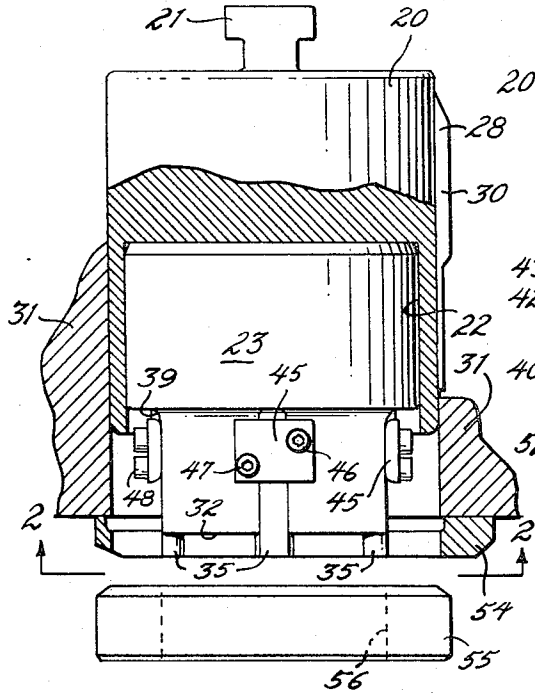
Oct. 24, 1967 W. M. SMITH ETAL 3,348,443

SHEARPROOF METAL PUNCH

Filed Jan. 24, 1966 2 Sheets-Sheet 1

Fig. 1.



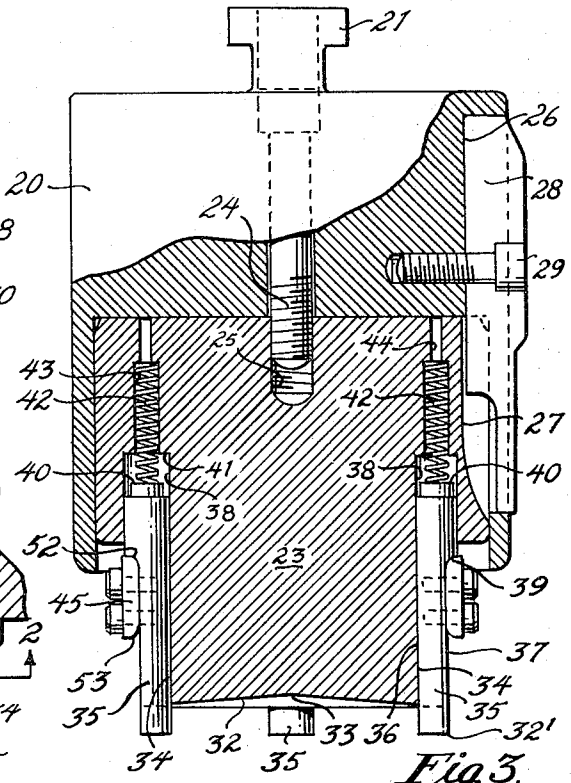


Fig. 3.

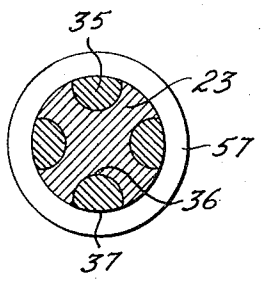


Fig. 8.

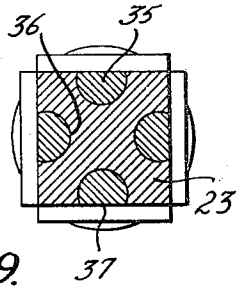


Fig. 9.

