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L. E. YOHO ET AL

3,494,431

SHEET MATERIAL PUNCH GUN

Filed Oct. 9, 1968

3 Sheets-Sheet 1

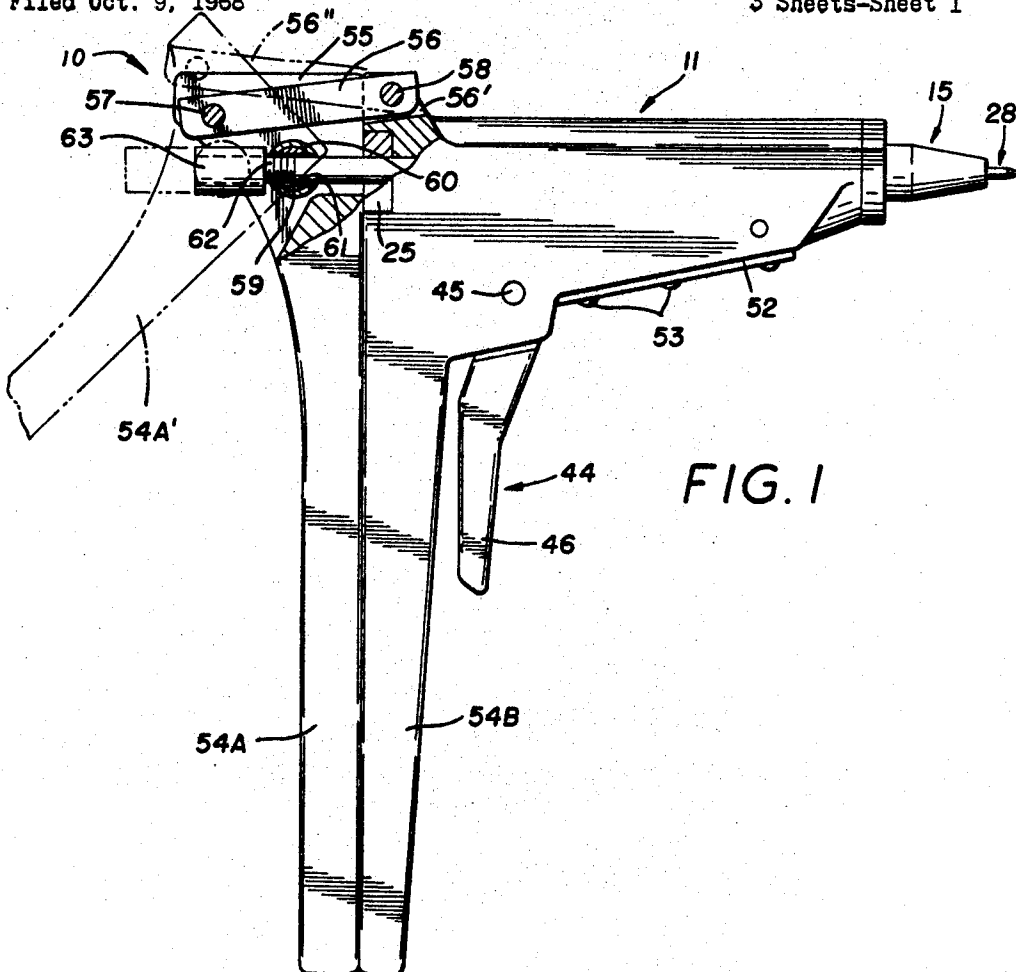


FIG. 1

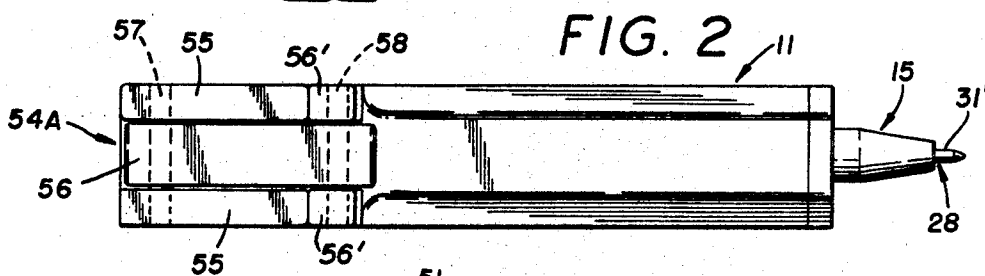


