Nov. 25, 1947. J. F. KOPCZYNSKI 2,431,566

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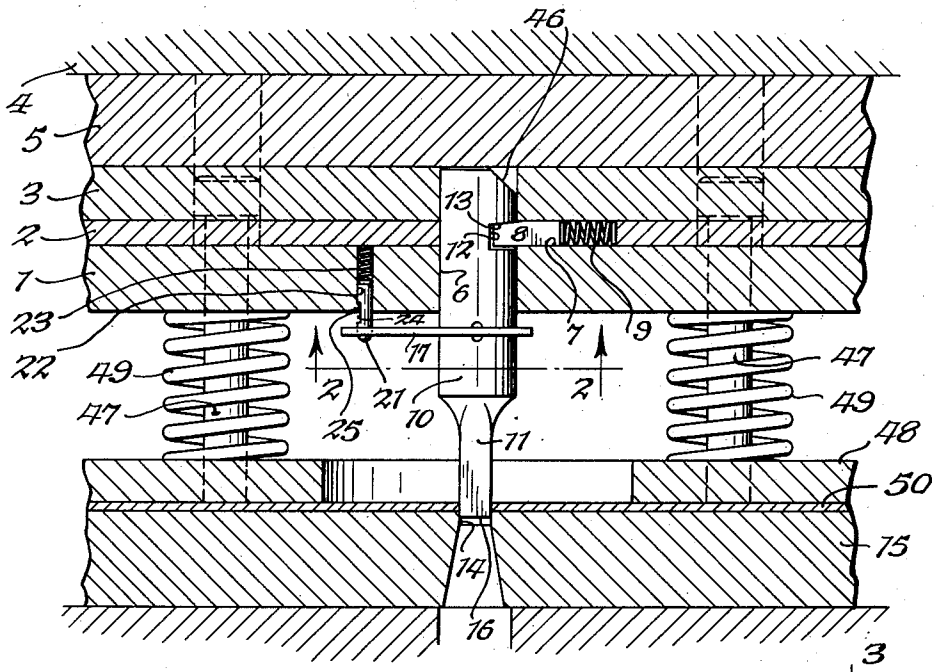


Fig. 1.

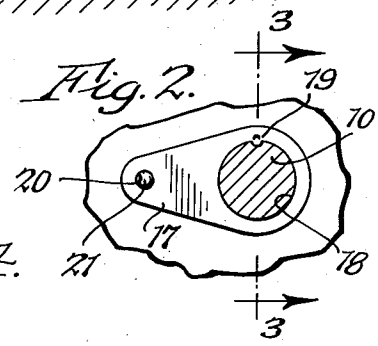


Fig. 2.

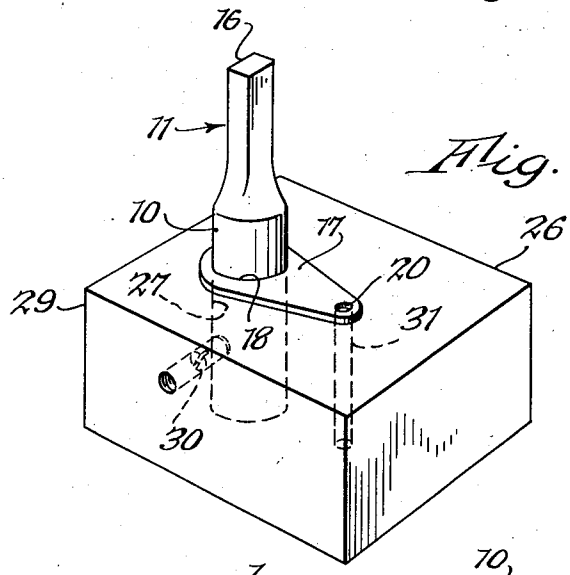


Fig. 4.

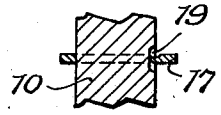


Fig. 3.

