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G. F. WALES

2,334,138

PUNCHING APPARATUS

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2 Sheets-Sheet 2

Fig. 4.

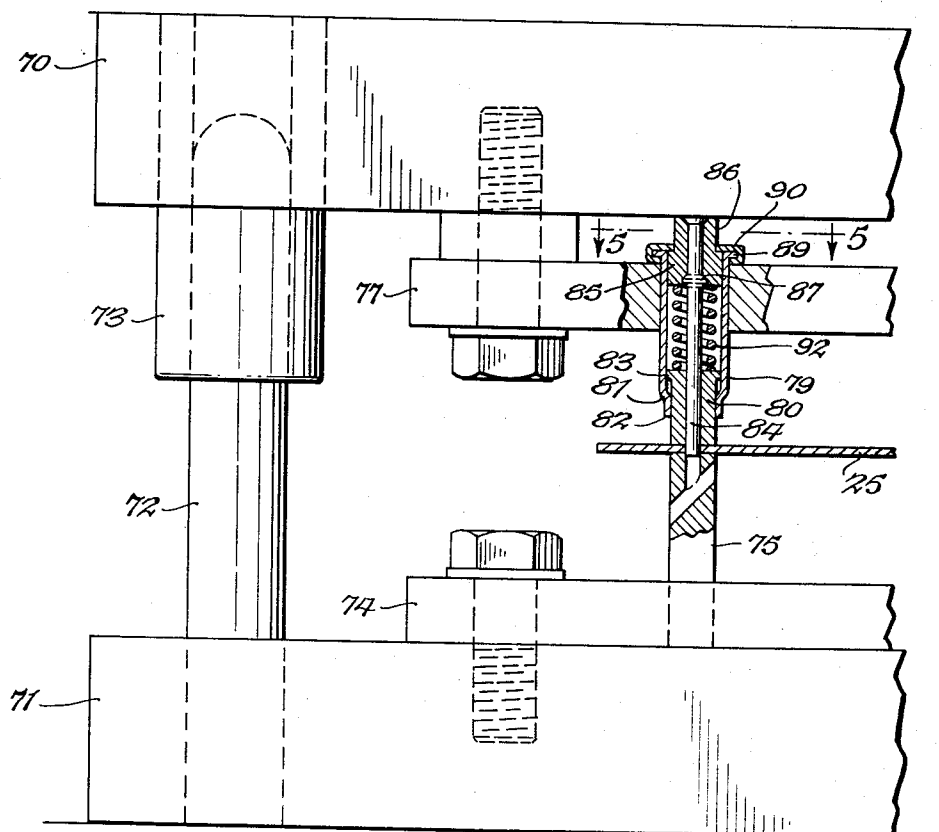
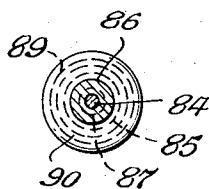


Fig. 5.



INVENTOR
George F. Wales
BY
Parker Prochnow & Garner
ATTORNEYS

UNITED STATES PATENT OFFICE

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PUNCHING APPARATUS

George F. Wales, Kenmore, N. Y.

Application June 17, 1943, Serial No. 491,171

19 Claims. (Cl. 164—90)

This invention relates to an apparatus for punching holes at specified locations throughout the areas of sheets of material such as sheet metal, and is particularly adapted for punching the numerous rivet holes required in the thin metal panels or sheets which are used in aircraft construction to form the outer surfaces of wings, fuselages, and the like, but the invention may be applied to other uses where relatively large numbers of holes are required in panels or sheets of materials. The invention relates particularly to apparatus of this kind in which the punch and die units are arranged on plates mounted for accurate movement toward and from each other.

In my application for patent Serial No. 486,629, I have shown an apparatus which is particularly desirable for use in producing work of which a relatively small number of pieces is required and in which the punch and die plates may be made of non-metallic materials. The present invention deals particularly with apparatus of this kind which is constructed to have a much longer life.

One of the objects of this invention, therefore, is to provide apparatus of this kind which is so constructed that the punch and die plates are not subjected during use to wear resulting from moving parts, so that such plates may be made of non-metallic material and may be used for turning out large numbers of work pieces.