FIG. 2

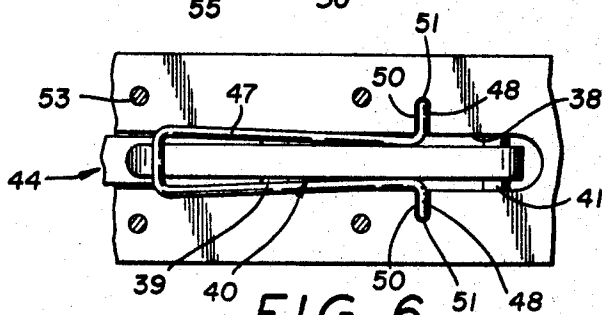


FIG. 6

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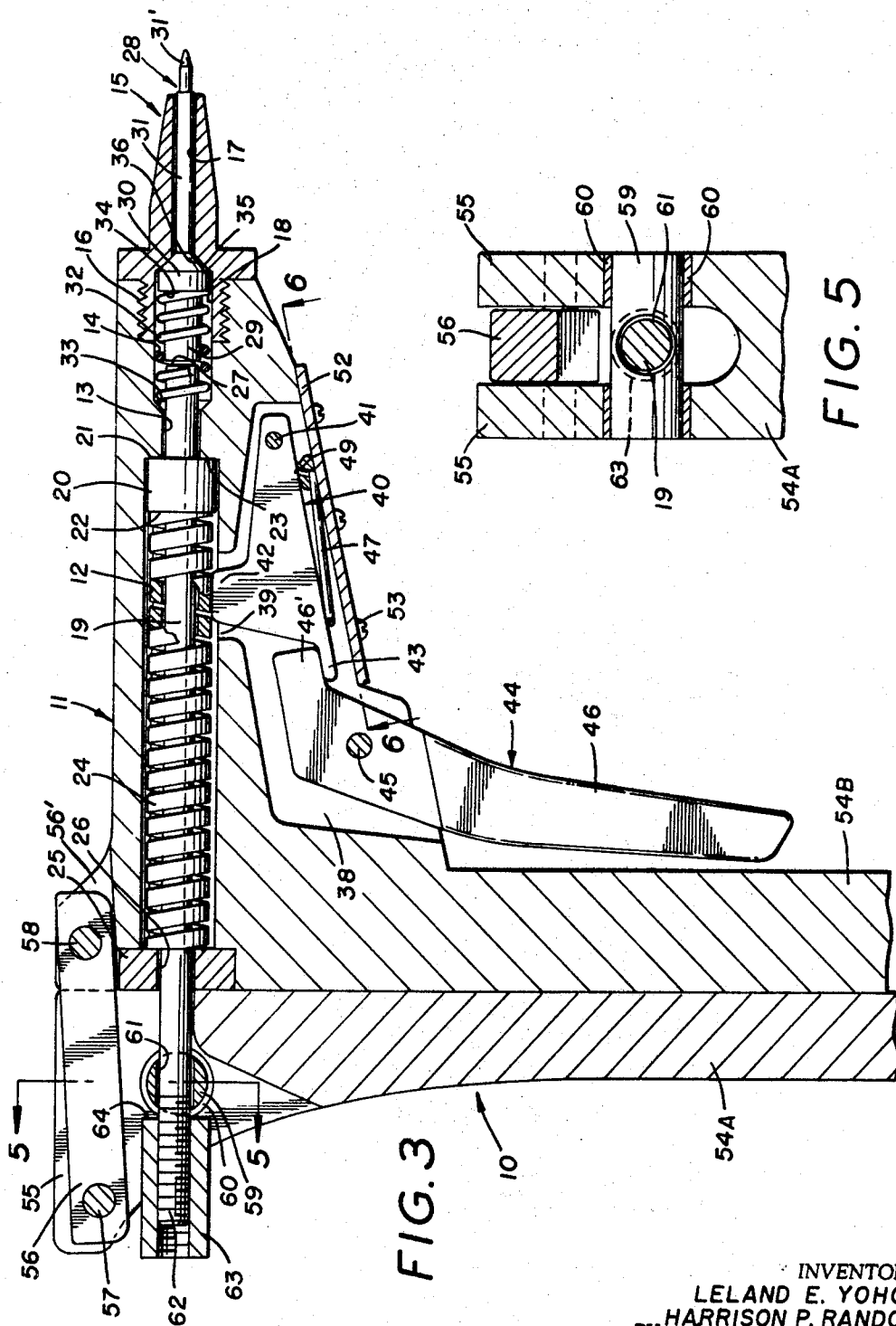
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3 Sheets-Sheet 2



