Dec. 10, 1957 P. H. TAYLOR 2,815,814

SELF-CONTAINED PERFORATING IMPLEMENT

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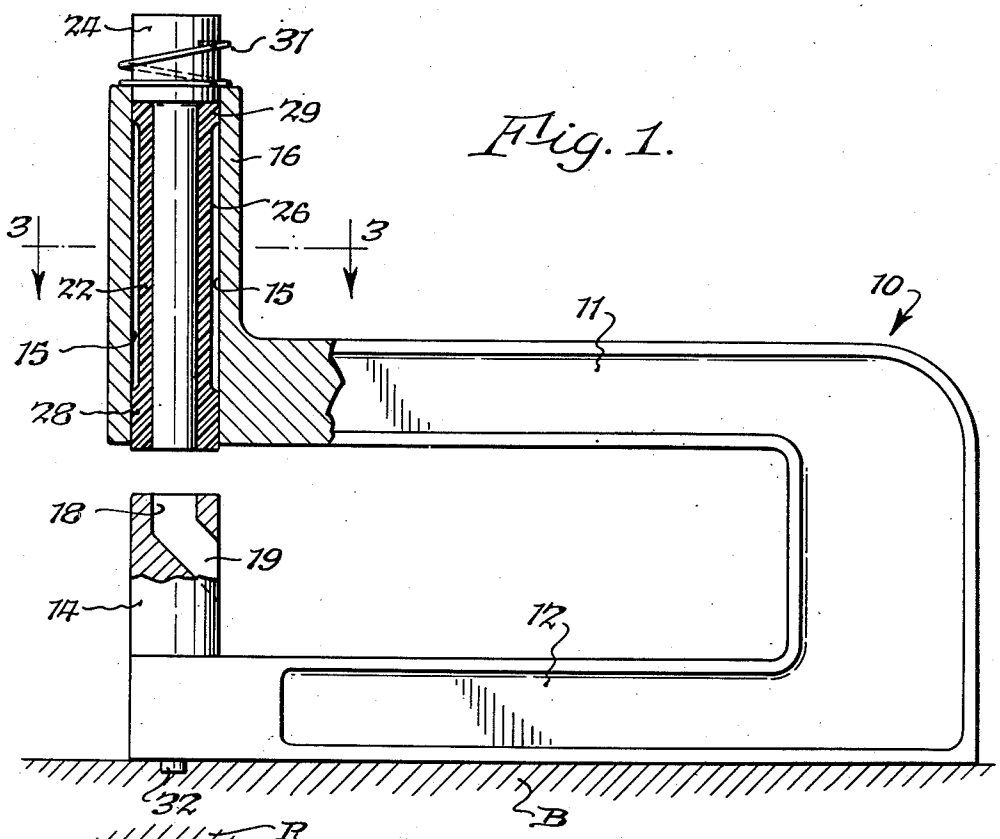



Fig. 1.

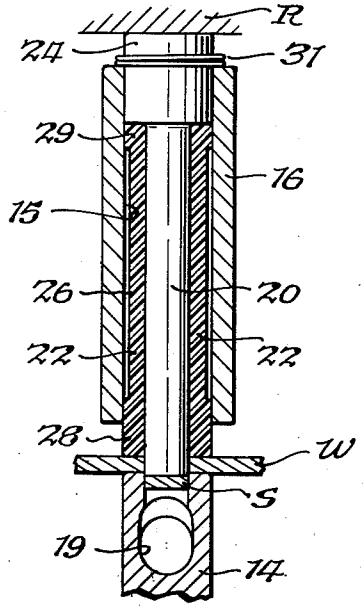



Fig. 2.

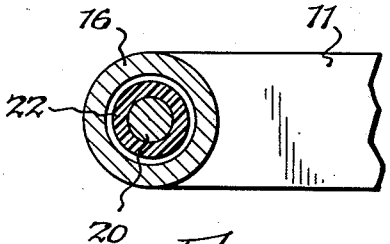



Fig. 3.