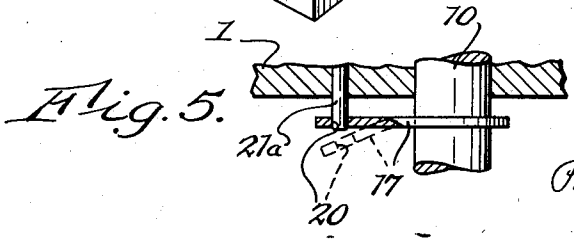


Fig. 5.

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Fig. 6.

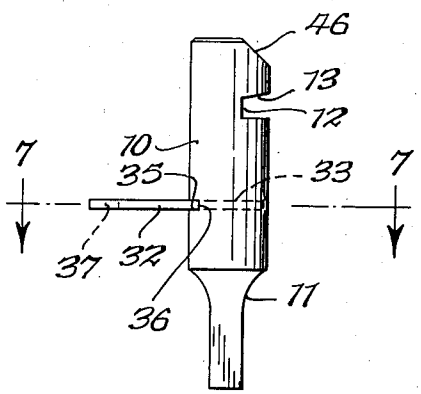
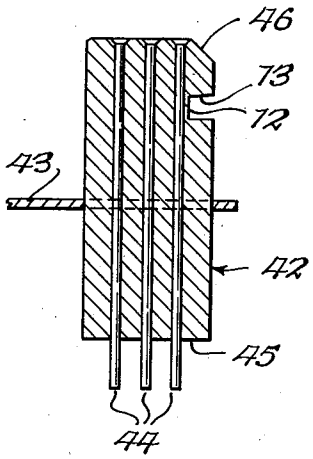


Fig. 9.



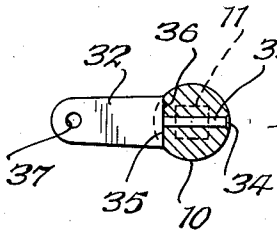
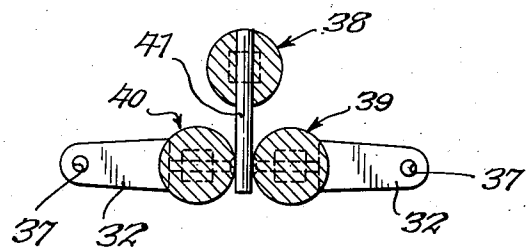


Fig. 7.

Fig. 8.



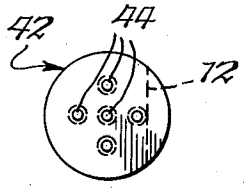


Fig. 10.

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UNITED STATES PATENT OFFICE

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John F. Kopczynski, Buffalo, N. Y.

Application May 23, 1945, Serial No. 595,318

12 Claims. (Cl. 164—124)

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This invention relates to tools, and particularly to punches of the type where punch elements are detachably coupled to a holder. In my prior Patents Nos. 2,324,852 and 2,239,061, are illustrated punch elements that are detachably and interchangeably secured in a recess in a holder, so that when a punch element becomes unduly worn or breaks, it may be quickly and easily replaced with a similar punch element.

No particular difficulty arises from such a construction when the end faces of the punch elements that do the punching are circular, but where the punch element has a non-circular punching end, such as one that is square in shape, or has a plurality of quill punches detachably mounted in the punch shank, it must, when placed in its recess, be moved angularly about the axis of the recess until the punch face or end is properly located to enter the cooperating die element, and is then secured in that position. In such cases it is very desirable that one be able to easily and quickly adjust the punch elements angularly in the recesses.

In said prior patents, the punch elements are detachably secured in the recesses of the holder by flat keys which are projected into segmental kerfs in the portions of the shanks of the punch elements that are within the recess, and it is desirable that such keys confine the punch elements against the inner ends of the recesses without lost motion or play, but without hampering the easy and rapid insertion or removal of a punch element.

An object of this invention is to provide an improved method of preparing punch elements for interchangeable mounting in a recess in a tool holder, and for angularly adjusting them about their longitudinal axes into similar positions with respect to a cooperating die; with which the punch elements may be easily and quickly interchanged in said punch holder; and which will require a minimum of apparatus, manual effort and skill.