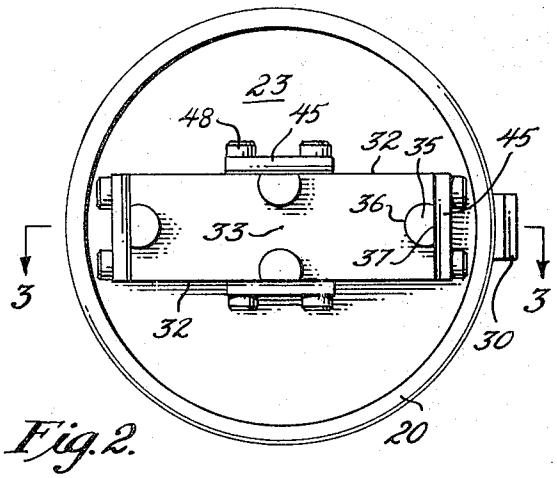


Fig. 2.

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Fig. 5.

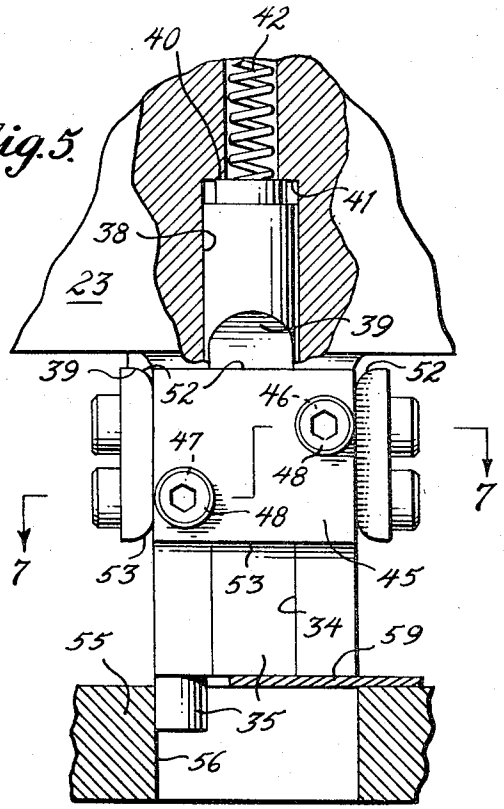
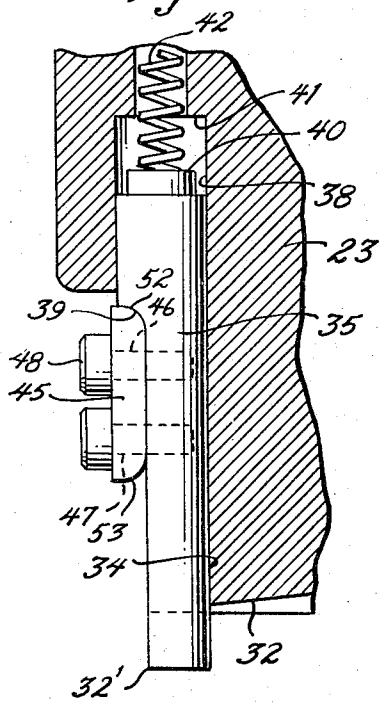


Fig. 4.



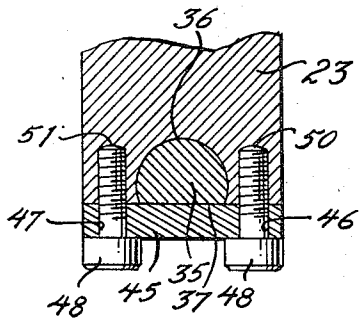


Fig. 7.

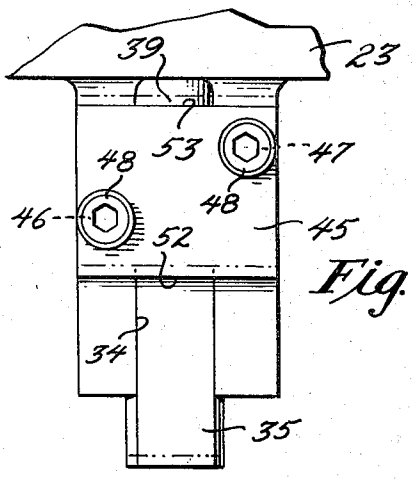


Fig. 6.

