March 15, 1960 F. M. BELDING 2,928,450

SELF-CONTAINED PERFORATING AND COUNTERSINKING UNIT

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Fig. 1.

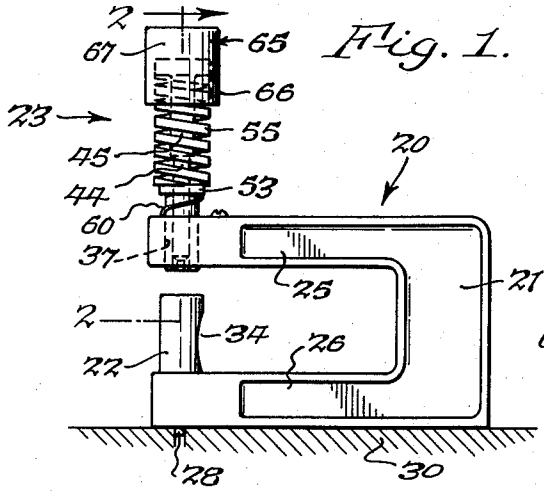


Fig. 2.

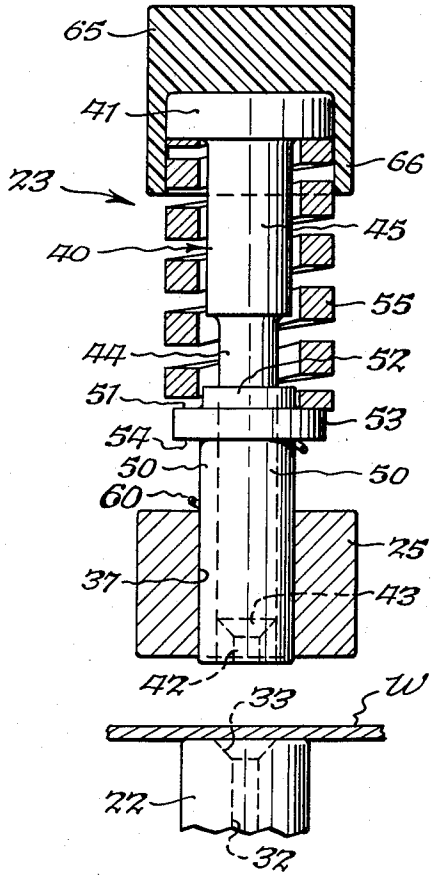
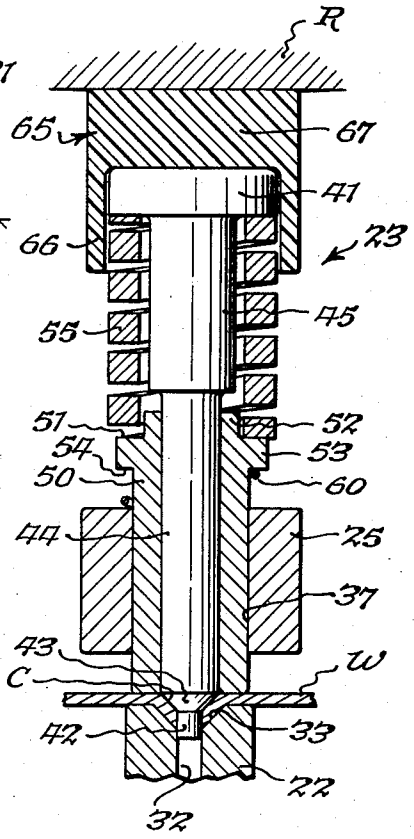


Fig. 3.



INVENTOR.
Francis M. Belding
BY
Attorney.

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SELF-CONTAINED PERFORATING AND COUNTERSINKING UNIT

Francis M. Belding, Kenmore, N.Y., assignor to Wales-Strippit Corporation, North Tonawanda, N.Y., a corporation of New York

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1 Claim. (Cl. 153—21)

The present invention relates generally to self-contained perforating units, and more particularly to a self-contained perforating unit adapted to punch and countersink a hole simultaneously.

