook may be engaged to resist separation of the engaging faces of breech block and frame plate when said members are latched in barrel breech closing relationship.

13. A tool as described in claim 9, including a firing pin mounted for sliding movement in said breech block, said firing pin being urged to move from a cocked position to a released position, a sear engageable with said firing pin to releasably hold same in cocked position, a sear lock engageable with said sear to prevent release thereof, means defining holes in said frame plate and breech block which are in alignment only when said breech block closes the breech end of the barrel, and means including sear lock release means mounted on said barrel, said sear lock release means being operable on said sear lock only by projection through said aligned holes whereby release of said sear from holding engagement with the firing pin is positively prevented except when said breech block closes the breech end of said barrel.

14. An explosively operated tool comprising a breech block, a hinge bolt passing through said breech block, a frame plate hinged on said bolt and confined thereby in interfacial engagement with said breech block but capable of rotation with respect to said breech block about the axis of said hinge bolt, means on said breech block extending beyond the face of said frame plate, defining a hook facing toward said breech block, means defining a recess in said frame plate facing away from said breech block and adapted to receive said hook, a barrel mounted in said frame plate in substantial parallelism with said hinge bolt, the breech end of said barrel being opposed by said breech block when said hook is engaged in said recess and exposed when said frame plate has been manually rotated to a position in which said hook is no longer engaged in said recess, a manually retractible slide mounted on said breech block, a latch pin on said slide, and lock means in said frame plate engageable by said latch pin when said hook is engaged in the recess to releasably latch the frame plate and breech block in barrel breech closing relationship.

15. A tool as described in claim 14, including a spring-urged firing pin mounted for sliding movement in said breech block arranged to cooperate with a cartridge chambered in the barrel, a flange on said firing pin, and a wedge-like cam surface on said slide engageable with said flange to at least partially retract the firing pin from said barrel as said slide is manually retracted to disengage the latch pin thereon from said lock means.

16. A tool as described in claim 15, the outer periphery of said frame plate adjacent to said lock means being shaped to define a cam engageable with said latch pin during manual barrel breech exposing rotation of the frame plate relative to said breech block about the axis of said hinge bolt to further retract said slide and by action of said wedge-like cam on the firing pin flange to complete the cocking of the firing pin.

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