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# SELF-CONTAINED PERFORATING IMPLEMENT

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7 Claims. (Cl. 164—110)

The present invention relates to perforating apparatus, and more particularly to self-contained perforating implements. In a still more specific aspect, the invention constitutes an improvement on the invention disclosed in my pending U. S. patent application, Serial No. 464,722, filed October 26, 1954, now Patent No. 2,805,717.

The ordinary self-contained perforating unit comprises a C-frame, a punch-stripper assembly mounted on the upper arm of the C-frame, and a die mounted in the lower arm of the C-frame in axial alignment with the punch. The stripping means in such a conventional unit comprises a stripper sleeve or guide, which is reciprocable in the upper arm of the C-frame and in which the punch is reciprocable, and a wound steel wire spring which is interposed between the punch and the stripper sleeve. The punch and the stripping means move as a unit until the stripper sleeve contacts the workpiece. Then the punch is forced through the workpiece to perforate the same, while the stripping spring is compressed between the punch and the stripper sleeve. Upon release of the perforating force, the compressed stripping spring expands and strips the punch from the work.

Such conventional self-contained perforating units have the disadvantage that it is impossible with them to punch simultaneously a plurality of holes on close centers. This is because of the stripping springs. In each unit, the stripping spring surrounds the punch; and the thicker the material which is to be punched, the larger the stripping spring must be. Different perforating units cannot be placed any closer together than their stripping springs will allow.

In the perforating unit disclosed in my U. S. patent application above mentioned, both the stripper sleeve and the stripping spring of conventional perforating units are eliminated; and a single, tubular, plastic, stripping sleeve is substituted therefor. This stripping sleeve reciprocates in a bore in the upper arm of the C-frame. When the punch is forced through a workpiece, the stripping sleeve is compressed between the punch and the workpiece. Upon release of the perforating force, the stripping sleeve expands to its original size and form, and, in so doing strips the punch from the workpiece.

A perforating implement, such as disclosed in my application above mentioned, operates with great efficiency, but is limited as to the thickness of workpiece which it can perforate. If the work, which is to be perforated, is too thick, the plastic stripping sleeve will be overloaded and will rupture easily.

The primary object of the present invention is to provide a self-contained perforating unit having a plastic stripping sleeve but capable of perforating thicker workpieces without fatigue than has heretofore been possible with comparable perforating units of this type.

Another object of the invention is to provide a self-contained perforating unit which is capable of a longer working stroke without increasing the width of the unit, thus enabling the units to be used to punch simultaneously a plurality of closely-spaced holes through a metal sheet of substantial thickness.



Another object of this invention is to provide perforating apparatus of the character described in which a single resilient, tubular, plastic member may serve as a bearing and guide for the punch and to provide the stripping force.

Another object of the invention is to provide perforating apparatus of the character described which can be manufactured at low cost.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims.

In the drawing:

Fig. 1 is a side elevation, with parts broken away, of a self-contained perforating unit constructed according to one embodiment of this invention, the unit being shown with the punch in withdrawn, idle, position;

Fig. 2 is a fragmentary section, taken at right angles to Fig. 1, showing the punch-stripper assembly and a portion of the die, the parts being illustrated with the punch at the end of a perforating stroke; and

Fig. 3 is a fragmentary section, taken on the line 3—3 of Fig. 1 looking in the direction of the arrows.

Referring now to the drawing by numerals of reference, 10 denotes the C-frame; and 11 and 12 are the upper and lower arms, respectively, of this frame. The die 14 is secured on the lower arm 12 of the C-frame. The punch-stripper assembly is mounted to reciprocate in a bore 15 formed in the elongate cylindrical guide portion 16 of the upper arm 11 of the C-frame.

The die comprises a cylindrical body having a central bore 18 communicating with an angular discharge chute 19 through which slugs S (Fig. 2) punched from the workpiece W may pass.

