July 3, 1962 C. B. GILMAN ET AL 3,041,906

EXPLOSIVE HOLE FORMING APPARATUS

Filed Aug. 14, 1959 2 Sheets-Sheet 1

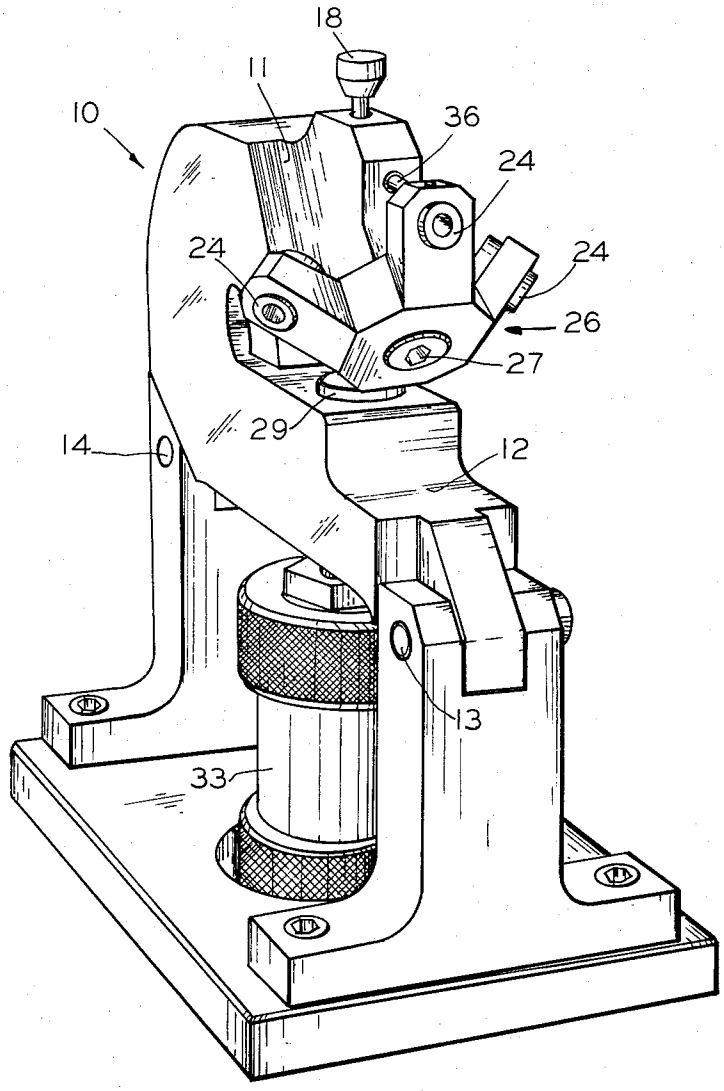


FIG - I

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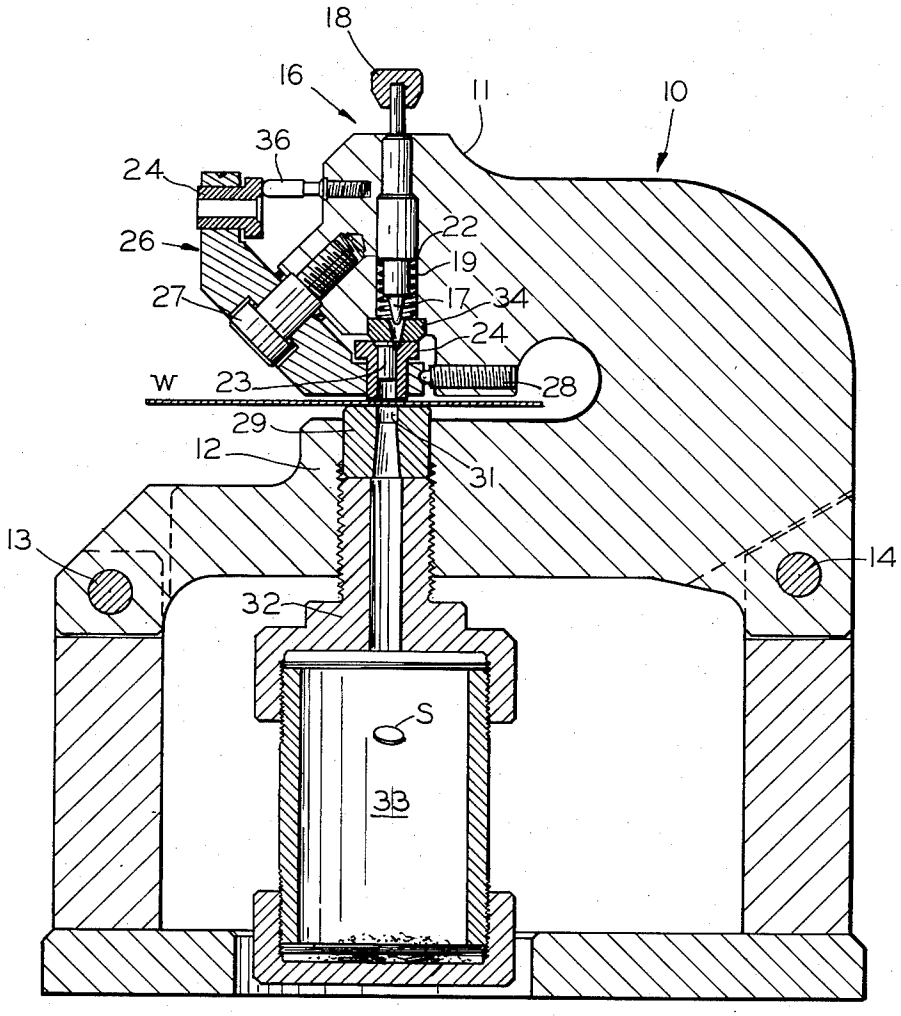