Another object of the invention is to provide an improved mounting for punch elements by which any of a plurality of similar punches may be interchangeably mounted in a recess in a holder, and easily and quickly positioned similarly in relation to a cooperating die; with which each element may be easily and quickly replaced by another similar element; which may be employed even where a plurality of punch elements must be closely disposed in the holder; and which will be relatively simple, practical, dependable and inexpensive.

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Another object of the invention is to provide an improved jig for use in preparing punch elements for interchangeable mounting in a holder.

Another object of the invention is to provide improved means for detachably securing punch elements in a tool holder; with which end play of the element in the recess will be eliminated; with which the punch elements will be securely held in the holder but may be easily and quickly detached for replacement; and with which any additional cost will be negligible.

Another object of the invention is to provide an improved tool; with which punch elements may be easily and quickly replaced; and with which the substituted elements may be easily and quickly positioned with respect to the cooperating die.

Various other objects and advantages will be apparent from the following description of several embodiments of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a sectional elevation through a punch unit constructed in accordance with this invention, and illustrating one embodiment thereof;

Fig. 2 is a bottom sectional plan of a portion of the same, the section being taken approximately along the line 2—2 of Fig. 1;

Fig. 3 is a sectional elevation through a portion of the structure shown in Fig. 2, the section being taken approximately along the line 3—3 of Fig. 2;

Fig. 4 is a perspective of a jig with a punch element mounted therein and illustrating the manner in which the punch elements may be prepared for detachable interengagement in the holder;

Fig. 5 is a sectional elevation of a portion of the structure shown in Fig. 1, but illustrating a slight modification thereof;

Fig. 6 is an elevation of a punch element having a laterally extending positioning arm secured to the shank of the punch element in a slightly different manner, and which is useful where punch elements must be grouped closely;

Fig. 7 is a sectional plan of the same, the section being taken approximately along the line 7—7 of Fig. 6;

Fig. 8 is a similar sectional plan through a plurality of closely disposed punch elements, and illustrating how the laterally extending positioning arms may be used in providing for quick replacement of any of the punch elements with

rapid alignment or positioning of the replacing elements;

Fig. 9 is a longitudinal, sectional elevation through a quill punch having applied thereto the positioning means in accordance with this invention; and

Fig. 10 is a bottom plan of the same before the positioning arm is applied.

In the embodiment of the invention illustrated in Figs. 1 to 4, the tool is illustrated as a punch having one punch element, but it will be understood that various other punch elements may be similarly mounted in the same holder. A plurality of retainer plates 1, 2 and 3 are secured face to face, and these plates, as a group, are secured to a suitable frame member 4 with preferably a hardened backer plate 5 interposed between the plate 3 and the frame member 4. The plates 1, 2 and 3 have aligned apertures punched or drilled therein to form a recess 6 which opens through the lower face of the plate 1. The plate 2 has another aperture formed therein so as to form a recess 7 in the interior of the holder formed by the plates.

The recess 7 intersects the recess 6 and carries a key 8 which is yieldingly and resiliently projected partly across the recess 6 by a spring 9 which is compressed between an edge surface of the key 8 and the edge wall of recess 7 opposite from the recess 6, as disclosed in my prior Patent No. 2,329,061.

The recess 6 is cylindrical in character, and rotatably received therein is the cylindrical shank 10 of a punch element 11. The shank 10 abuts at its inner end against the backer plate 5, and a segmental kerf 12 is cut transversely across that portion of the shank 10 which is within the recess 6 and in alignment with the recess 7 in which the key 8 moves. The side wall 13 of the kerf 12 which is nearest to inner end of the recess 6, lies in a plane which makes an angle between about 82° and 90° to the longitudinal axis of the shank. The portion of the upper face of the key 8 which engages and slides along this slightly oblique wall 13 of the kerf, as the key 8 enters the kerf, is bevelled off slightly, so as to lie in a plane which is approximately parallel to the side wall 13 of the kerf.