Another object is to produce apparatus of this kind in which the punch units are of improved and compact construction, so that they can be placed closely together. A further object is to provide a punch unit of improved construction comprising a plurality of punches mounted in a single unit. A further object is to provide a multiple hole punching unit of this type which is so formed that its lateral dimensions are substantially the same as those of the hole in the punch plate into which it is pressed, so that there are no lateral projections to interfere with the close spacing of these units.

A further object is to provide punch units of this type in which the punches are simple in construction, economical to make and readily removable and replaceable in the punch units.

It is a further object to provide punching apparatus of this type in which the multiple hole punching unit is of the same size and shape as the cooperating die unit, thus making it possible to prepare the punch and die plates with holes of the same dimensions for accommodation of these cooperating elements.

It is also an object of this invention to provide a device of improved and simplified construction

for stripping sheets of metal or other material from parts of metal working apparatus.

Other objects and advantages of this invention will appear from the following description and claims.

In the accompanying drawings:

Fig. 1 is a fragmentary elevation, partly in section, of a die set having a perforating apparatus embodying this invention applied thereto.

Fig. 2 is a fragmentary sectional plan view, on line 2—2, Fig. 1.

Fig. 3 is an elevation, partly in section, showing a punch unit of slightly modified construction.

Fig. 4 is a fragmentary elevation, partly in section, of a die unit having a perforating apparatus of slightly modified construction applied thereto.

Fig. 5 is a sectional plan view thereof, on line 5—5, Fig. 4.

My improved punching apparatus is intended for use with a die set of any usual or suitable construction, that shown including an upper punch holder 10 and a lower die shoe 11, the die shoe having a plurality of guide posts 12 rigidly secured thereto and arranged to enter into guide holes on the upper shoe 10 for guiding the punch holder for accurate movement toward and from the die shoe. It will, of course, be understood that in the use of this die set, the die shoe 11 will be rigidly secured to the bed of a press and the punch holder will be secured to the movable ram of the press, but none of the parts of the press are shown in the accompanying drawings. A die set of any other suitable or desired construction may be employed.

My perforating apparatus includes a die plate 15 which may be suitably bolted or otherwise secured to the die shoe 11, and a punch plate 16 constructed to be secured to the punch holder 10 of the die set. In some cases, a plurality of spacers 17 are employed for spacing the punch plate 16 at the desired distance from the punch holder, one of these spacers being shown in Fig. 1, but the spacers may be omitted and the punch and die plates mounted in direct contact with the punch holder and die shoe, as shown in Fig. 3.

The punch and die plates may be made of any suitable or desired material, but the apparatus is so designed that these plates may be made of suitable non-metallic materials, in the event that metallic plates are difficult to obtain.

In preparing the plates to receive the punch and die units, the plates are preferably clamped together and a plurality of holes are then drilled through both plates in accordance with the pattern of holes required in the work. After these

plates have thus been drilled, they are separated and some of the holes may be enlarged, if necessary. The die plate may then be provided with die units 20 of any suitable or desired type, those shown being of cylindrical form and having an axially extending die aperture 21 in the upper portion thereof, and an inclined aperture 22 at which the die aperture terminates and through which slugs or punchings may be discharged from the die. The die unit and the hole in the die plate are preferably so formed that each die unit 20 may be pressed into its hole in the die plate, and consequently, when the desired number of work pieces 25 have been perforated, the die units may be removed from the die plate 15 and used on another die plate for perforating other work pieces.

The punch units may be of any suitable or desired construction, but each is preferably provided with an outer shell 26 which houses the parts of the punch unit and guides some of these parts for movement lengthwise of the shell. The shell 26, as shown in the middle portion of Fig. 1 and used for punching a round hole is preferably of cylindrical form and circular in cross section. This shell is provided at one end thereof with a punch guide and stripper member or sleeve 28 which has a sliding fit in the shell and the lower portion of which is of reduced cross sectional dimensions and extends out of the lower end of the shell. This end of the shell is also of reduced diameter, which may, for example, be accomplished by turning in or flanging inwardly this end of the shell, as shown at 30. This reduced end of the shell confines the enlarged portion 29 of this sleeve within the shell.