Devices of the type disclosed herein have been needed for some time by the sheet metal industry where it is often desirable to punch a hole and countersink simultaneously; for with a self-contained perforating unit that will punch and countersink a hole simultaneously need for composite or progressive dies will be avoided. With these dies the holes must first be punched and then these holes must be accurately registered with the countersinking unit in order to countersink the holes. Heretofore, however, where attempts have been made to use a self-contained unit for simultaneously punching and countersinking a sheet metal piece, the punch has had to be solid enough to perforate the workpiece, which has meant a substantial column. This, in turn, has meant that when the countersinking portion of the punch is bottomed, the punch itself seats against solid metal; and the pressure of the press ram on the punch is transmitted directly through the punch to the die of the unit and to the bed of the press. As a result, extremely high stress levels are produced in the punch, with consequent failure of the mechanism, and in particular of the punch. Generally, the life of conventional self-contained perforating units for punching and countersinking a hole simultaneously, has been extremely short.

In some instances, stop-blocks have been used on the press to prevent overloading the punch members. When stop-blocks are used, however, the high forces developed are usually transmitted to the press itself because a press by nature is a piece of heavy equipment and cannot be accurately set to stop on its downward stroke within precise limits.

Despite their short life and other disadvantages the use of conventional perforating units for punching and countersinking has been justified because of the reduction in overall cost as compared with the cost of the complex dies required where punching and countersinking are effected progressively.

One manner in which overloading of the punch member can be prevented in a perforating-countersinking unit is through the use of resiliency somewhere in the system.

In the Wales U.S. Patent No. 1,955,866, granted August 24, 1934, for instance, there is shown a self-contained unit which is intended primarily for perforating workpieces. On occasion, however, this type unit has been used for perforating in a countersinking application, for in many instances it is possible to do the countersinking without failure of the unit, because the spring-stripper provides the unit with the required compensating resiliency. Since it is difficult, however, to hold a tool, which has to both perforate and countersink, very accurate in length, that is, to an accuracy of less than .001", and since it is also extremely difficult to adjust the shut height of the press close enough so that simultaneous perforating and countersinking can be done without a high rate of failure of the punches, the problem is presented of achieving resiliency in such way that sufficient force can be transmitted to the punch member to enable it to perforate and countersink a workpiece, while preventing a buildup in stress levels to a point where, because of overtravel of the press ram, inaccuracy in the length of the punch, or the like, the punch will be fractured. In the past all attempts to use, for this purpose, rubber or other resilient devices have failed. This is because such high forces must be transmitted through the resilient medium, that the resilient member had to be so large that it has rendered the unit itself impractical. Moreover, none of the resilient mediums heretofore available were suitable for the purpose. As a result, in most instances it has been preferred to overload the punch or the stop blocks, and to replace these parts when they failed.

When stop blocks are used, however, extreme accuracy in manufacture of the punching units is still required to control the distance from the head to the countersink very accurately, as well as the height of the die member, and of the holder to which the unit is attached. Tolerances in the neighborhood of .0002" are necessary on these parts of the unit to prevent excessive buildup in stress levels with resultant early failure of the units. Even when such close tolerances are maintained, poor countersinking by some of the units, where a multiple unit set-up is used, sometimes occurs because of this .0002" tolerance.

An alternative, when a number of perforating and countersinking units are to be used for simultaneous operation on a workpiece, is to take the units after they have all been assembled and to grind the punches to the same identical lengths, when closed. This is time-consuming and costly, and prevents the interchangeability of punches and other parts, normally associated with a mass production operation.

One object of this invention is to provide a non-bottoming perforating-countersinking unit.

Another object of this invention is to provide in a countersink type of perforating unit means for compensating for a buildup in tolerances in the several parts of the unit.

Another object of this invention is to provide perforating-countersinking apparatus in which commercial parts may be used to provide a non-bottoming perforating unit.

Another object of the invention is to provide a countersink type of perforating unit, which will eliminate failure of punches when a plurality of them are used simultaneously for multiple punching-countersinking operations on a workpiece.

Another object of this invention is to provide perforating-countersinking apparatus of the character described which has incorporated therein resilient means for preventing excessive buildup in stress levels.