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3,348,443

SHEARPROOF METAL PUNCH

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Filed Jan. 24, 1966, Ser. No. 522,479
10 Claims. (Cl. 83—686)

This invention relates to improvements in a device for punching sheet metal and more particularly to an improvement in the manner of constructing the male member of such a device.

In punching operations and more particularly when notching or slotting a piece of sheet metal with only a portion of the male member of a punch, the punch will be deflected to a certain degree in a direction away from the workpiece. This has been obviated in the past in order to prevent damage to the female member or die of the punch by providing depending guides or heels yieldably and slidably mounted in advance of the punch that enter the die prior to the entrance of the punch. The heels are provided with a cutting edge that aligns itself with the cutting edge of the punch by sliding with respect to it, when their advanced position is arrested by a workpiece.

When so arrested, the heels move up and retract along the body of the punch seating against an abutment at their opposite end so as to form a continuous cutting edge along the bottom of the punch, where the work is to be cut. Hence, in notching some guides will contact the work and retract into alignment whereas others will remain extended and enter the die ahead of the punch. When the punch and those retracted guides strike the workpiece, the guides that had remained extended and had entered the die ahead of the punch will now prevent it from being deflected. Punching machines constructed in this manner are shown for example in U.S. Patents Nos. 2,341,976 and 2,997,907 to F. Constantino and 3,086,418 to J. E. Levine.

These heels or guides ride in channels on the sides of the male punch body and form a continuous contour on the outer vertical sides of the punch. In their normal position, the heels depend from the punch a given distance, which must be exactly equal to the distance that they can travel within the punch body before striking the abutment. This is to assure that the cutting edge of the heel will be aligned with that of the punch. A suitable spring bias means within the body of the punch is conventionally used to hold the heels in an extended or advanced position.

One way of accurately maintaining the length of advancement of the heels has been to provide a valve type of head on the heels that seats in a chamfered seat in the body of the punch. The spring bias above referred to, used to keep the heels seated, is disposed between the head of the heel and the abutment in the punch body. When the heel strikes a piece of work it moves upwardly against the spring until the head of the heel reaches the abutment.

However, in using a valve seating arrangement to control the length of dependency of the heels, the head of the heel and the aperture through which it travels must of necessity be of greater dimension than that of the body of the heel. This creates a number of disadvantages in a punching machine, one important one being that the heels must be mounted into openings in the top of the punch body. This necessitates constructing the punch body out of at least two parts since an abutment surface for the heel must be provided above these openings. Additionally, since permanent seats within the body of the punch must be provided, the length of extension of the heels will always remain constant, thus making it unadjustable for

different die depths. Furthermore, a valve seat requires machining of all surfaces and necessarily increases the cost of manufacture. Additionally, when the heels retract to form a continuous cutting edge, the narrow body of the heel will be in the larger aperture through which the head of the heel travels and hence will not have full support along its entire length when being used as a cutting element. This tends to make the heel wobble, which will alter the continuity of the cutting edge of the punch and create an uneven notch in the workpiece.

Accordingly, it is an object of this invention to provide an improved guided male punch member for a shearproof metal punch.

It is a further object of this invention to provide a punch with retractable depending guides or heels that is simplified in construction, less expensive to manufacture and to operate and more accurate and more readily adjustable than heretofore possible in a shearproof punch.

A further object of this invention is to provide retractable heels for a shearproof punch wherein the heels are headless, having a straight shaft which permits them to be inserted into the punch from the operating end of the punch.

A further object of this invention is to simplify construction of a punch by providing straight heels for the punch to eliminate the necessity of constructing the punch out of a plurality of parts.

A further object of this invention is to provide full support along the entire sides of the heels when in all operating positions.

A further object of this invention is to provide a means for readily adjusting the depth of penetration of the guides or heels for different die depths.