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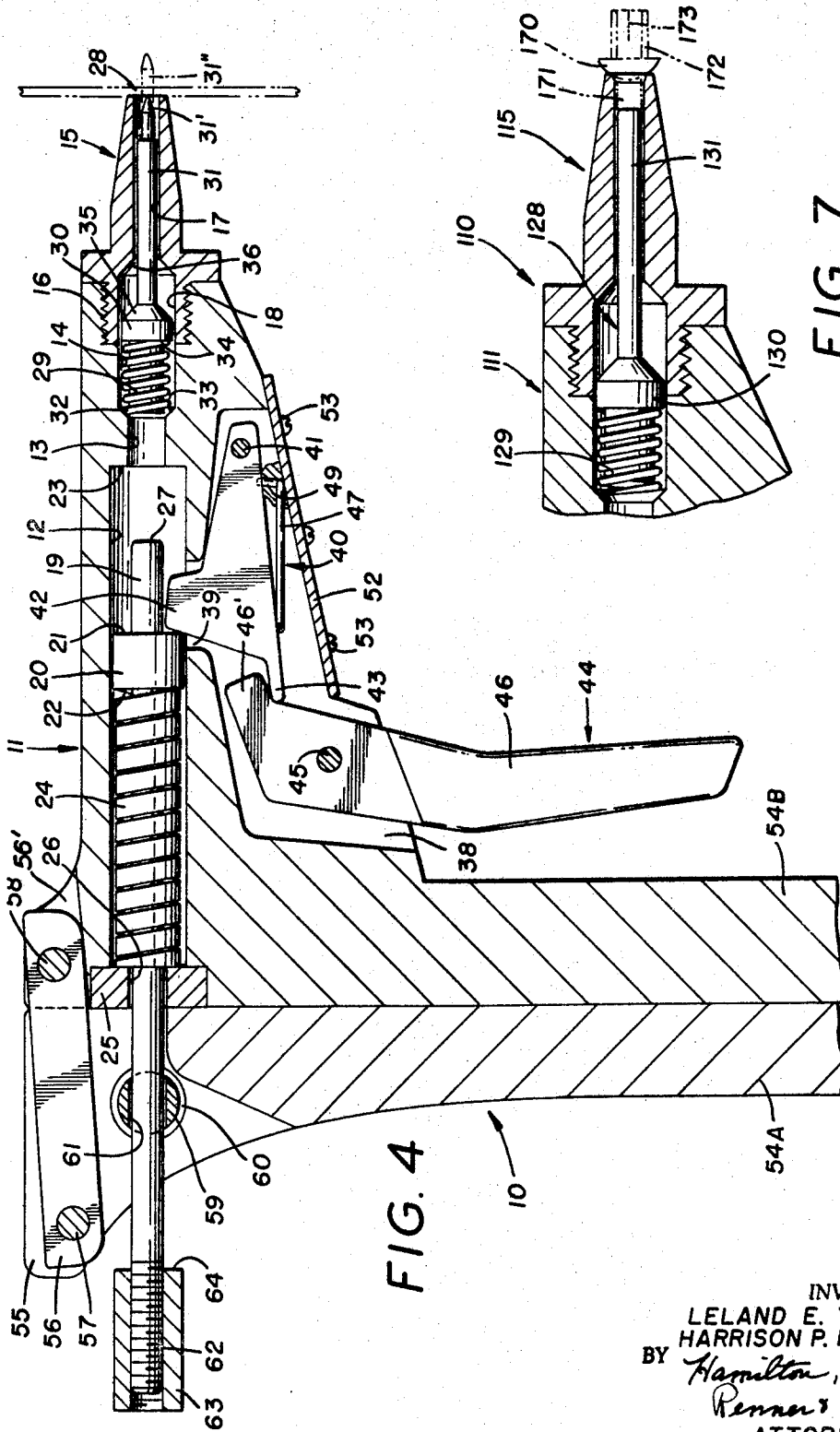
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3 Sheets-Sheet 3