The guide and stripper member 28 is apertured to cooperate with the work perforating portion of a punch 32, which is arranged within the shell 26 coaxially therewith. The punch is preferably removable lengthwise or axially through the open upper end of the shell 26, but during the operation of the perforating apparatus, the punch remains in fixed relation to the shell. Any suitable means may be provided for confining the upper portion of the punch coaxially in the shell 26, such for example as a bushing 33 arranged in the upper end of the shell 26 and through which the punch 32 extends. The upper end of the punch has a head 34 which may be formed integral with the punch by upsetting the upper end of the punch, to prevent the punch from dropping down through the shell and the stripper member 28. The upper end of the shell may also be turned or flanged inwardly, as indicated at 35, thus confining the cylinder 33 against movement out of the shell.

Any suitable resilient stripping means may be employed to act on the stripper and guide member 28, to urge the same in its end of the shell, as shown in Fig. 1. The resilient stripper member employed in the construction shown is in the form of a coil spring 37 arranged within the shell 26 and interposed between the bushing 33 and the punch guide or stripper member 28.

The punch units described have the advantage that they are of simple and compact construction, and are entirely self-contained and the punches are readily removable therefrom through the upper ends thereof, for sharpening or replacement. The shells of the punch units are of such size that the punch units may be assembled on the punch plate by pressing them into the holes in the punch plate.

It will be obvious that in the operation of a

perforating apparatus, the punch and die units are normally spaced apart to a sufficient extent to permit the work 25 to be readily inserted between the punch and die units of the apparatus. When the ram of the press descends, the punch holder 10 and the punch plate 16 secured thereto move downwardly toward the die 15. After the lower end of the punch unit contacts the upper face of the work 25, then upon further downward movement of the plate 16, the lower ends of the punches 32 will penetrate the work 25 while the stripper and guide members 28 move into their shells, compressing the springs 37. After the punch has penetrated the work, and the punch plate 16 moves upwardly, the pressure of the springs 37 will urge the stripper members 28 outwardly with reference to the shells, thus stripping the work from the punch.

38 represents a ring, which may be arranged about the shell 26 of the punch unit to make sure that the same does not slide downwardly through the hole in the punch plate 16, in the event that the shell of a punch unit fits loosely in its hole in the punch plate. Normally, however, the ring 38 is not necessary, since the shells 26 and their holes in the punch plate 16 are so formed as to produce a press fit. The shells 26 are preferably so arranged in the punch plate 16 that the upper ends of the punch units will engage with the lower face of the punch holder 10 of the die set, but it is not necessary that this be accurately done, since if a punch unit is too low in the plate 16, it will be pressed upwardly at the first punching operation into the position shown in Fig. 1.

By means of the construction described, it will be obvious that during the use of the punching apparatus, there is no movement of the shells 26 relatively to the punch plate 16. Consequently, there is no wear on the punch plate 16 which would tend to enlarge the holes therein, and thus interfere with the proper punching of the work. Since the only movable part of each punch is the stripper member 28, which moves relatively to the shell and the punch, it will be obvious that the apparatus can be used for producing large quantities of work, and when the required number of work pieces of any kind has been produced, the punch and die plates can be readily removed from the die set and replaced by another pair of plates. The punch and die units can then be removed from their plates and used on other plates.

The general principles embodied in the single punch unit described may, with some modifications, be embodied in a multiple punch unit as shown in the right-hand side of Fig. 1, in which construction, three punches are mounted in a single punch unit. In this construction, the punch unit includes an outer shell 42 which is of elongated cross-section, as shown in Fig. 2, and which is constructed to have a drive fit in a correspondingly-formed hole in the punch plate 16. In this construction, a punch guide sleeve or unit 43 is employed, having apertures therein for three punches, the middle punch 44 in the construction illustrated by way of example, being of larger size at the work penetrating end thereof than the other punches 45. The punch guide sleeve or stripper member 43 is mounted to slide relatively to the shell 42 and to the punches. The upper ends of the punches are held in correct relation to each other and to the punch unit by means of a stationary bushing 46 arranged in the upper portion of the shell 42,

and this end of the shell may be flanged inwardly, as shown at 47 to hold the bushing 46 in place. Springs 48 may be arranged about one or more of the punches to strip the work from the punches, only two such springs being shown in the construction illustrated and arranged about the punches 45. In this construction, as in the single-punch construction described, the springs may be under initial compression when the punch unit is assembled.