A further object of this invention is to eliminate the cost of machining and fitting necessary in the accurate positioning of the valve type of headed heels.

These and other objects will become apparent from the following description of the drawings wherein like numbers designate like parts.

FIGURE 1 is a vertical plan view of a shearproof punch assembly partially in section.

FIGURE 2 is an enlarged bottom plan view of the rectangular male punch member taken along the line 2—2 of FIGURE 1.

FIGURE 3 is a vertical sectional view taken along the line 3—3 of FIGURE 2 of the male punch only.

FIGURE 4 is an enlarged fragmentary sectional view of a heel or guide constructed according to the objects of this invention.

FIGURE 5 is a fragmentary side view partially plan and partially in section of a square punch assembly, the punch in a position just prior to notching the workpiece interposed between the punch and the die.

FIGURE 6 is a fragmentary vertical plan view of a square male punch member showing the retaining plate reversed for altering the length of extension of the heel.

FIGURE 7 is a fragmentary broken sectional view taken along the lines 7—7 of FIGURE 5.

FIGURES 8 and 9 are horizontal sections through alternative punch shapes suitable for use with this invention.

Referring to the drawings and in particular FIGURE 1, there is depicted in vertical section a shearproof punch embodying the objects of this invention. A shearproof punch suitably includes a punch holder **20** having an extension **21** for mounting into a tape controlled turret mechanism. While the punch will be described for use with such an automated punching machine, it will be understood that the invention is applicable to any type of punching apparatus from a hand operated punch to a complex fully automatic system.

Mounted within an aperture **22** of the punch holder is the main body of the punch **23**. The punch may be secured to the holder in any desired manner, such as by bolt **24** threaded into the body at **25** suitably holding it rigidly within the holder.

To accurately position the punch within the holder, a slot **26** in the holder is aligned with the slot **27** in the punch by means of a key **28** extending through both slots. The key also includes an extension **30** for accurately positioning the entire punch holder with respect to a stationary guide **31** when the turret swings into punching position. The screw **29** holds the key in the slot **28** of the holder. By providing a punch holder **20** the main body **23** of the punch can easily be replaced by removing bolt **24** when a different size is needed or if it has become dulled or broken.

The punch body **23** has fixed cutting edges **32** along the bottom of the punch, the bottom slanting inwardly and upwardly from all sides to a point **33** in the middle of the punch. Disposed along the sides of the punch and slidably mounted within channels **34** of the punch are guide members or heels **35**. These heels include a semi-cylindrical side **36** adapted to slide within these channels **34**, the opposite side **37** of the heels that is exposed, conforming to the outside surface of the punch body whether it be flat or cylindrical so as to provide a continuous outer surface for the punch. These heels extend into the body of the punch through apertures **38** and at this point the heels become fully cylindrical. The change from semi-cylindrical to cylindrical creates a lip **39** which is suitably rounded. The top surface **40** of the heel is adapted to abut against the bottom **41** of the apertures **38**. Springs **42** are seated in wells **43** within the punch body and ride against the top surface **40** of the heels so as to yieldably keep the cutting edges **32'** of the heels in advance of the cutting edges **32** of the punch body **23**. Small access holes **44** are provided in the top of the punch body to aid in the removal of the springs when necessary.

The straight headless heels are maintained within their channels by retaining plates **45** having holes **46** and **47** therein for slidably securing the plate to the punch using suitable cap screws **48**, threaded into holes **50** and **51** in the punch as shown in FIGURES 5–7, disposed on either side of the channels **34**. The retaining plates have a rounded edge **52** that mates with the lip **39** of the heel, acting as the seat for the heels to accurately position the length of extension of the heels. There is also provided a similar rounded corner **53** on the opposite side of the plate also adapted to fit under the lip **39** of the heels **35**.