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SHEET MATERIAL PUNCH GUN

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10 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for punching holes in sheet materials and the like having a spring driven piston housed in a cylindrical bore of the apparatus, a punch which is housed in a second bore, the two bores axially communicating to the extent that the forward portion of the piston is movable into the punch bore. The punch is maintained biased outwardly by a second spring so that the piston cannot contact the punch unless the punch is depressed to overcome the biasing force of the second spring. A cocking means selectively orients a sear plate against a collar on the piston so that actuation of a trigger means which engages the sear plate causes the release of the piston which will strike the punch when the punch is depressed against an object.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus used primarily for punching holes in sheet metal and other durable sheet materials. The apparatus is constructed to allow an easier and safer piercing of the object being worked on, and is capable of varying the size of the opening made.

The sheet metal working art, involving the installation of ducting for heating and air conditioning purposes and other projects requiring that a hole be placed in sheet material, has a long existing requirement for a portable, safe, and rapid operating punching device. Heretofore, the most efficient method of piercing sheet metal and the like was to use a drill powered by electricity, air, or other source of energy. However, the use of the power drill has many disadvantages, one being that its area of use is confined within the transmission limits of the power source. Thus, if it becomes necessary to work at a place remote from the power source, as is often the case when working on scaffolding during building construction, a great deal of complex wiring or hosing may be necessitated, making it impossible or highly impractical to reach the remote source.

Other disadvantages of the electrically powered drills are the initial cost of the drills themselves and the cost of the power to operate them. It also becomes quite costly to replace broken drill bits, and to sharpen dull ones, for the drills must be quite sharp to penetrate even thin samples of hard materials. If the drill is not sharp, more pressure must be applied by the operator, thus often causing premature drill bit breakage. Even with a sharp drill bit, the drilling process is often slow and tedious, for the operator must be quite careful in precisely locating the bit (using a starter or pilot hole on heavy sheeting), applying just the right amount of pressure to assure accurate placement of the bit, and then maintaining that pressure throughout the drilling period which may be an appreciable time interval. Finally, while the use of a power drill eventually makes a "clean" hole, this too has its disadvantages in that if a screw is to be threaded into it, there is a minimum of surface for the threads to engage.

On jobs where it is impossible to reach a power source, or on low-budget jobs where power equipment is not justified, the workman must use a hammer and punch

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to place the desired hole in the sheet material. This method is also used on jobs where screws are to be threaded into the holes, because the hammer and punch procedure will not leave the "clean" hole as produced by the drilling devices, but rather create a flared portion on the back side of the material to which the threads of a screw can grasp. However, the hammer and punch method also has inherent disadvantages. First, it takes a great deal of physical labor and time to pierce hard materials, particularly a thick sheet of metal, by this hand process. The punch must be battered by a hammer a number of times for each of the large quantity of holes usually required with the attendant risk of missing the punch, thereby injuring the hand of the workman or damaging the material.

Another disadvantage of this hand method is that the laborer must have room to swing the hammer. Often when working on ducting in confined areas, there is insufficient room to move the hammer with enough force to penetrate the material, therefore necessitating repeated strokes. Then too, where there is room to swing the hammer, the location of the work relative to a scaffold or ladder, may require extreme extension of the workman's body so that he must take care not to lose his balance while trying to exert enough force to achieve penetration with the punch.