The multiple punch unit cooperates with a multiple die unit 50 which is provided with three die holes 51 of the sizes of the diameters required for cooperation with the punches 45 and inclined holes of larger diameter 52 are provided which intersect the die holes 51, and which preferably extend in different directions, as shown in Fig. 1, to discharge the punchings from the die.

In order to facilitate the making of the holes in the punch and die plates, I preferably make the multiple die 50 of the same external dimensions as the shell 48, and since both the die unit and the shell are formed for press fits in their holes, the holes in the die plate and punch plate may be simultaneously formed while the two plates are clamped together. For example, when preparing the punch and die plates to accommodate one or more multiple punch units, the first step in forming the holes in the two plates would be to use a drill jig having two holes therein spaced apart to form the two end portions of the elongated holes. After these holes have been formed, the material between the holes may be removed, thus forming the elongated holes which receive the punch and die units. Any other means for forming these holes may, of course, be employed, if desired.

Both the single and multiple punch units described, have the advantage that if the punches become dulled or broken, they can easily be removed by first removing the punch plate 16 from the die set, and then sliding the punches upwardly out of their shells. After the work for which the apparatus was constructed is completed, the punch and die units may be removed from the plates by applying sufficient pressure thereto, and may then be pressed into the holes of other plates to operate on work of another type. It is, of course, also possible that a plurality of sets of holes may be provided in the punch and die plates for a plurality of different types of work, in which case, the punch and die units may either be removed from one set of holes and placed into another set, or, if desired, the punches may be removed from those punch units which are arranged in holes which are not to be used. Without the punches, the punch units, of course, will have no effect on the work except to hold the same on the dies and possibly to assist to some extent in stripping the work from those punches which are used.

In Fig. 3, I have shown a slightly modified form of apparatus. In this construction, the die shoe may be the same as described in connection with Fig. 1. The punch plate 55 is, however, secured directly against the punch holder or shoe 10 of the die set, and when this construction is desired, it is, of course, also desirable to provide shorter punch units. Consequently, in the construction shown in Fig. 3, a shorter shell 56 is provided, in the lower end of which a punch guide and stripper member 57 is arranged for cooperation with a punch 58. The lower end of the shell is turned or flanged inwardly at 59 or otherwise reduced in diameter to confine the stripper member in the

shell and the upper end of the shell is flanged or turned inwardly, as shown at 60, to a larger extent than necessary to accommodate the outwardly flaring upper end 61 of the punch. This flanged-in end of the shell 56 may, consequently, be drilled or machined to provide an axial hole, which in the construction shown is tapering to accommodate the tapering or flaring head 61 of the punch, so as to support the punch axially in the shell 56. In this construction, no bushing is used in the upper end of the shell. A coil spring 65 may be arranged between the flanged-in portion 60 of the shell 56 and the lower end of the spring bears against the stripper or punch guide sleeve or member 57. In Fig. 3, this punch guide sleeve is shown in the position in which it has penetrated the work, and consequently, the stripper or punch guide sleeve 57 is shown in its inner position at which it has slid upwardly within the shell 56 and has compressed the spring 63. The shells of these punch units are also pressed in the holes in the punch plate so that the upper ends of the punch units are flush with the upper face of the punch plate 55.

In the modified form of this invention shown in Figs. 4 and 5, punch units of slightly different construction are employed. The die set includes a punch holder 70 and a die shoe 71, the latter having guide posts 72 secured to the die shoe and which enter accurately formed holes in the punch holder and a boss 73 secured thereto. A die plate 74 secured to the die holder or shoe 71 has dies 75 pressed in holes in this plate, as described in connection with Figs. 1 to 3. 77 represents the punch plate which is mounted in spaced relation to the punch holder of the die set.