FIG-2

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EXPLOSIVE HOLE FORMING APPARATUS

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The present invention relates to metal fabrication and is directed, in particular, to a scheme for forming holes in sheet metal stock explosively.

A prime feature of the invention is the provision of a novel apparatus for forming holes in sheet metal stock quickly and without the need for ordinary hole forming tools.

A further feature of the invention is the provision of a novel method of forming holes in sheet metal stock.

The present invention is especially suited to forming holes in sheet metal stock which is ordinarily exceedingly difficult to work by conventional tools.

A further feature of the invention is the provision of a method and apparatus for forming holes in sheet metal stock which is readily adaptable to mass production methods.

It is a still further feature of the invention to provide a method for forming holes or apertures in sheet metal stock in which the die element utilized comprises a single apertured block.

A further feature of the invention is the provision of a fixture operable to receive and clamp a sheet metal work piece between a cartridge chamber and an apertured die so that upon actuation of a cartridge or other explosive charge disposed in the chamber, heat and pressure developed is effective to "blow" an aperture in the work piece where the conformation of the aperture is substantially identical to the opening formed in the die.

A hole forming method embracing the principles of the present invention may comprise the steps of providing a die having an aperture formed therein, disposing a charge of propellant on one side of the die, interposing a work piece in the form of a sheet of metal stock between the die and the propellant and activating the propellant so that the heat developed is operative to blow an opening in the metal stock where the opening so formed has a cross sectional configuration substantially the same as the cross sectional configuration of the aperture in the die.

An apparatus embracing certain features of the present invention and operative to practice the process steps thereof may comprise a frame including an anvil element and a head element, a die having an aperture movably mounted in the anvil element, said aperture having a predetermined configuration in cross section, a firing mechanism mounted in the head element, a turret carrying a plurality of cartridge chambers rotatably mounted in the head element, said turret being operable in step-by-step fashion to move a cartridge chamber into alignment with the die and into alignment with the firing mechanism so that the mechanism is operable to actuate a cartridge disposed in the chamber, said chamber when in alignment with the firing mechanism being spaced from said die so as to receive a sheet of metallic stock therebetween, means for moving the die towards the chamber effective to clamp the metal stock rigidly between the die and the chamber to create a gas seal, actuation of said cartridge being effective to blow an opening in the sheet metal, said opening having a cross sectional configuration corresponding to the cross section of the aperture formed in the die.

Other features and advantages of the present invention will become more apparent from the succeeding specification when read in conjunction with the appended drawings in which:

FIG. 1 is a perspective view of a fixture embracing the principles of the present invention, and,

FIG. 2 is a central vertical section of FIG. 1.

Referring now to the drawings, the reference numeral **10** denotes a frame having a generally C-shaped configuration and including a head element **11** and an anvil element **12**. For convenience, the frame **10** is fabricated in two pieces and is pinned together by suitable bolts or through pins **13** and **14**. The head element carries a firing mechanism, indicated generally by the reference numeral **16**, comprising a firing pin **17** and an impact head **18**.

The structure of the firing mechanism is not critical and in the present embodiment of the invention the pin **17** is held in the cocked position, as shown, by a coil spring **19**, one end of which bear on the upper surface of a breech plate **34** while the other end supports the firing pin in the region of the annular shoulder **22**.

The firing pin is actuated by striking the impact head **18** by a suitable instrument effective to drive the pin downwardly to actuate a cartridge of propellant material **23** disposed in a movable chamber **24**.

