Sept. 24, 1957 P. H. TAYLOR 2,807,323

SELF CONTAINED PERFORATING UNIT

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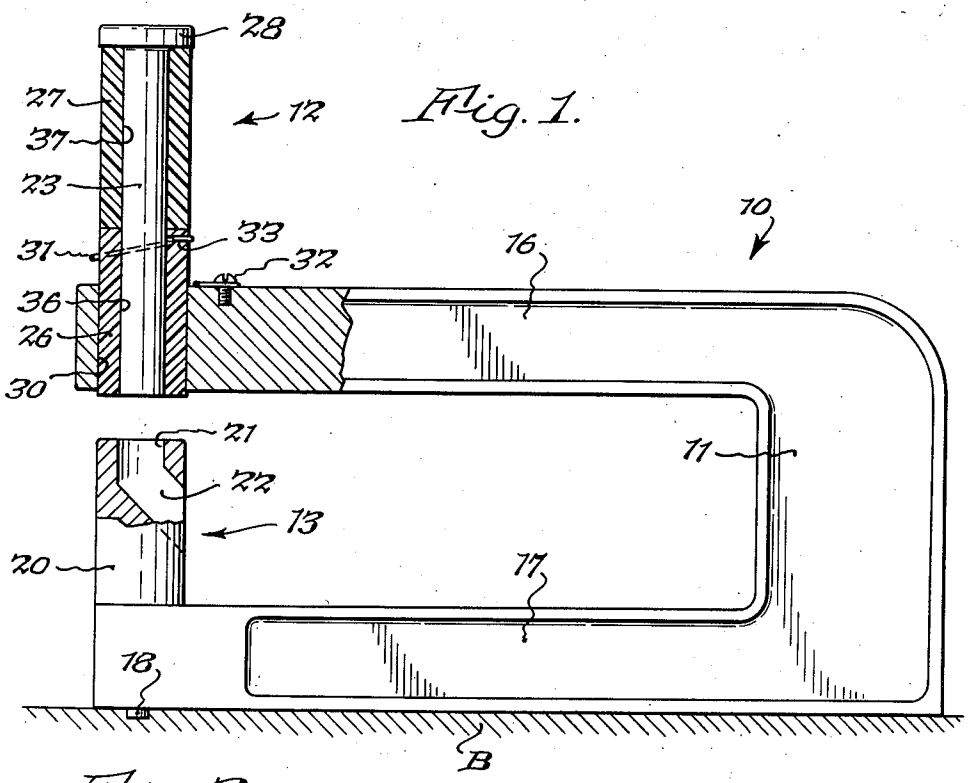


Fig. 1.

Fig. 2.

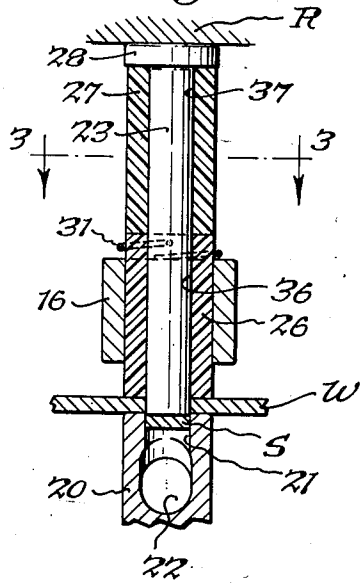
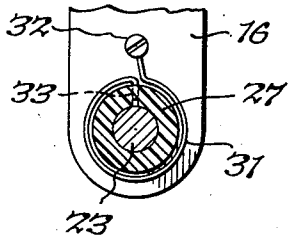


Fig. 3.



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Fig. 4.