The punch units each include a shell 79 having a stripper member 80 arranged in one end thereof. This end of the shell has a turned-in or flanged portion 81, which terminates at its lower end in a cylindrical portion 82 of reduced diameter which serves as a guide for the stripper member 80. The stripper member also has an enlarged or flanged upper portion 83 which is guided for movement in the shell, and which cooperates with the turned-in portion 81 of the shell to limit the extent to which the stripper member may move out of the shell.

84 represents the punch, the work penetrating end portion of which is arranged in the central bore of the stripper member. The punch has a head suitably secured to the other end thereof, the head having a portion 85 which fits snugly within the upper end of the shell 79, and a portion 86 of reduced diameter, which extends beyond the upper end of the shell. The punch extends through an axial hole in the head and, in the construction shown, is secured to the head by means of an enlargement 87 which engages the lower portion of the head, and the upper end of the punch is preferably enlarged or peined over to fit into a recess in the upper end of the head. Any other means for securing the head to the punch may be employed.

The head of the punch may be held in correct relation to the shell in any suitable manner. In the construction shown, the upper end of the shell is turned or flanged outwardly at 89 and a cap 90 is secured to the upper end of the shell, for example, by turning the outer portion of the cap over the flange 89 of the shell. The cap 90 has a central hole or opening through which the reduced portion 86 of the head extends. The cap engages the shoulder of the head which is formed at the junction of the portions 85 and 86 thereof,

and thus confines the head within the shell. 92 represents a resilient stripper member, that shown being in the form of a coil spring, the opposite ends of which bear against the stripper member 80 and the head of the punch. The shell 72 also has a press fit in its hole in the plate 77, and when mounted on punch plates, as shown in Fig. 4, the punch unit operates in the same manner as those in Figs. 1 and 3. It will be noted, however, that this punch unit may also be mounted differently so that the head of the punch is moved downwardly relatively to the shell so that the punch descends and passes through the work while the stripper member remains stationary relatively to the shell.

The constructions described all have the advantage that none of the strains of punching and of stripping the work from the punches are transmitted to the punch and die plates. The punch plates in these constructions are only required to support their own weight and the weight of the punch units mounted thereon. If the punch plates are of very large size, they may be secured to the punch holder at intervals between the ends or sides thereof.

I claim as my invention:

1. A perforating apparatus for use in a die set having a punch holder and a die shoe, said apparatus including a punch plate formed to be secured to said punch holder and having apertures therein formed according to the pattern of holes required in the work, and a die plate formed to be secured to said die shoe, dies rigidly mounted on said die plate, and punch units on said punch plate for cooperation with said dies and each including an outer shell formed for a press fit in an aperture in said punch plate, a punch guide and stripper member guided for movement lengthwise of said shell and having a longitudinal aperture, a punch having the work penetrating end portion thereof extending into said aperture in said guide member and the other end portion thereof held in fixed relation to said shell while penetrating the work, and resilient means in said shell and urging said guide member to move relatively to said shell and said punch in a direction to strip work from said punch.

2. A perforating apparatus for use in a die set having a punch holder and a die shoe, said apparatus including a punch plate formed to be secured to said punch holder and having apertures therein formed according to the pattern of holes required in the work, die means formed to be secured to said die shoe, and punch units on said punch plate for cooperation with said dies, and each including an outer shell having a press fit in an aperture in said punch plate, a punch extending through said shell and having its work penetrating end extending beyond one end of said shell and having its other end arranged to engage said punch holder of said die set, a stripper member guided in said shell for movement relatively to said shell and punch and extending beyond said first mentioned end of said shell for engagement with the work, and resilient means in said shell acting on said stripper member for stripping the work from said punch.