A plurality of chambers **24—24** are removably disposed in a turret element, indicated generally by the reference numeral **26**. The turret is rotatably mounted to the head **11** by means of a bolt **27** and is operable to rotate about an axis forming an acute angle with the horizontal.

As is apparent in FIG. 1, the turret is movable about its axis in step-by-step fashion to bring individual chambers **24** into alignment with the firing mechanism. A spring detent **28** is utilized to hold a given chamber **24** releasably to aid in aligning the chamber with respect to the firing pin.

The anvil element **12** carries a die **29** apertured as at **31**. The die is slidably received in the anvil element and is normally spaced apart from the chamber so that a work piece W comprising a piece of sheet metal stock can be disposed between the top surface of the die and the bottom face of the chamber **24**.

The anvil element also carries a die screw **32** formed integral with a slug and powder trap **33** and is operable to raise and lower the die **29**.

For example, the die screw is rotatable to withdraw the die in a downward direction to provide a gap between the die and the chamber. After insertion of the work piece W between the die and the chamber, the die screw is operable to drive the die upwardly against the work piece to effect a fluid tight seal between the work piece and the die and between the work piece and the chamber.

Note that although the chambers **24** are movably mounted within the turret **26**, in the firing position, the chamber is backed up or supported by a breech block or plate **34**. Thus, the stress developed in sealing the die, the work piece, and the chamber is confined to the head element **11** and the anvil element **12** and there is virtually no stress upon the turret **26**.

Upon actuation of the propellant carried by the cartridge **23**, the heat and pressure developed is effective to blow a slug of material S from the work piece W forming an aperture in the work piece of generally the same conformation as the aperture formed in the die. As shown in FIG. 2, the slug of metal blown from the work piece is received in the slug trap **33** in the same fashion the propellant residue and exhaust gases are also retained in the trap **33**.

After blowing a slug of material from the work piece the die screw is rotated in an appropriate direction effective to withdraw the die thereby releasing the work piece.

Thereafter the turret may be rotated one step in the

appropriate direction to bring a new cartridge and chamber **24** into alignment with the die and the firing mechanism. Upon an appropriate adjustment of the work piece and upon clamping the die and chamber to the work piece in the manner previously described, the fixture is in condition to fabricate another opening.

A spring loaded plunger **36** is provided to back up the movable chamber **24** to facilitate ejecting a spent cartridge.

In practicing the process of the present invention a work piece W is disposed between a charge of propellant represented by a cartridge **23** and a die **29**. The propellant is confined within a cartridge in turn confined within a chamber **24** thus making it possible to effect a gas seal between the chamber, the work piece and the die.

Thereafter the propellant is activated effective to develop heat and pressure operative to blow an opening in the work piece where the opening formed is of substantially the same cross sectional configuration as that of the aperture in the die.

The principal advantages of the present invention are as follows:

(1) The provision of a metal fabrication method useful in handling high strength sheet metal stock such as heat treated stainless steel, alloys of cobalt, titanium and the like, ordinarily very difficult to machine.

(2) The provision of a method and apparatus which lends itself to modern mass production methods.

(3) The provision of a method and apparatus which can be readily designed into portable metal fabrication tools useful in aircraft and missile industries.

(4) The invention also lends itself very well to automatic feeding and ejection of propellant charges.

(5) The invention contemplates tools arranged in gangs where all may be operative simultaneously to fabricate a plurality of openings in a work piece explosively.

It is anticipated that a wide variety of embodiments of the present invention may be devised without departing from the spirit and scope thereof. For example, it is anticipated that the explosive propellant charge may be in powder or liquid form.

What is claimed is:

1. A fixture operative to form holes in sheet metal stock explosively comprising a frame having a generally C-shaped configuration and including an anvil element and a head element, a die having an aperture movably mounted in the anvil element, said aperture having a predetermined configuration in cross-section, a firing mechanism mounted in the head element, a turret carrying a plurality of axially movable cartridge chambers rotatably mounted in the head element, said turret being rotatable about an axis which forms an acute angle with respect to the horizontal, said turret being operable in step-by-step fashion to move a cartridge chamber into alignment with the die and the firing mechanism so that the firing mechanism is operable to actuate a cartridge disposed in the chamber, said chamber when in alignment with the firing mechanism being spaced from said die so as to receive a sheet of metal stock therebetween, means for moving the die towards the chamber effective to clamp the metal stock rigidly between the die and the chamber to create a gas seal, said chamber being buttressed by the head element whereby the turret is free of clamping stress actuation of said cartridge being effective to blow an opening in the sheet metal, said opening having a cross sectional configuration corresponding to the cross section of the aperture formed in the die.

2. The device of claim 1 wherein an exhaust chamber is formed contiguous with the die operative to receive exhaust gases including the metal blank blown out of the sheet metal.

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