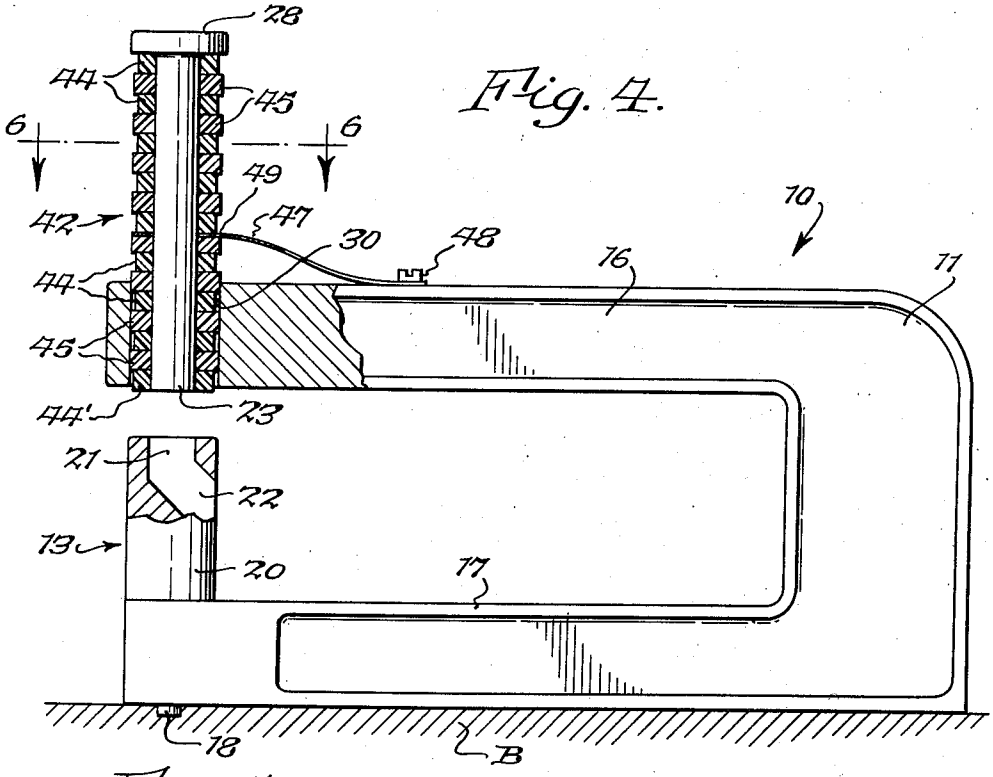


Fig. 5.

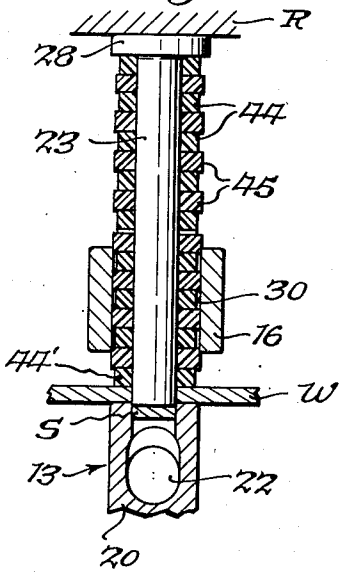
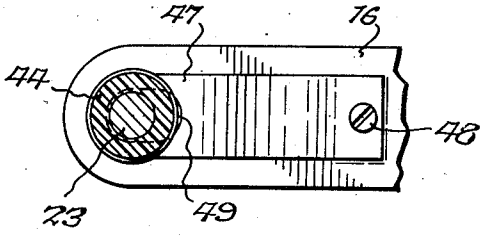


Fig. 6.



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2,807,323

SELF-CONTAINED PERFORATING UNIT

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Application April 14, 1955, Serial No. 501,275

15 Claims. (Cl. 164—94)

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.

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 stripper of such a conventional unit comprises a wound steel wire spring, and a sleeve or guide which is reciprocable in the upper arm of the C-frame, and in which the punch is reciprocable. The punch and stripper move as a unit until they contact the workpiece. Then the punch is forced through the workpiece, while the stripping spring is compressed between the punch and the stripper sleeve. Upon release of the punching force, the compressed stripping spring expands and withdraws 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 spring. The stripping spring surrounds the punch; and the thicker the material which is to be punched, the larger the stripping springs 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 guide and the stripper 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 punching 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 size of workpiece which it can perforate. When the workpiece is of substantial thickness, the plastic stripping sleeve may become overloaded and rupture.

One object of the present invention is to provide a self-contained perforating unit employing resilient, plastic means as a combination stripper sleeve and stripping spring, but which is capable of perforating thicker workpieces without fatigue than has heretofore been possible where such a combination resilient plastic stripper sleeve and stripping spring has been employed.

Another object of the invention is to provide a self-contained perforating unit of the character described in which the combination stripper and stripping spring is a plastic sleeve.

Another object of this 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 a number of such 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 member may still serve as a bearing and guide for the punch and to provide at least part of the stripping force.

Another object of this invention is to provide perforating apparatus of the character described in which the combination spring and guide is so constructed that its manufacture is simple and of low cost.