A further disadvantage to the manual hammer and punch system is evident when working on thin sheets of relatively hard materials. In this instance, while less strokes of the hammer are required, the relatively dull nature of the punch, combined with the slow rate of travel of the punch through the material will cause an unsightly indentation or dishing of the material around the hole.

All of the aforementioned problems are further compounded when rivets or the like are to be used as the fastening means in the hole. In this situation additional tools and/or more strokes of a hammer are required to secure the rivet in place.

Some of the above problems have been solved by the development of portable center or marking punches; however, these devices are not capable of completely piercing the sheet material. For example, one type of marking device presently used has a cylindrical housing having the punch protruding at one end with an intricate and delicate cocking device therein, so that when the user grasps the body of the device and depresses the point against the object to be marked, the device cocks and fires in the same motion. However, devices of this nature are inherently limited to marking functions and do not contemplate piercing.

Other center or marking punches are concerned with "self-cocking" or "one-finger" operation features which are inherently impossible in the punch art where the material is to be completely pierced. Further, the center marking devices do not concern themselves with all the problems of the punch art, such as safety, hole alignment, and impact regulation, since the objectives of each type of device are radically different.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a device for punching holes in sheet metal and the like that is capable of complete, rapid penetration of even the heaviest of such materials.

It is another object of the present invention to provide a punching device which fires only if actuated after depression of the punch point as a safety feature.

It is still another object of the present invention to provide a punching device, as above, which allows accurate placement and retention in the desired position for the hole.

It is yet another object of the present invention to provide a punching device, as above, which provides regulation of the impact of the punch and thus controls the size of the hole.

It is a further object of the present invention to provide a punching device, as above, which is inexpensive to maintain and operate, relatively safe from the hazards of prior devices and completely portable in not requiring an outside power source.

It is a still further object of the present invention to provide a punching device, as above, which can create a hole suitable for receiving a screw without denting the material.

It is even another object of the present invention to provide a punching device, as above, which requires a minimum of physical labor to operate.

It is an even further object of the present invention to provide a punching device, as above, which can be adapted to rivet driving and other similar uses.

These and other objects which will become apparent from the following specification are accomplished by structures hereinafter described and claimed.

In general, a sheet metal punching device constructed according to the concept of the present invention comprises a gun-like housing having bores containing a spring driven piston and separate punching point. The punch point rides in a cylindrical bore near the tip of the gun housing and is biased outwardly by a small spring. The piston, which rides in another bore, has an enlarged collar portion near the forward end which serves to provide a rear shoulder, behind which rests the large driving spring, and a front shoulder which provides a stop surface for the piston. The piston bore and the punch bore communicate to a degree such that the end of the piston strikes the rear of the punch when the latter is depressed.

Also communicating with the piston bore is a sear plate which is urged toward the piston by a wire spring so that when the piston is forced rearwardly by a cocking means, the sear plate will move into position in front of the stop surface shoulder against the collar portion of the piston. The preferred cocking means shown is a hinged split handle which, when divided, draws the piston straight back, compressing the spring. A trigger device rests against the sear plate in such a manner that the sear, which is holding the piston back when the gun is cocked, supplies a certain amount of tension to the trigger. A mere pulling of the trigger moves the sear to release the piston which drives the punch forward at a high rate of speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view, partly broken away and partly in section, of the preferred embodiment of the sheet metal punch gun according to the present invention showing the operation of the split handle for cocking the mechanism in chain lines.

FIG. 2 is a top plan view of the sheet metal punch gun depicted in FIG. 1.

FIG. 3 is an enlarged cross-section of the punch gun of FIG. 1 with the mechanism in the uncocked state.

FIG. 4 is a view similar to FIG. 3 depicting the preferred embodiment of the invention in the cocked state, ready to fire, after actuation of the split handle as depicted in chain lines in FIG. 1.