3. A perforating apparatus for use in a die set having a punch holder and a die shoe, said apparatus including a punch plate formed to be secured to said punch holder and having apertures therein formed according to the pattern of holes required in the work, die means formed to be secured to said die shoe, and punch units on said punch plate for cooperation with said dies, and

each including an outer shell arranged tightly in an aperture in said punch plate in position to have the upper end of said punch unit engage said punch holder of the die set, a punch guide and stripper member slidably arranged in the lower portion of said shell, a punch arranged in fixed relation to said shell and having its upper end arranged to bear on said punch holder of the die set and having its lower work penetrating end extending below the bottom of said shell, a punch guide and stripper member arranged in the lower portion of said shell and slidable relatively to said shell and said punch, and a stripper spring in said shell and acting on said member for urging the same into a position in which the lower end of said punch is within said member.

4. A perforating apparatus according to claim 2 in which said punch is slidable out of said first mentioned end of said shell for replacement by another punch and for sharpening, while said unit is mounted on said punch plate.

5. A perforating apparatus according to claim 2 in which said stripper member and said resilient means are secured in their operative positions within said shell and in which said punch is removable through said first mentioned end of said shell.

6. A punch plate for use with die means in a press, said punch plate having a series of holes formed therein in accordance with the pattern of holes required in the work, and a series of punch units each including a shell having a press fit in one of said holes and extending completely through said plate, a punch extending through said shell and having the work penetrating end thereof extending beyond one end of said shell, a stripper member guided for movement lengthwise of said shell and punch and having a work engaging portion extending out of said end of said shell, and resilient means in said shell urging said stripper member toward said end of said shell.

7. A punch plate for use with a perforating apparatus in a press, and having holes formed therein in accordance with the pattern of holes required in the work, punch units for use in said holes and each including a shell formed for a press fit in one of said holes and extending completely through said hole, a punch normally remaining in fixed relation to said shell and having the work penetrating portion extending beyond one end thereof, a guide and stripper member having an aperture into which said work penetrating portion of said punch extends and guided for movement in said shell, and resilient means in said shell and acting on said guide member and urging the same in a direction to strip work from said punch.

8. A punch unit including a stripper member and a stripper spring, a unitary shell arranged about said stripper member and spring and having its ends of reduced diameter to confine said stripper member and spring within said shell, said stripper member having a portion thereof extending beyond one end of said shell and having another portion within said shell for guiding said stripper member for movement lengthwise of said shell, said spring urging said stripper member into its outermost position in said shell, said stripper member and the opposite end of said shell being apertured to receive a punch.

9. A punch unit including a unitary shell having its opposite ends of reduced diameter, a stripper member slidably arranged in one end of said shell and having a portion of smaller cross

sectional dimensions extending beyond one end of said shell, a stripper spring in said shell bearing against the inner end of said stripper member and reacting against the opposite reduced end of said shell, said stripper member being apertured to receive a punch which extends to the opposite end of said shell.

10. A punch unit including a unitary shell having its opposite ends of reduced diameter, a stripper member slidably arranged in one end of said shell and having a portion of smaller cross sectional dimensions extending beyond one end of said shell, a bushing in the opposite end of said shell and held in said shell by said end portion of reduced diameter, a stripper compression spring in said shell between said stripper member and said bushing and urging said stripper member into its end of said shell, said stripper member and said bushing being apertured to receive a punch.

11. A punch unit movable toward and from a die and including a shell, a punch arranged in said shell to remain in fixed relation to said shell during the perforating of the work and having a work penetrating portion extending beyond one end of said shell, a stripper member having a part thereof extending out of said end of said shell, and into which said work penetrating portion of said punch extends, said stripper member having another part within said shell which is guided for movement lengthwise thereof, said shell having an end portion thereof of reduced diameter to limit the extent to which said stripper member may move out of said shell, a bushing at the opposite end of said shell and having a central aperture through which said punch extends, said shell having said opposite end portion turned in and engaging said bushing for confining the same within said shell, and a resilient stripping means arranged in said shell between said sleeve and said bushing.

12. A punch unit movable toward and from a die and including a shell, a punch arranged in said shell to remain in fixed relation to said shell during the perforating of the work and having a work penetrating portion extending beyond one end of said shell, a stripper member having a part thereof extending out of said end of said shell, and into which said work penetrating portion of said punch extends, said stripper member having another part within said shell which is guided for movement lengthwise thereof, said shell having one end portion thereof of reduced diameter to limit the extent to which said stripper member may move out of said shell and having the other end portion thereof turned inwardly, and resilient stripping means arranged between said last mentioned end of said shell and said stripper member for yieldingly urging said stripper member into a position in which the work penetrating end of said punch is arranged within said stripper member.