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

In the drawings:

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 withdrawn;

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 working stroke;

Fig. 3 is a fragmentary section taken on the line 3—3 of Fig. 2, and looking in the direction of the arrows;

Fig. 4 is a view, similar to Fig. 1, showing a further embodiment of the invention;

Fig. 5 is a fragmentary section, similar to Fig. 2, taken at right angles to Fig. 4 and showing the punch-stripper assembly of the unit of Fig. 4 at the end of a working stroke; and

Fig. 6 is a fragmentary section on the line 6—6 of Fig. 4 looking in the direction of the arrows.

Referring now to the drawings by numerals of reference and first to the embodiment of the invention shown in Figs. 1 to 3 inclusive, 10 denotes a self-contained perforating implement which comprises, generally, a C-frame 11, a punch-stripper assembly 12, and a die 13 in axial alignment with assembly 12. The C-frame 11 has an upper arm 16, in which the punch-stripper assembly 12 is reciprocably mounted, and a lower arm 17 on which die 13 is mounted. On the underside of the lower arm 17 is a conventional pilot pin 18 which is adapted to fit into a suitable hole in the bed B of the press, on which the implement is used, to properly locate the implement on the bed.

Die 13 comprises a cylindrical body 20 having a central bore 21 communicating with an angular discharge chute 22 through which slugs S (Fig. 2) punched from a workpiece W may pass.

The punch stripper assembly 12 comprises a punch 23, and a pair of resilient, plastic, tubular members 26 and 27, in which the shank of the punch is mounted and is reciprocable. The tubular member 27 is mounted on top of the tubular member 26. Punch 23 has an enlarged head portion 28 which engages the upper end of member 27. Member 26 is mounted to reciprocate in a bore 30 in the upper arm 16 of the C-frame.

A light, wire, coil spring 31 serves as a lifter for the punch stripper assembly 12. Spring 31 surrounds the upper end of lower stripper member 26. The upper end of this spring is secured in a hole 33 in resilient, stripper member 26 and the lower end of the spring seats on the upper arm 16 of the C-frame 11 and is fastened thereto by a screw 32. Spring 31 normally holds assembly 12 in a raised position, as shown in Fig 1, to provide clearance between the lower end of the assembly and the top of die 13 so that a workpiece may be readily inserted therebetween.

The bore 37 of the tubular stripping member 27 in normal, at rest, position has a diameter slightly greater

than the diameter of the shank of punch **23**. Tubular stripping member **26** may also have normal clearance with reference to punch **23**, but because of its resilience may, also, have a tight fit around the shank of the punch at all times. The outside diameter of tubular member **26**, however, is preferably made less than the diameter of bore **30** in the upper arm **16** of C-frame **11**, thereby providing relatively, an initial clearance between member **26** and the bore **30**. For precision machine tool components, the outside diameter of member **26** may be, for instance, .002 inch to .004 inch less than the diameter of bore **30**, where normally, that is, with conventional construction, such parts would have to be held to a tolerance of at least .0005 inch.

Tubular stripper members **26** and **27** are both made of a suitable plastic such as nylon. However, they are made of different types of nylon. Upper tubular member **27** is made of a nylon, such as nylon 7001, having greater compressibility and elasticity than lower member **26**, which is made of a more rigid, less compressible nylon, such as nylon 10,001. Member **27** is adapted to be highly compressed on actuation of the unit to store a large amount of energy for stripping punch **23** from a workpiece upon completion of a working stroke. Member **26** is adapted to be compressed to a lesser degree, storing energy for use in stripping the punch from a workpiece, but more important, for guiding punch **23** in its reciprocating movement and providing a bearing-like support for the punch in bore **30** of upper arm **16**.

Although it has been found that nylon is preferable for most applications, members **26** and **27** may be made instead of other plastic materials such as "Kel-F," "Teflon," "polystyrene" or the like.

The manner in which perforating implement **10** operates is illustrated in Figs. 1 and 2. When the punch press ram R (Fig. 2) is driven downwardly, it forces punch **23** and tubular plastic members **26** and **27** to move downwardly as a unit until member **26** contacts the workpiece W. In this downward movement of the punch and plastic members, lifter spring **31** is compressed. When member **26** strikes the surface of the workpiece W its downward movement is arrested. Thereafter, punch **23** moves relative to plastic members **26** and **27**, being forced through workpiece W, while members **26** and **27** are compressed between the workpiece and the head **28** of the punch. Since members **26** and **27** are made of different densities of nylon, the amount which they are compressed differs. As shown in Fig. **2**, member **27** is highly compressed while member **26** is compressed to a much lesser degree. The compression of member **26** causes it to distort elastically, thereby eliminating all clearance, if any, between its bore **36** and the shank of the punch **23**, and at the same time eliminating all clearance between it and the bore **30** of arm **16**. The elimination of these clearances causes the punch **23** to be accurately centered and positively guided in its working stroke. Moreover, by eliminating these clearances, punch **23** is supported and stiffened as it moves downwardly to perforate workpiece W. The compression of upper member **27**, on the other hand, permits of a much longer stroke of the punch than would be possible if the shank of the punch were surrounded for its full length by a single sleeve of the density of sleeve **26**.