FIG. 5 is a fragmentary sectional view taken substantially along line 5—5 of FIG. 3 and showing the pivotal attachment of the bifurcated handle.

FIG. 6 is a fragmentary sectional view taken substantially along line 6—6 of FIG. 3 and showing the sear plate and related components.

FIG. 7 is a fragmentary sectional view of the punch member of the present invention as adapted for the function of driving rivets.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and particularly FIGS. 1-4, punch gun apparatus for piercing holes in sheet materials and the like according to the present invention is indicated generally by the numeral 10. The major portion of gun 10 is a barrel or housing, generally indicated by the numeral 11, containing an elongate cylindrical bore 12. The bore 12 is of uniform diameter through a portion of its length and has, preferably toward the front of barrel 11, a reduced neck portion 13 which flares outwardly to form a punch receiving bore 14 at a surface of barrel 11. Proximate the punch receiving bore 14, a punch housing generally indicated by the numeral 15 is attached to barrel 11 as by threads 16 and has an axial through bore 17 and a counterbore 18 which communicates with and is preferably the same size as punch receiving bore 14. When punch housing 15 is threaded onto barrel 11, bore 12, neck portion 13, punch bore 14, through bore 17 and counterbore 18 are all axially aligned, for reasons more fully discussed hereinafter.

Housed within bore 12 of barrel 11 is a piston 19 which may be of substantially uniform diameter with a portion slightly smaller than that of neck portion 13 of barrel 11. Piston 19 is provided with a collar 20, which may be near the front end thereof, forming a forward shoulder 21 and a rear shoulder 22. The travel of piston 19 within bore 12 is restricted in the direction toward punch housing 15 by the forward shoulder 21 engaging a stop surface 23 formed by neck portion 13 in bore 12. A coil spring 24 encases piston 19 and is interposed between rear shoulder 22 of collar 20 and an insert 25 at the rear extremity of bore 12. Insert 25 is provided with a bore 26 to permit passage of a portion of piston 19. The piston 19, forward of collar 20, forms a ram 27 which, as previously discussed, is insertable into neck 13 and may extend a distance into punch receiving bore 14.

Substantially housed within by punch receiving bore 14 and punch housing 15 is a punch, indicated generally by numeral 28, which may be generally cylindrical. The punch 28 consists of a blow-receiving base 29 and an enlarged collar 30 which may taper inwardly at its forward end to form a punch shaft 31. Shaft 31 is adapted to be slidably received within the through bore 17 of punch housing 15, while the collar 30 slidably engages punch bore 14 in barrel 11 and counterbore 18 of punch housing 15 to maintain punch 28 suitably aligned. The shaft 31 has a tip portion 31' which normally protrudes from housing 15, as shown in FIGS. 1 and 3, and is normally maintained biased in this outward position by a coil spring 32 which fits around the blow-receiving base 29 and is interposed between a flared shoulder 33 formed by neck portion 13 and a rear shoulder 34 of collar 30. It should be noted that when the punch 28 is in the extended position, as in FIG. 3, the tapered shoulder 35 of punch collar 30 is engaged by a stop surface 36 of punch housing 15 at the termination of counterbore 18.

Referring particularly to FIGS. 3, 4, and 6, the lower portion of the barrel 11 is provided with a slot-like cavity 38 which communicates with bore 12 via a segmental aperture 39 located generally toward the forward end and at the bottom of bore 12 and extending approximately the width of cavity 38. Positioned within cavity 38 is a sear plate, indicated generally by the numeral 40, being pivotally mounted therein on a pin 41 which is journaled in housing 11. Sear plate 40, as shown, is wedge-like in shape, flaring outwardly rearwardly, and terminating in an upwardly oriented cocking flange 42 being in the general area of aperture 39. The sear plate 40 also has a lip 43 extending rearwardly for a purpose to be described hereinafter. Also partially housed in cavity 38 is a trigger, generally indicated by the numeral 44, being pivotally mounted on a pin 45. The trigger is preferably a somewhat elongate member having a handle 46 extending outwardly of barrel 11 and a projecting shoulder 46' within

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cavity 38 which selectively engages lip 43 of sear plate 40 as described more fully hereinafter.