13. A punch unit movable toward and from a die and including a shell, a punch arranged in said shell to remain in fixed relation to said shell during the perforating of the work and having a work penetrating portion extending beyond one end of said shell, a stripper member having a part thereof extending out of said end of said shell, and into which said work penetrating portion of said punch extends, said stripper member having another part within said shell which is guided for movement lengthwise thereof, said shell having one end thereof restricted in diameter to limit the outward movement of said stripper member, a head on said punch arranged at the opposite end

of said shell, resilient compressible means arranged between said head and said stripper member, and a cap on the other end of said shell for holding said head against movement out of said shell.

14. A punch unit including a hollow unitary shell having its opposite ends of reduced diameter, a stripper member having a portion arranged in said shell for slidable movement relatively to said shell and having a portion extending out of one end of said shell for engagement with the work, a compression spring in said shell urging said stripper member into its outer position in said shell, and a punch having a head, said shell and stripper member being formed to receive said punch and having means cooperating with said head to prevent said punch from dropping through said shell, said punch head cooperating with power actuated pressure means to move said punch and shell toward the work while said stripper member yields on contacting the work and presses the work from the punch upon return movement of said punch unit from the work.

15. A punch unit movable toward and from a die and including a shell, a plurality of punches arranged in parallel and spaced relation to each other in said shell and mounted in said shell to remain in fixed relation thereto during the perforation of the work, a stripper member slidably arranged in one end of said shell and having a portion thereof extending outwardly beyond said end of said shell and having apertures into which said punches extend, a bushing arranged in the other end of said shell and having apertures to receive said punches, and resilient means between said stripper member and said bushing for urging said stripper member into its outer position with reference to said shell.

16. A punch unit movable toward and from a die and including a shell of elongated cross sectional shape, a plurality of punches arranged in parallel and spaced relation to each other in said shell and mounted in said shell to remain in fixed relation thereto during the perforation of the work, an elongated stripper member slidably arranged in one end of said shell and having a portion thereof extending beyond said end of said shell and having apertures for the work penetrating ends of said punches, an elongated bushing in the other end of said shell and having apertures aligned with said apertures in said stripper member to receive the other end portions of said punches, and a stripper spring arranged in the space between said bushing and said stripper member and which is compressed when said stripper member is moved into said shell by contact with the work.

17. A perforating apparatus including a punch plate and a die plate, one of which is formed to be secured to the bed of a press and the other of which is to be moved by the ram of a press, toward and from the first plate, multiple punch and die units of elongated cross sectional shape, said punch unit including a shell of elongated cross sectional shape, a plurality of punches mounted in said shell in parallel spaced relation to each other, and stripping means carried by said shell for stripping said punches from the work, said die having a plurality of holes adapted to cooperate with said punches, said die and said shell being identical in cross sectional shape, said plates having identical holes extending there-through, one of which is formed to have the shell pressed into it and the other of which is formed to

have the die pressed into it, to place said punches in axial alinement with the holes in said die.

18. A device for use in a metal working apparatus comprising a stripper member and a stripper spring, a unitary shell arranged about said stripper member and spring and having its ends of reduced diameter to confine said stripper member and spring within said shell, said stripper member having a portion thereof extending beyond one end of said shell and having another portion within said shell for guiding said stripper

member for movement lengthwise of said shell, said spring urging said stripper member into its outermost position in said shell.

19. A device for use in a metal working apparatus, comprising a stripper plunger and a stripper spring, a unitary shell arranged about a portion of said stripper plunger and about said spring and having its ends of reduced diameter to confine a part of said plunger and said spring within said shell.

GEORGE F. WALES.

CERTIFICATE OF CORRECTION.

Patent No. 2,334,138.

November 9, 1943.

GEORGE F. WALES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 29, claim 1, for "form" read --formed--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of January, A. D. 1944.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.