When the force applied to the ram R is removed, compressed members **26** and **27** expand back to their original sizes and shapes, thereby stripping punch **23** from workpiece W. Then lifter spring **31** raises assembly **12** back to its starting position.

The unit above described punches holes in a workpiece with a degree of accuracy heretofore practically impossible to attain. This results from the action of the member **26** which serves many purposes. Its resiliency helps member **27** to provide the stripping force to withdraw punch **23** from the workpiece W after a perforating stroke. At the same time it provides an accurate guide for guiding the punch as it perforates the workpiece; in fact it provides a more accurate guide for this purpose than has heretofore been attainable in a self-contained perforating implement of conventional construction. In expanding, it also serves to center and stiffen the punch, augmenting the strength of the small-diameter punch shank by the added strength of the expanded stripper sleeve **26** which, upon expansion, intimately embraces the punch shank around its whole periphery. Thus in the single tubular member **26** there is provided not only a spring but also a guide, and a centering and stiffening agent, with excellent bearing surfaces. This tubular member is loose enough to resiliently slide up and down in the bore **30** of the arm **16** during the initial part of the working stroke and during the return stroke. During the actual punching operation, however, it holds the punch in a tight, yet, because of the nature of plastics such as nylon, "Kel-F," "Teflon," etc., lubricated embrace, and guides the punch very accurately. The expansion of the member **26** on the working stroke, moreover, prevents upward extension of the metal of the workpiece into the bore **36** of the tubular member when thin gauge stock is punched. Being made of nylon, or similar material, the tubular member **26** is self-lubricating, thereby eliminating all lubricating normally associated with conventional perforating apparatus. Further, since member **26** is made of plastic, it is softer than the workpiece being perforated, even when the workpiece is aluminum or some other soft metal. Therefore, when it engages the workpiece on a working stroke, it will not mar or mark the workpiece.

The greater compressibility of member **27** allows the punch **23** to have a greater stroke. Therefore, workpieces W of substantial thickness can be perforated. If member **27** was made of the same nylon as member **26**, the stroke of the punch would be limited, and any attempt to drive punch **23** through a thick workpiece would cause the plastic members to be overloaded and ruptured. Therefore, by using a dense nylon in member **26** and a highly compressible nylon in member **27**, punch **23** is properly guided and stiffened in its reciprocating stroke, its working stroke can be extended, and, at the same time, a sufficient stripping force is developed in the plastic members to strip the punch from the workpiece.

The use of resilient, plastic, tubular stripping members **26** and **27** greatly reduces the cost of the perforating implement. Since the member **26** expands elastically when compressed and firmly engages the bore **30** in arm **16**, it need not be manufactured with an outside diameter to a very close tolerance. Likewise because the member **26**, when expanded, tightly embraces the shank of punch **23**, its bore **36** and the punch shank need not be manufactured to very close tolerances. Since member **27** serves only to provide additional stripping force for a long punch stroke, it also need not be made to close tolerances. Members **26** and **27** can, therefore, be made of commercial, extruded plastic tubing having the approximate inside and outside diameters desired. By contrast, the punch stripping assembly in conventional, self-contained perforating units have had to be carefully manufactured with minimum practical clearances between the parts so that the stripper sleeve will properly support and guide the punch and the formation of burrs will be avoided.

In conventional perforating units, the clearance between the stripper sleeve and the bore of the upper arm of the C-frame has to be extremely small because the clearance between the punch and the die in the punching operation must be extremely small to prevent formation of a downwardly extending burr on the part being punched. In some instances, for light aircraft stock, for example, the normal clearance between the stripper sleeve and the bore of the upper arm of the C-frame is less than .002 inch. This requires that conventional punch-stripper assemblies be made extremely accurate to permit the tight sliding fit required. In contrast with

conventional construction, in the perforating implement of the present invention, the only dimension, that has to be held accurately, is the clearance between the punch and the die for the working stroke. This must be held to a tight clearance to avoid formation of undesirable burrs in the punching operation. However, this tight clearance accuracy need only be maintained at the punch tip, and the punch does not have to be made to fit the tubular stripper members tightly for its whole length, as is required with conventional perforating implement construction.