The punch-stripper assembly is axially aligned with the die. It comprises a punch 20, and a resilient, plastic, tubular stripping sleeve 22. The shank portion of the punch is mounted in the bore of the sleeve 22 and the head 24 of the punch bears on the top surface of this sleeve. The sleeve itself is mounted to reciprocate in the bore 15 of a cylindrical guide portion 16 of upper arm 11 of the C-frame.

The plastic stripping sleeve 22 is preferably made of nylon, such as nylon 6503. It may, however, be made of any other suitable resilient, plastic material, such as "Kel-F," "Teflon" (tetrafluoroethylene resin), etc. This sleeve is relieved between its ends, as denoted at 26. It has portions 28 and 29 at its lower and upper ends, respectively, which are of sufficiently large diameter to engage the wall of the bore 15 and to guide the sleeve in its reciprocating movement; but the portion 26 of the sleeve between these two end portions 28 and 29 has considerable clearance, especially in the at-rest position of the sleeve (Fig. 1), with reference to the bore 15. The relief 26 in the sleeve 22 makes the sleeve more elastic than a sleeve made of the same material but unrelieved.

In this embodiment of the invention, it is preferred to have the head 24 of the punch engage in the bore 15 even in the at-rest position of the punch, as shown in Fig. 1. Thus, the steel head of the punch acts as a guide for the punch from the very beginning of its working stroke; and there is less tendency of the punch to deflect because the head of the punch prevents deflection at the top, at least. Preferably the enlarged portion 28 of the sleeve, at least, has no clearance at any time with reference to the bore 15; and, in fact, may have an interference with that bore.

A light, wire, coil spring 31 serves as a lifter spring for the punch-stripper assembly. This spring 31 surrounds the head 24 of the punch, and is anchored at its upper end in this head. At its lower end, it may rest on the

top of the cylindrical portion 16 of the upper arm 11 of the C-frame, or preferably is secured thereto. Spring 31 normally holds the punch-stripper assembly in raised position as shown in Fig. 1, to provide clearance between the lower end of this assembly and the top of the die 14, so that a workpiece may readily be inserted between the punch and the die.

The sleeve 22 is preferably shrunk on the shank of the punch, to be held thereon by its innate resilience.

The C-frame may be located in correct position on the bed B of the press, on which the perforating implement is to be used, by a conventional pilot pin 32 which is adapted to fit into a suitable locating hole in the bed of the press or in a template secured to the press bed.

In use, after the implement has been properly located on the bed of the press or on the template, and the work W, which is to be perforated, has been introduced between the punch 20 and the die 14, the press is actuated, causing the ram R of the press to descend. The descending ram engages the head 24 of the punch, driving the punch and stripping sleeve 22 downwardly as a unit until the stripping sleeve 22 contacts the workpiece W. In this downward movement of the punch-stripper assembly, the lifter spring 31 is compressed. When the stripping sleeve 22 engages the work, its downward movement is arrested. The ram, however, continues to descend, to drive the punch through through the work to perforate the same, as shown in Fig. 2; and during this perforating movement of the punch the nylon sleeve 22 is compressed between the work W and the head 24 of the punch. The pressure on the nylon sleeve 22 will cause the sleeve to distort elastically, as shown in Fig. 2, so that some of the clearance between the relief portion 26 of the sleeve and the bore 15 is taken up, and so that, at the same time, the portions 28 and 29 of the sleeve tightly engage the bore 15 to rigidly support and guide the punch as it perforates the work. The elastic distortion of the sleeve 22 will eliminate all clearance, if any, between the sleeve and the shank of the punch, and between the sleeve portions 28 and 29 and the bore 15. Thus the punch is accurately centered and positively guided during the perforating operation.

When the compressive force is relieved, by raising the ram R, the compressed and elastically distorted sleeve 22 expands back to its original size and shape, thereby stripping the punch 20 from the workpiece W. Then the lifter spring raises the punch-stripper assembly back to its starting position, shown in Fig. 1.