As best seen in FIG. 6, a small wire spring 47, which may be somewhat U-shaped, rests against the bottom of sear 40 so that it is biased generally clockwise (FIGS. 3 and 4), cocking flange 42 thus being continually urged toward opening 39 in bore 12. Spring 47 has an anchor flange 48 (FIG. 6) at each extremity, each having a prong-like foot 49 (FIGS. 3 and 4) thereon. Anchor flanges 48 rest in slots 50 in the underside of housing 11 on each side of cavity 38. The outward ends of slots 50, in turn, are provided with small holes 51 for receiving feet 49. To accomplish the dual function of closing off cavity 38 and holding feet 49 of spring 47 in holes 51, a cover plate 52 is fastened to housing 11 by screws 53 and positioned to clear trigger 44. The plate 52 also provides ready access to the chamber 38 in the event that any of the components therein require maintenance.

To enable an operator to cock the apparatus disclosed herein, there is provided a split handle 54A and 54B. As shown, handle 54B is formed integral with barrel 11, while handle part 54A bifurcates at the top into two fork-like prongs 55 of substantial width, as best shown in FIG. 2. Handles 54A, 54B are joined by a link 56 which is located between prongs 55 of handle 54A and upstanding space flanges 56' on barrel 11 at the top of handle 54B being attached to each by pivot pins 57 and 58, respectively, for limited rotational movement.

Handle 54A is operatively connected to piston 19 by a bearing pin 59 freely rotatably mounted in bushings 60 inserted in each of the prongs 55 of bifurcated handle 54A. Bearing pin 59 has a bore 61 which slidably receives the piston 19 forward of a threaded portion 62 thereon. The piston 19 is moved rearwardly with handle 54A by means of a stop nut 63 having a shoulder 64 of larger dimensions than the bore 61 of bearing pin 59. The travel of piston 19 during the cocking operation may be varied as necessary by adjusting the position of the stop nut 63 on the threaded portion 62 of piston 19.

The operating sequence of the punch gun apparatus 10 may be traced from the uncocked position of FIG. 3 which would be the condition after completion of an operating cycle. As shown, coil spring 32 is maintaining punch 28 outward so that tapered shoulder 35 is resting against stop surface 36, the tip 32 being fully extended. At this stage trigger 45 is at rest or untensioned, trigger shoulder 46' resting against lip 43 of sear plate 40, but cocking flange 42 barred from entry into bore 12 of barrel 11 by the presence of coil spring 24 on piston 19.

In order to cock the sheet metal punch gun 10 for another operating cycle, an operator separates handle part 54A from part 54B, as shown in the chain line position of FIG. 1 as 54A'. The dual hinge nature of link 56 provides a substantially "straight back" or linear travel of piston 19. During the beginning of the cocking movement, link 56 moves upward in an arc centered on pin 58, as shown in FIG. 1 as chain line position 56". Continued movement of handle part 54A away from handle part 54B causes handle 54A to rotate in an arc centered on pin 57. Throughout this dual arc movement, bearing pin 59 is translated rearwardly against shoulder 64 to move nut 63 and thus draw piston 19, rearwardly, compressing spring 24 until collar 20 passes opening 39. At this point, the sear plate 40 is urged upwardly by spring 47 so that the cocking flange 42 rests in front of shoulder 21 of collar 20 as seen in FIG. 4. Simultaneously, lip 43 of sear plate 40 moves trigger shoulder 44 upwardly and pivotally in a counterclockwise direction about pin 46, thereby putting tension on trigger 45. With the gun thus fully cocked, handle 54A is returned to the position shown in FIG. 4, leaving the stop nut 63 on the end of piston 19 extending rearwardly away from bearing 59.