The perforating implement of the present invention, furthermore, can produce a stripping force of great magnitude and the punch is able to travel a considerable distance without rupturing the plastic stripping members because of the high compressibility of upper member **27**. Thus, implement **10** can punch much thicker workpieces than has been possible with a conventional self-contained perforating unit; or conversely, the width of the holder or C-frame can be reduced by reduction in the width of the stripping assemblage, thereby enabling punching of holes on closer centers than is possible with conventional implements.

The embodiment of the invention shown in Figs. 4 to 6 has all the advantages of the embodiment of Figs. 1 to 3, and the additional advantages of simplicity and lower cost so far as the plastic stripper-spring members are concerned. Here, as before, a C-frame **11** may be employed with the die **13** mounted in its lower arm **17** and the punch-stripper assembly, here designated **42**, mounted in its upper arm **16**. Identical parts are designated by the same reference numbers in all figures. Here, however, the combination guide and stripping means comprises a plurality of nylon or other resilient, plastic washers, which fit on the shank of the punch **23**.

Alternate washers **44** and **45** may be made of a soft, pliable plastic and of a thick, dense plastic, respectively. Thus, washers **44** may be made of nylon 7001, while washers **45** may be made of nylon 10,001. The latter is thicker and denser than the former.

The washers may be hot-punched to fit the punch **23** closely. In fact, the lowermost, denoted **44'**, may be shrunk on the shank of the punch so that it resiliently grips the shank of the punch and will not fall off. Thereby it will retain all the other washers on the shank of the punch.

The washers may be all molded together so that in effect they form one single part. It is preferable, however, to make them separate since in this way they can be slipped on and off the punch shank readily.

The soft pliable washers **44** in their normal, at rest, positions have considerable clearance with reference to the bore **30** of the arm **16** of the C-frame, whereas the hard dense washers **45** in their normal, at-rest positions have less clearance with reference to this bore, and in fact may have an interference fit therewith. All the washers may also have clearance with reference to the shank of the punch **23** if they are molded together. If they are separate from one another and are retained on the punch by lowermost washer **44'**, then all except this lowermost washer may have considerable clearance with reference to the shank of the punch.

A flat, leaf spring **47**, which is secured at one end on top of arm **16** of the T-frame and which engages at its opposite end between two adjacent washers **44** and **45**, serves as a lifter-spring for the punch-stripper assembly **42**. This spring has an elongate slot **49** (Fig. 6) in it through which the shank of the punch passes. This slot permits of relative movement between the punch and the spring during perforation and during stripping. Spring **47** normally holds the assembly **42** in raised position, as shown in Fig. 4, to provide clearance between the lower end of the punch-stripper assembly and the top of die **13** so that a workpiece may readily be inserted therebetween.

The perforating unit of Figs. 4 to 6 inclusive operates in a manner similar to the perforating unit of Figs. 1 to 3 inclusive. When the punch press ram R descends it forces punch **23** and washers **44**, **45** downwardly as a unit until washer **44'** contacts the work W. In this downward movement, lifter spring **47** is loaded. When washer **44'** engages the work, downward movement of the washers is arrested, but punch **23** continues on to perforate the work under pressure of ram R. During perforation of the work, the washers **44** and **45** are compressed between the sheet metal plate W and the head **28** of the punch.

Since washers **44** and **45** are nylon parts of different densities, they are differently compressed. The softer, more pliable nylon washers **44** will be highly compressed, while the denser, harder nylon washers **45** will be compressed to a much lesser degree. Moreover, the softer, more pliable nylon washers **44** will be compressed first and elastically distorted. Then the harder, nylon washers **45** will be compressed.

If there is any clearance between the washers **45** and the bore **30** and between them and punch **23**, the compression of these washers will also cause them to distort elastically, eliminating all clearance between them and bore **30** and between them and the punch **23**. The elimination of these clearances causes the punch to be accurately centered and positively guided in its working stroke. Moreover, by eliminating these clearances the punch is supported and stiffened as it perforates the work.

When the ram is reversed, the compressed washers **44** and **45** expand to their original sizes and return to their original shapes, thereby stripping the punch **23** from the workpiece W. Then lifter spring **47** raises assembly **42** back to its starting position.