The unit described can punch holes in a workpiece with a degree of accuracy heretofore practically impossible to attain. The nylon, or other plastic, sleeve 22 not only provides the stripping force to withdraw the punch from the work upon completion of a perforating stroke, but at the same time provides an accurate guide for the punch in the perforating operation. It serves to center and stiffen the punch, augmenting the strength of the small-diameter punch shank by the added strength of the compressed, but elastically distorted stripping sleeve, which, during the perforating operation, at least, intimately embraces the punch shank around its whole periphery, and rigidly engages the wall of the bore 15. Thus, in this single tubular member 22 there is provided not only a spring but a guide, and a centering and stiffening agent, with excellent bearing surfaces, which does not require lubrication, because of the character of the nylon or other material from which it is made.

As previously stated, by relieving the sleeve 22 between its ends, it is made more elastic than if it were of the same diameter throughout its whole length. Therefore, workpieces W of greater thickness can be perforated, than it would be possible to perforate were the sleeve of the same diameter from end to end.

The use of the resilient, plastic, tubular stripping sleeve 22 considerably reduces the cost of the perforating implement, for, since the member 22 distorts elastically when compressed, and thereby tightly embraces the shank of the punch and firmly engages the bore 15, the bore 23 of the sleeve, and the shank of the punch need not be manufactured to very close tolerances. By contrast, the punch-stripper assembly in conventional self-contained perforating units has to be manufactured carefully with minimum practical clearances between the parts so that the stripper sleeve will properly support and guide the punch and formation of burrs will be avoided.

The nylon, or other plastic, sleeve 22 has the further advantage that it will protect the punch against damage, for if a workpiece should happen to strike the sleeve, the sleeve would simply distort, without causing the punch to be bent.

It will be apparent that the present invention is not limited to self-contained perforating implements. It may be used, also, in other types of perforating apparatus with advantage. Thus, the invention may be employed, for instance, where a plurality of punches are mounted in a single supporting plate as shown in the U. S. patents to Wales Nos. 1,964,752 and 2,355,765, granted July 3, 1935 and August 15, 1944, respectively, for the stripping sleeve of the present invention can replace the stripper sleeve and stripping spring in the perforating apparatus shown in these prior patents.

While the invention has been described in connection with a particular embodiment thereof, therefore, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim is:

1. Perforating apparatus comprising a punch, a resilient compressible, plastic, tubular member in the bore of which said punch reciprocates, said tubular member being relieved on its periphery between its ends so that it is normally of less external diameter at points intermediate its ends than adjacent its ends, a holder having a bore in which said tubular member is reciprocably mounted, said tubular member having its ends in slidable engagement with the last-named bore, and means connecting said punch to said tubular member so that they move together when force is applied to said punch until said tubular member engages a workpiece, said tubular member being compressed and distorted when said punch moves relative to said tubular member in perforating the workpiece, said tubular member being adapted to expand upon release of the punching force to strip the punch from the workpiece.

2. Perforating apparatus comprising a punch, a resilient, compressible, plastic, tubular member in the bore of which said punch reciprocates, said tubular member having a circumferential, peripheral recess between its ends, a holder having a bore in which said tubular member is reciprocably mounted, and means connecting said punch to said tubular member so that they move together when force is applied to said punch until said tubular member engages a workpiece, said tubular member being compressed and distorted when said punch moves relative to said tubular member in perforating the workpiece, said tubular member being adapted to expand upon release of the punching force to strip the punch from the workpiece.

3. Perforating apparatus comprising a bored holder, a resilient, compressible, plastic tubular member reciprocable in the bore of said holder, a punch reciprocably mounted in the bore of said tubular member to reciprocate therein, said tubular member having an enlarged portion at one end, at least, fitting slidably in the bore of said holder, said tubular member being of smaller external diameter at another portion of its length whereby the latter portion normally has clearance with reference to the

bore of said holder, and means connecting said punch to said tubular member so that they move together, when force is applied to said punch, until said tubular member engages a workpiece, said tubular member being compressed and distorted when said punch moves relative to said tubular member in perforating the workpiece so that it firmly engages the bore of said holder and all clearance is eliminated between said tubular member and the portion of said punch which is engaged in the bore of said tubular member, said tubular member being adapted to expand upon release of the punching force to strip the punch from the workpiece.