These two rounded corners are provided so as to give adjustability to the punch for while the holes **46** and **47** in the plate are equally spaced from the center of the channel **34**, hole **46** is a greater distance away from the edge **52** than is hole **47** away from the edge **53**. Thus the retaining plates may be turned over and resecured to the punch with edge **53** now engaged by the lips of the heels as shown in FIGURE 6. The heels would thus extend a greater distance in advance of the punch than when the edge **52** was used as a stop for the lip. This would be utilized when thicker material is to be punched so that those heels not arrested by the material will still enter the die before the actual cutting of the material begins. Since the length of the heels has not changed, the space between the abutment **41** and the top surface **40** of the heel will increase the same distance as the heels have been advanced by reversing the plates. Hence, if the heel strikes a piece of work its cutting edge will retract and still be in perfect alignment with the cutting edges of the punch. When chamfered seats and heads were provided on the heels, the only way to adjust the depth of penetration of the heels in a die was to disassemble the punch, remove the heels and insert longer ones. By providing headless heels their length of dependency can easily be adjusted merely by reversing the retaining plates so that the opposite edge of the plate now rests under the lip of the heel.

Surrounding the punch of the die is a stripper **54** integrally connected to the guide **31** that remains rigid with respect to the movement of the punch and punch holder. The stripper prevents the workpiece from being pulled up by a retracting punch member. Positioned below the punch is a die **55** having an aperture **56** therein adapted to cooperate with the punch and the heels in a punching operation. When a piece of work or material is to be notched, nibbled at or punched out, the die holder **20** is caused to move downwardly in response to suitable controls causing the male punch **23** to move toward the die member. Since the heels **35** are yieldably positioned in advance of the punch they will enter the die ahead of the punch if not obstructed by a workpiece **59**. As stated above, this prevents the punch from being deflected when only a portion of it strikes the workpiece when notching or nibbling. In those areas where the heels strike the work, they will be retracted against the compression of the spring until their cutting edge is aligned with the cutting edge of the punch, thus providing a continuous edge for cutting, as shown in FIGURE 5. If the punch moves downwardly and there is no work to be punched, all of the heels will enter the die in advance of the punch. If, on the other hand, a hole is to be punched in the interior of a piece of work, all of the heels will strike the work and hence all will retract to form a continuous cutting edge around the whole bottom of the punch. Reference is again made to the above identified patents with respect to the operation of the punch.

The use of the headless heels as the guide members for the punch permits the punch body to be constructed out of one piece eliminating errors accumulated in prior art devices caused by an assembly of various parts. The simplified design of the shearproof punch now consists merely of the punch body, the heels and the heel retaining plates. When heels with heads were used, it was necessary to construct the punch in two sections as access to the top of the apertures **38** was necessary for sliding the heels into place. The springs then had to be mounted in the second piece, or adaptor placed above and secured to the main body of the punch. This assembly of parts was then placed within a conventional punch holder **20**. However, by using straight or headless heels that can be slid into the body of the punch from below, the punch can now be constructed of a single piece. This, of course, also reduces manufacturing costs which included machining of the various sections so as to achieve the desired fit between them and also a reduction in assembly time of up to 40%, resulting in a lower cost for manufacture of the shearproof punch.

A punch utilizing straight heels was tested on a piece of mild steel and after 2,000 and 8,000 punches using all heels contiguous with the body of the punch no noticeable wear on the punch heels was detected.

Since the function of the retaining plates is to keep the heels within the channels and to restrict the extension of the heels, no direct force is applied against the plates during the actual punching operation. However, the force of the spring element returning the heel to an extended position after it has been retracted can create fatigue in the bolts **48** holding the retaining plates to the sides of the punch. Accordingly, it was found that a minimum screw or bolt size of approximately No. 8–32 was necessary to insure proper retention of the plates. However, smaller bolts or screws could be used if other elements such as dowels between the plate and the punch were provided to take all of the load off the bolts.