The soft, pliable washers **44** permit of a much longer stroke of the punch, that is, perforation of thicker material, than would be possible if hard dense washers, or a hard dense nylon sleeve, only were used. The use of washers generally has the advantage that they can be molded more easily than a sleeve and at less cost.

While it is preferred to make the washers **44** and **45** both of a resilient, plastic material, such as nylon, it is possible to make either set of washers of another material such as steel. For instance, if washers **45** are made of steel, they will have a sliding fit in bore **30**, and will act as the guiding and supporting members for the punch. The stripping force will then depend wholly on the degree of compression of the washers **44**.

It will be apparent, that the present invention is not limited to self-contained perforating implements. It may also be used in other types of perforating apparatus, with advantages such as those attained in a self-contained perforating implement. Thus, the invention may be employed, for instance, where a plurality of punches are mounted in a single supporting plate, as in the case of the apparatus shown in Wales Patents Nos. 1,964,752 and 2,355,765, granted July 3, 1935 and August 15, 1944, respectively. The denser plastic guide sleeves will be mounted, reciprocably loosely in the supporting plate, and both the denser and the more compressible sleeves will normally be held in their upper positions by lifter springs; and the punch will be mounted reciprocably loosely in the plastic sleeves being connected with the upper, more compressible, sleeve by its head, or other means so that punch and stripping forces may be transmitted between the punch and sleeves as in the illustrated embodiments of the invention.

While the invention has been described in connection with particular embodiments thereof, then 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 pair of resilient plastic tubular members mounted one on top of the other and surrounding said punch, at least one of said tubular members having a bore the normal diameter of which is slightly larger than the outside diameter of the portion of said punch which is mounted in the tubular member, thereby providing a normal clearance between the periphery of the punch and said one tubular member, the upper tubular member of said pair of members having a greater compressibility than the lower member, a holder having a bore in which the lower tubular member is reciprocably mounted, said lower tubular member constituting a combined guide sleeve and stripping spring for said punch, means connecting said punch to said upper member so that said members move with said punch on a working stroke until said lower member engages a workpiece, said tubular members being thereafter compressed as said punch passes through said workpiece so that the normal clearance between said one tubular member and said punch is taken up, and said tubular members expanding to their original forms on removal of the punching force thereby to strip said punch from the workpiece.

2. Perforating apparatus comprising a punch, a plurality of bored, resilient, plastic members mounted one on top of the other and surrounding said punch, at least one of said bored members having a bore the normal diameter of which is slightly larger than the outside diameter of the portion of said punch which is mounted in said one bored member, thereby providing a normal clearance between the periphery of the punch and said one bored member, said members having different degrees of compressibility, a holder having a bore in which at least one of said bored members is reciprocably mounted, said last-named one bored member, at least, constituting a combined guide sleeve and stripping spring for said punch, means connecting said punch to said bored members so that said bored members move with said punch on a working stroke until the lowermost of said members engages a workpiece, said bored members being thereafter compressed and distorted elastically as said punch passes through said workpiece so that the normal clearance between the first-named one bored member and said punch is taken up, and said bored members expanding to their original forms on removal of the punching force thereby to strip said punch from the workpiece.

3. Perforating apparatus comprising a punch, a pair of resilient plastic tubular members mounted one on top of the other and surrounding said punch, at least one of said tubular members having a bore, the normal diameter of which is slightly larger than the outside diameter of the portion of said punch which is mounted therein, thereby normally providing clearance between the periphery of the punch and said one tubular member, the upper tubular member of said pair of members having a greater compressibility than the lower member, a holder having a bore in which the lower tubular member is reciprocably mounted, said lower tubular member constituting a combined guide sleeve and stripping spring for said punch, said lower member having a normal outside diameter which is slightly smaller than the diameter of said bore of said holder, means connecting said punch to said upper member so that said members move with said punch on a working stroke until said lower member engages a workpiece, said tubular members being thereafter compressed as said punch passes through said workpiece, and said tubular members expanding to their original form on removal of the punching force to thereby strip said punch from the workpiece, the difference in diameters of said one tubular member and the portion of the punch which is reciprocable therein and the difference in diameters between the periphery of said lower tubular member and said bore of said holder being such that the clearance between the periphery of said punch and the bores of said one member and between the periphery of said lower member and the bore of said holder are eliminated when said members are elastically distorted.