4. Perforating apparatus comprising a bored holder, a resilient, compressible, plastic, tubular member reciprocable in the bore of said holder, a punch reciprocably mounted in the bore of said tubular member to reciprocate therein, said tubular member being relieved on its periphery between its ends so that it is normally of less external diameter at points intermediate its ends than adajcent its ends, the ends of said tubular member being in slidable engagement with the bore of said holder, said punch having an enlarged head at its end remote from its operating end a portion of which is disposed within the bore of said holder to engage said holder bore slidably and which seats on the adjacent end of said tubular member to transmit a punching force to said tubular member, said tubular member being adapted to move with said punch on a working stroke of the punch to engage the work, said tubular member being adapted to be compressed and distorted after it engages the work while the punch is perforating the work, and said tubular member being adapted to expand upon release of the punching force to strip the punch from the work.

5. Perforating apparatus comprising a bored holder, a resilient, compressible, plastic, tubular member reciprocable in the bore of said holder, a punch mounted in the bore of said tubular member to reciprocate therein, said punch having an enlarged head at its end remote from its operating end and having a shank connecting its head and its operating end, said head having sliding engagement in the bore of said holder to act as a guide for said punch in its reciprocatory movement, said head seating on the adjacent end of said tubular member to transmit a punching force to said tubular member, said tubular member having an enlarged portion at one end, at least, fitting slidably in the bore of said holder, and said tubular member being of smaller external diameter at another portion of its length whereby the latter portion normally has clearance with reference to the bore of said holder, said tubular member being compressed and distorted when said punch moves relative to said tubular member in perforating the workpiece so that the smaller diameter portion of said tubular member firmly engages the bore of said holder and clearance is eliminated between said tubular member and the shank of said punch, said tubular member being adapted to expand upon release of the punching force to strip the punch from the workpiece.



6. Perforating apparatus comprising a bored holder, a resilient, compressible, plastic, tubular member reciprocable in the bore of said holder, a punch mounted in the bore of said tubular member to reciprocate therein, said punch having a shank portion with an operating portion at one end and an enlarged head at its opposite end, said head having sliding engagement in the bore of said holder to act as a guide for said punch in its reciprocatory movement, said head seating on the adjacent end of said tubular member to transmit a punching force to said tubular member, said tubular member having a length in its uncompressed condition equal to the length of the shank portion of said punch, said tubular member having an enlarged portion at one end, at least, fitting slidably in the bore of said holder, and said tubular member being of smaller external diameter at another portion of its length whereby the latter portion normally has clearance with reference to the bore of said holder, said tubular member being compressed and distorted when said punch moves relative to said tubular member in perforating the workpiece so that the smaller diameter portion of said tubular member firmly engages the bore of said holder and clearance is eliminated between said tubular member and the shank of said punch, said tubular member being adapted to expand upon release of the punching force to strip the punch from the workpiece.

7. Perforating apparatus comprising a bored holder, a resilient, compressible, plastic, tubular member reciprocable in the bore of said holder, a punch mounted in the bore of said tubular member to reciprocate therein, said punch having a shank portion with an operating portion at one end and an enlarged head at its opposite end, said head having sliding engagement in the bore of said holder to act as a guide for said punch in its reciprocatory movement, said head seating on the adjacent end of said tubular member to transmit a punching force to said tubular member, said tubular member having a length in its uncompressed condition equal to the length of the shank portion of said punch, said tubular member having enlarged portions at both ends slidably engaging in the bore of said holder, said tubular member being of smaller external diameter between its ends whereby it normally has clearance between its ends with reference to the bore of said holder, and a coil lifter spring surrounding said head and connected at one end to said head and interposed between said head and said holder.

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