Another object of this invention is to provide perforating-countersinking apparatus which will have a vastly longer life than similar units of prior design, but which at the same time will be reasonable in cost.

Other objects of this 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 of a perforating unit constructed according to one embodiment of this invention, the unit being shown with the tool in withdrawn, non-working position;

Fig. 2 is a fragmentary section taken on line 2—2 of Fig. 1 looking in the direction of the arrows, illustrating on an enlarged scale the structure of the punching, countersinking assembly and showing a workpiece dis-

posed on the die in position to be punched and countersunk, the punch and the parts associated therewith being shown in withdrawn, non-working position; and

Fig. 3 is a section, similar to Fig. 2, but showing the positions of the parts on completion of a working stroke of the punch.

Referring now to the drawing by numerals of reference, 20 denotes generally a self-contained perforating-countersinking unit constructed according to one embodiment of this invention. The unit comprises, generally, a C-frame 21, a die member 22 and a punch-countersink-stripper assembly 23. The C-frame 21 has an upper arm 25, in which the punch-countersink-stripper assembly is mounted, and a lower arm 26 on which the die is mounted. The lower arm 26 has a pilot pin 28 projecting downwardly from its underside. Pin 28 is adapted to engage a hole in the bed 30 of the press, on which the unit is used, to thereby properly locate the unit on the bed.

Die member 22 has a central bore 32 formed with a conical portion 33 at its upper end, and communicating with a discharge chute 34 through which slugs punched from a workpiece W may be discharged.

The punch-countersink-stripper assembly 23 comprises the tool 40, the tubular, combined stripper and guide member 50, a coil spring 55; and a secondary lifter spring 60. Member 50 is reciprocable in bore 37 of the upper arm 25 of holder 21. Coil spring 55 surrounds the tool 40 and the upper, neck portion 52 of stripper 50, and is interposed between the head 41 of the tool and the upper face 51 of a collar 53 formed on the stripper 50. Lifter spring 60 surrounds the stripper sleeve 50 and is interposed between the lower face 54 of this collar and the upper surface of arm 25. Lifter spring 60 acts to hold the assembly 23 in raised position (Figs. 1 and 2) to provide clearance for the insertion of workpiece W between the tool and die.

Referring now to Fig. 3 it will be noted that the tool or punch member 40, instead of having just a punch tip 42 on it, has also a conical countersink portion 43 formed thereon above punch tip 42. Countersink portion 43 is complementary to the mating countersink portion 33 formed in the die member 22. Countersink portion 43 connects the tip 42 of the tool with the shank 44 of the tool. The shank 44 is mounted to reciprocate in and to be guided by the bore of stripper sleeve 50. Above the stripper sleeve the tool shank is of increased diameter as denoted at 45. Portion 45 of the tool shank connects with the tool head 41.

In operation, the tool 40 descends and its part 42 punches a slug out of the workpiece into the die; after which continued downward movement of the tool causes the tapered countersink portion 43 of the tool, in cooperation with the conical recess 33 in the die, to form a countersink C in workpiece W. This latter is the operation that has caused the difficulties heretofore in achieving a practical tool for simultaneously punching and countersinking a workpiece. It will be obvious that, if the ram R of a press engages directly with the head 41 of the punch, the height of the arm 26, the height of the die 22 above its seat on arm 26, the height or length of the tool 40, and the height of the stripper 50 must be held to absolute accuracy to avoid a buildup in tolerance from one part to the other under the ram. Obviously this is a physical impossibility and variations in total height as high as .005" occur even with the most accurate manufacture.

Where there are a plurality of holes to be punched and countersunk simultaneously in a workpiece by a plurality of perforating units, it may become necessary even to grind the heads of the punches so that they are all engaged simultaneously by the ram, but this renders the punches no longer interchangeable. Even grinding of the heads of the punches may be of no avail if the ram of the press has a taper or belly in it on its lower face. Moreover, as previously stated, it is extremely difficult

to accurately adjust the stroke of the ram of a heavy punch press, capable of producing say a two hundred ton force, within a few thousandths of an inch. That is why, as stated above, it has been necessary in the past to put heavy stop blocks in the press to prevent the ram from overloading the perforating units. However, as also stated, this simply transfers the stress from the punch member to the bed and ram of the press, often causing failure of the press.