4. Perforating apparatus comprising a punch, a pair of resilient plastic tubular members mounted one on top of the other and surrounding said punch, the upper tubular member having greater resiliency and compressibility than the lower member, said punch having an enlarged head at its upper end, which abuts against said upper tubular member, a holder having a bore in which the lower tubular member is reciprocably mounted, said punch and tubular members being adapted to move together on a working stroke until said lower member engages the workpiece, said tubular members being compressed between said head and said workpiece and elastically distorted as said punch passes through the workpiece, said tubular members expanding to their original form on removal of the punching force to strip said punch from the workpiece.

5. Perforating apparatus comprising a punch, a pair of resilient plastic tubular members mounted one on top of the other and surrounding said punch, at least one of said tubular members having a bore the normal diameter of which is slightly larger than the diameter of said punch, the upper tubular member having greater resiliency and compressibility than the lower member, said punch having an enlarged head at its upper end, which abuts against said upper tubular member, a holder having a bore in which the lower tubular member is reciprocably mounted, said lower tubular member constituting a combined guide sleeve and stripping spring for said punch, the lower tubular member having a normal outside diameter which is slightly smaller than said bore, said punch and tubular members being adapted to move together on a working stroke until said lower member engages the workpiece, said tubular members being compressed between said head and said workpiece and elastically distorted as said punch passes through the workpiece, said tubular members expanding to their original forms on removal of the punching force to strip said punch from the workpiece, the differences in diameters of the bore of said one tubular member and of the portion of the punch which is reciprocable therein and the difference in diameters between the periphery of said lower tubular member and the bore of said holder being such that the clearances between the periphery of said punch and the bore of said one tubular member and between the periphery of said lower member and the bore of said holder are eliminated when said members are elastically distorted.

6. Perforating apparatus comprising a punch, a pair of resilient plastic tubular members mounted one on top of the other and surrounding said punch, at least one of said tubular members having a bore the normal diameter of which is slightly larger than the diameter of said punch, the upper tubular member having greater resiliency and compressibility than the lower member, said punch having an enlarged head at its upper end, which abuts against said upper tubular member, a holder having a bore in which the lower tubular member is reciprocably mounted, said lower tubular member constituting a combined guide sleeve and stripping spring for said punch, the lower tubular member having a normal outside diameter which is slightly smaller than the bore of said holder, said punch and tubular members being adapted to move together on a working stroke until said lower member engages the workpiece, said tubular members being compressed between said head and said workpiece and elastically distorted as said punch passes through the workpiece, said tubular members expanding to their original forms on removal of the punching force to strip said punch from the workpiece, the difference in diameters of the bore of said one tubular member and the portion of the punch which is reciprocable therein and the difference in diameters between the periphery of said lower tubular member and the bore of said holder being such

that the clearances between the periphery of said punch and the bore of said one tubular member and between the periphery of said lower member and the bore of said holder are eliminated when said members are elastically distorted, and a coil spring interposed between said lower tubular member and said holder which constantly urges said tubular members to their normal, at-rest positions, said spring having its lower end connected to said holder and its upper end connected to the upper end of said lower tubular member.

7. Perforating apparatus comprising a punch having an enlarged head at one end and a cutting face at its opposite end, a holder having a bore therethrough, a plurality of bored, resilient, plastic members surrounding said punch and reciprocable in said bore, said members having different degrees of compressibility, the less compressible of said members having an outside diameter normally slightly less than the diameter of the bore of said holder, whereby when a punching force is applied to said punch, the punch and plastic members move together until the plastic member which is disposed adjacent the cutting face of the punch engages the workpiece and thereafter the less compressible of said members is compressed and distorted elastically, as the punch passes through the workpiece, to take up the clearance between said less compressible member and the bore of said holder, whereby said less compressible member acts as a support and guide for the punch as it perforates the workpiece.

8. Perforating apparatus comprising a punch, a holder having a bore therethrough, a plurality of bored, resilient, plastic members surrounding said punch and mounted on top of one another, means connecting said punch to said members so that they move together when a punching force is applied to said punch, alternate plastic members having greater and lesser degrees of compressibility, respectively, at least one of said members being reciprocable in the bore of said holder, said one member being of lesser compressibility, said one member having an outside diameter normally slightly less than the diameter of the bore of said holder, whereby when a punching force is applied to force said punch through a workpiece said plastic members are compressed and said one member, at least, is elastically distorted to take up the clearance between said one member and said holder whereby said one member acts as a guide for the punch as the punch perforates the workpiece, said plastic members expanding upon release of said punching force to strip the punch from the workpiece.