The gun having been cocked, an operator places the tip portion 31' of punch 28 at the desired position for penetrating the material, depresses the tip portion until

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it is flush with the punch housing 15, and moves the trigger handle 46 toward the handle 54B. FIG. 4 shows the gun being precisely aimed by the depression of punch 28 against the workpiece, thus compressing spring 32. A rearward pull of trigger 46 rotates that member in a clockwise manner around pin 45 which, in turn, rotates sear plate 40 in a counterclockwise direction around pin 41 overcoming the resistance of wire spring 47 and moving flange 42 downwardly and outwardly through opening 39 to release piston 19 which is driven forward by spring 24. Ram 27 thus contacts base 29 of punch 28 forcing tip portion 31' completely through the workpiece, as shown in chain line position 31" of FIG. 4. Should partial penetration or a lesser force be desired, the operator depresses punch 28 only a portion of the way to the fully depressed flush position. Punches 28 of appropriate size and physical characteristics may be substituted by merely unscrewing the punch housing 15 and inserting an appropriate punch 28.

It is evident that even if the gun were cocked as described, were punch 28 not depressed against a workpiece, a subsequent pulling of the trigger would not move punch 28 because, as shown in FIG. 3, spring 32 maintains shoulder 35 of punch collar 30 against stop surface 36 of punch housing 14 and shoulder 21 of piston collar 20 engages stop surface 23 of barrel 11, thus stopping ram 27 prior to striking punch base 29. This provides an important safety feature in that accidental discharge when the punch 28 is contacting, but not depressed against, an object produces no striking force which could cause inadvertent damage.

A modified form of the invention for inserting drive rivets is shown in the punch gun apparatus, generally indicated by the numeral 110, in FIG. 7. The structure and operation of the barrel 111 and other components are identical to that described above, except as hereinafter noted. A modified punch 128 is substituted for the punch 28 by removing and subsequently replacing the punch housing 115. The modified punch 128 has a blow receiving base 129 and an enlarged collar 130 which tapers to form a punch shaft 131. As shown, the shaft 131 is shorter than shaft 31 and without a tip portion 31'. The shaft 131 is of such a length so as to engage the extremity of a rivet generally indicated by the numeral 170, and particularly the driven shaft 171 which moves into hollow housing 172 and splays it open radially along the axial slot 173. If necessary to accommodate different rivet sizes, the dimensions of receiver 115 and punch 128 could be varied by providing interchangeable parts.

We claim:

1. Apparatus for piercing sheet material comprising, barrel means, piston means housed in a first bore in said barrel means, punch means housed in a second bore in said barrel means which communicates with the first bore means, spring means forcing said piston means toward said punch means, biasing means urging said punch means away from said piston means and outwardly of the barrel means, cocking means compressing said spring means, trigger means selectively releasing said piston means to strike said punch means and operable independent of the position of said punch means.

2. Apparatus according to claim 1, wherein said piston means has a collar engaging a neck in the first bore to restrict the travel of said piston means to strike said punch means only when said punch means is depressed against said biasing means.

3. Apparatus according to claim 2, wherein a portion of said piston means extends into the second bore to selectively strike said punch means.

4. Apparatus according to claim 2, wherein said biasing means is a coil spring.

5. Apparatus according to claim 1, wherein said cocking means comprises handle means, a portion of said handle means engaging said piston means and movably mounted to displace said piston means to compress said spring means.

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6. Apparatus according to claim 5, wherein a portion of said handle means is pivotably mounted by a dual hinge and has a bifurcated portion freely rotatably mounting a bearing pin selectively positioned longitudinally of said piston means.

7. Apparatus according to claim 5, including a sear plate pivotable into the first bore in said barrel means to engage a collar on said piston means and maintain said piston displaced with said spring means compressed.

8. Apparatus according to claim 7, wherein said trigger means cooperatively engages said sear plate, whereby actuation of said trigger rotates said sear plate to release said piston means.

9. Apparatus according to claim 8, wherein said trigger has a shoulder which engages a lip on the sear plate.

10. Apparatus according to claim 9, including a sear

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plate spring pivotally urging said sear plate against said trigger and toward said piston means.

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U.S. Cl. X.R.

30—367; 173—133