The heels of this invention may be used in square, as shown in FIGURE 9, rectangular, triangular or any polygonal shaped punches. It is to be understood that the invention is also applicable to round dies wherein a circular retaining ring **57** as shown in FIGURE 8 or a series of arc shaped retaining plates would be used to hold the

heels in place. A series of holes may also be provided within these circular plates in order to permit adjustment of the extension of the heels as described above.

In view of our invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of our invention without copying the structure shown, and we therefore claim all such insofar as they fall within the reasonable spirit and scope of our claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. A male punch member having cutting edges with a plurality of channels vertically disposed around the sides of the punch, comprising a plurality of retractable elements having a cutting edge on each element slidably mounted within the channels of the punch, resilient means acting from the punch yieldably maintaining the cutting edges of the elements in advance of the cutting edges of the punch, said elements entering a female die, adapted to cooperate with the male punch member, in advance of the member when not arrested by a workpiece in order to prevent deflection of the punch member, the elements retracting to align their cutting edges with those of the punch when arrested by a workpiece, wherein the slidable elements have straight sides along their entire length where slidably engaged with the punch and seating means for the elements limiting their length of advancement.

2. A male punch member according to claim 1, including apertures within the body of the punch cooperating with and comprising extensions of the channels of the punch, wherein the straight slidable elements include a semicylindrical portion riding in the channels and a cylindrical portion integral therewith extending into the apertures of the punch, the transition from semicylindrical to cylindrical creating a lip engaged by the seating means to limit the length of advancement of the elements.

3. In a punch according to claim 2, wherein the exposed side of the elements riding in the channels substantially conforms with the vertical sides of the punch forming the semicylindrical portion of the elements and the lip.

4. In a punch according to claim 3, wherein the seating means comprises a plate secured to the side of the punch across the channels, said plate having an edge adapted to mate with and seat under the lip of the elements.

5. In a punch according to claim 4, wherein the plate has a plurality of edges adapted to seat against the lip of the elements, capable of being secured to the punch in different positions thereby altering the length of advancement of the elements.

6. In a punch according to claim 4, wherein the plate has a plurality of edges adapted to seat against the lip of the elements and has apertures therein spaced at equal distances from the center of the plate but at different distances from the edges of the plate, the apertures cooperating with retaining means in the sides of the punch, whereby the plate can be secured to the punch through these apertures in different positions to alter the length of advancement of the elements.

7. A four-sided right angled male punch member having cutting edges on its operating face having channels vertically disposed and extending from the operating face upwardly along all sides of the punch into apertures within the body of the punch remote from the operating face, a plurality of retractable elements having a cutting edge thereon, each element comprising a semicylindrical portion riding in the channels of the punch, the exposed surface of the elements conforming to the vertical sides of the punch, and a cylindrical portion integral therewith riding in the apertures, a plurality of wells in the punch extending beyond the bottom of the apertures, spring means disposed in each well acting against the elements yieldably maintaining the cutting edges of the elements in advance of the cutting edges of the punch, said elements entering a die, adapted to cooperate with the male punch member, in advance of the member when not arrested by a workpiece to prevent deflection of the punch member, the elements retracting to align their cutting edges with those of the punch when arrested by a workpiece, wherein the retractable elements have straight sides along their entire length where engaged with the punch, the transition from the exposed conforming side of the semicylindrical portion of the elements to the cylindrical portion creating a lip and retainer plates secured to the four sides of the punch across the channels having an edge adapted to seat the lip of the element to limit the length of advancement of the cutting edge of the elements.

8. In a punch according to claim 7, wherein the punch has a rectangular operating face and one channel and one retractable element vertically disposed the channel in the center of each vertical side of the punch.

9. A punch according to claim 7, having a square operating face with one channel and one retractable element vertically disposed in the channel in the center of each vertical side of the square punch.

10. A punch according to claim 7, wherein the retaining plate has a plurality of the edges adapted to seat the lip of the element, the plate having means for securing it to the punch in different positions to alter the length of advancement of the elements.

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JAMES M. MEISTER, *Primary Examiner.*