9. Perforating apparatus comprising a holder having a bore therethrough, at least two contiguous, resilient, bored, plastic members, one of said plastic members being more dense and less elastic than the other, said one plastic member, at least, being reciprocable in the bore of said holder, a punch reciprocable in the bores of said plastic members, means connecting said punch to said plastic members so that upon application of a punching force to said punch the plastic members are moved with the punch until the plastic member, which is nearest the workpiece, engages the workpiece, and thereafter the plastic members are compressed as the punch perforates the workpiece, said plastic members expanding upon release of the punching force to strip the punch from the workpiece.

10. Perforating apparatus comprising a holder having a bore therethrough, at least two contiguous, resilient, bored, nylon members, one of said members being made of more dense, less elastic nylon than the other, said one member, at least, being reciprocable in the bore of said holder and normally having clearance with reference to the bore of said holder, a punch reciprocable in the bores of said members, said punch normally having clearance with reference to the bore of at least one of said members, said punch having an enlarged head at its end remote from its cutting face which engages the uppermost of said members so that upon application of a punching force to said punch said members are moved with the punch until the member, which is nearest the workpiece, engages the workpiece, and thereafter said members are compressed and elastically distorted as the punch perforates the workpiece, the normal clearances being such that said first-named one member in its elastic distortion takes up the normal clearance between it and the bore of said holder to support and guide the punch as it perforates the workpiece, said members expanding upon release of the punching force to strip the punch from the workpiece.

11. Perforating apparatus comprising a bored holder, a plurality of axially-aligned, bored members, alternate members having different degrees of compressibility, a punch reciprocable in the bores of said members, at least one of said members being reciprocable in the bore of said holder, said one member having normally clearance with reference to the bore of said holder, and means connecting said punch to said bored members so that said bored members move with said punch on a working stroke until the lowermost of said members engages a workpiece, said bored members being thereafter compressed and elastically distorted as said punch passes through said workpiece whereby said one member fills the bore of said holder to support and guide the punch, and said bored members expanding to their original forms on removal of the punching force thereby to strip said punch from the workpiece.

12. Perforating apparatus comprising a bored holder, a plurality of axially-aligned bored members mounted one on top of the other, one of said members being more compressible than another of said members and at least one of said members being reciprocable in the bore of said holder, a punch mounted in the bores of said members to be reciprocable therein, and means connecting said punch to said bored members so that said bored members move with said punch on a working stroke until the lowermost of said members engages a workpiece, the first-named one member being thereupon compressed as said punch passes through the workpiece, said first-named one member expanding on removal of the punching force thereby to strip said punch from the workpiece.

13. Perforating apparatus comprising a bored holder, a plurality of axially-aligned, plastic, compressible, bored members, a plurality of second bored members alternating with the first-named members, the bores of the second bored members being aligned axially with the bores of the first-named members, at least one of each of said members being reciprocable in the bore of said holder, a punch mounted in the bores of said members to reciprocate therein, and means connecting said punch to said bored members so that said bored members move with said punch on a working stroke of the punch until the lowermost of said members engages a workpiece, the first-named bored members being thereupon compressed as said punch perforates the workpiece, said first-named bored members expanding on removal of the punching force thereby to strip the punch from the workpiece.

14. Perforating apparatus comprising a bored holder, compressible means comprising a plurality of axially-aligned, plastic, compressible, bored members, a plurality of second bored members axially aligned with and alternating with the first-named bored members, the second bored members being less compressible than the first-named bored members and being normally of larger diameter than said first-named bored members, at least one of each of said members being reciprocable in the bore of said holder, a punch mounted in the bores of said members to reciprocate therein, and means connecting said punch to said bored members so that said bored members move with said punch on a working stroke of the punch until the lowermost of said members engages a workpiece, the compressible bored members being thereupon compressed as said punch perforates the workpiece, said compressible bored members expanding on

release of the punching force thereby to strip the punch from the workpiece.

15. Perforating apparatus comprising a bored holder, compressible means comprising a plurality of axially-aligned plastic, compressible, bored members, a plurality of second bored members axially aligned with and alternating with the first-named bored members, the second bored members being also compressible but less compressible than the first-named bored members and being normally of larger diameter than said first-named bored members, at least one of each of said members being reciprocable in the bore of said holder, a punch mounted in the bores of said members to reciprocate therein, and means connecting said punch to said bored members so that said bored members move with said punch on a working stroke of the punch until the lowermost of said members engages a workpiece, the bored members being

thereupon compressed as said punch perforates the workpiece, said bored members expanding on release of the punching force thereby to strip the punch from the workpiece.

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