The difficulties and disadvantages of previous apparatus may be avoided in the perforator-countersinker of the present invention by providing punch-stripper assembly 23 with a cap member 65 which is adapted to be engaged by ram R (Figs. 2 and 3) of the press. Cap 65 is made of a resilient material, preferably nylon. It is formed with a skirt portion 66, which nests over the punch head 41 and the upper end of stripper-spring 55. Skirt 66 has an inside diameter equal to or even slightly less than the outside diameter of head 41 and of spring 55. Thus, when it is pressed onto the head 41 and spring 55 it will grip the peripheries of these parts and stay in place. As a result, when the implement is transported there is no danger of cap 65 falling off.

On punching and countersinking operations, the elastic member 65 serves to transmit the force of the ram R to the punch head 41; and at the same time it provides resiliency between the ram and the punch. If the stroke of the ram is in excess of that proper for the length of the punch, or if a punch in a multiple perforating tool set-up happens to be more than the desired length, the cap will deflect and distort to absorb the excess stroke of the ram as shown in Fig. 3 where it will be seen that the cap has been distorted so that its head portion 67 is reduced in thickness and its skirt portion 66 is expanded so that it no longer hugs tool head 41 and spring 55. The plastic cap 65 will therefore transmit the pressure required to press the countersink 43 of the tool into the work piece while at the same time providing sufficient elasticity to insure that a safe limit stress on the machine tool elements will not be exceeded. In other words, the plastic cap 65 is, in effect, a safety valve preventing overload of the tool 40 or of the press from the perforating forces.

When the ram R is retracted upon completion of its working stroke, the stripper spring 55 expands in the usual fashion to strip the tool from the work; and then the lifter spring 60 lifts the whole tool-stripper assembly 23 back to the position shown in Figs. 1 and 2. The cap 65 returns to its normal shape, skirt 66 again gripping head 41 and spring 55.

The apparatus described will perforate and countersink a workpiece, simultaneously, with a degree of accuracy and efficiency heretofore unattainable. The resilient member 65 in the implement transmits the working force and at the same time positively prevents excessive build up in stress levels in the punch-countersink member. This means that the implement will have a long life. The use of stop-blocks on the press is no longer required. Also, any necessity for grinding individual punches in an assembly operation is likewise eliminated, thus permitting interchangeability of parts. Further, the cost of manufacturing the implements is greatly reduced because extremely close tolerances need not be maintained. Nylon member 65 need not be precision made. A commercial part constructed with approximately the desired length and diameter is sufficient, as is apparent from the foregoing description.

While the invention has been described in connection with a specific embodiment thereof, it will be understood that it is capable of 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 may be

applied to the essential features hereinbefore set forth and as fall within the scope of the invention or the limits of the appended claim.

Having thus described my invention what I claim is:

A self-contained implement for use in a press for simultaneously punching and countersinking a workpiece, comprising a C-frame having upper and lower arms, a die mounted on said lower arm, a stripper sleeve reciprocably mounted in a bore in said upper arm in axial alignment with said die, a tool reciprocable in said sleeve, said tool having a shank portion of one diameter slidably guided in said sleeve, a punch bit of reduced diameter at its lower end, a conical countersink portion connecting said punch bit with said shank portion, and an enlarged head at its upper end, said die having a bore, to receive said punch bit, which has a conical portion at its upper end to cooperate with the conical countersink portion of said tool, a coil stripper-spring interposed between said stripper sleeve and said head, and a compressible, distortable, resilient plastic cap mounted on top of said head, said cap having a depending skirt which surrounds the periphery of said head and the upper end of said spring, and which resiliently embraces said spring in the normal position of said cap but which is free thereof, said cap being adapted to transmit the working force of the press to said tool, said cap being distortable and deflectable to protect the tool from being over-stressed, said skirt expanding away from said head and from said spring when said cap is distorted.

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