When the key 8 enters the kerf, this oblique, bevelled wall of the key engaging the oblique side wall 13 of the kerf will exert a wedging or camming action thereon which urges the shank 10 of the punch element endwise further into the recess 6 until the end of the shank engages against the backer plate 5 before the key engages the bottom wall of the kerf 12. Thus the key 8 will wedge the punch element firmly against the backer plate 5 so as to eliminate lost motion or play. This slight wedging action is effective in eliminating this end play, and when the angle of either cam surface is not more than about 10° deviation from a plane which is perpendicular to the direction of the movement, the friction is sufficient to prevent a camming aside of the key by endwise pull on the punch element during a stripping operation.

Usually this dihedral angle of either of the cam planes with a plane which is perpendicular to the longitudinal axis of the shank of the punch element, and which produces enough friction to prevent camming aside of the key 8, varies between 0° and 7°, but in view of the additional resisting action of the spring 9, the angle can be increased a little beyond the usual 7° maximum, without danger that the key 8 may

be cammed aside sufficiently to release the punch element during the pull created when the punch element is retracted from the sheet which it has pierced.

Where the end face that does the punching is circular, the punch element may assume any angular position in the recess 6 and be operative. If one punch element becomes broken, or worn down unduly, it may be replaced by another punch element that is similarly secured in the tool holder by the key 8, and the replacement or substitute punch element will have the same alignment with the cooperating die opening 14 in the die 15 that the replaced punch element possessed.

A punch element of this type is preferably released, for replacement by rotating it in the recess 6 until the uncut peripheral part of the shank of the punch element cams aside the key 8 sufficiently to release the shank for removal from the recess 6. While the engagement of the key in the kerf will tend to position a replacement punch element similarly to the replaced punch element, this positioning is not sufficiently accurate where the punching end face is not circular.

In the illustrated example, the end face 16 of the punch element which actually does the punching is rectangular in shape, and the die opening 14 of the cooperating die 15 necessarily has the same shape. A slight angular misplacement of the punch element in the recess 6 of the holder might cause serious damage to the punching end of the punch element or to the die 15, and therefore some means must be provided for accurately positioning each punch element angularly about its longitudinal axis when it is inserted into the recess 6, so that when new punch elements are substituted, they may be quickly and easily positioned or aligned with respect to the cooperating die opening 14. In Figs. 1 to 4, one construction for accomplishing this alignment is illustrated.

A member or arm 17 which may be stamped from a plate of suitable material such as metal, is provided adjacent one end with an aperture 18 just slightly smaller than the diameter of the shank 10 of the punch element. The arm 17 is heated to cause it to expand sufficiently to slide down over the shank 10 to the desired position, and then when it cools after it is placed on shank 10, it will contract and firmly and tightly grip the shank 10 to form an arm extending laterally therefrom, but fixed rigidly thereon. This is called shrinking the arm 17 over the shank 10 of a punch element.

The portion of the shank surface adjoining the aperture 18 in the arm 17 is provided with a shallow cavity 19, and after the arm 17 has been secured upon the shank 10 by the shrinking operation, a prick punch or other similar or suitable tool is used to upset or displace into the cavity, some of the metal of the arm 17 that borders the cavity, as shown in Figs. 2 and 3, so as to form a key coupling the arm 17 to the shank 10. This avoids any danger that rotation of the arm 17 on the shank 10 might occur. The free end of the arm 17 is provided with a hole or aperture 20 extending from face to face, which slidingly receives a pin 21 projecting from the outer face of the plate 1 in a direction parallel to the axis of the recess 6. The engagement of the pin 21 in the aperture 20 of the arm 17 holds the punch element against rotation in the recess 6, and thus

hold the punch element in properly aligned position with respect to the die opening 14.

Since a punch element of the type illustrated must be rotated to some extent in order to release it from the key 8, provision should be made for removing the pin 21 from the aperture 20. For this purpose the pin 21 is slidingly mounted in a recess or bore 22 in the plate 1, and a spring 23 is compressed between the inner end of the bore 22 and the inner end face of the pin 21, so as to yieldingly and resiliently urge the pin 21 outwardly. The bore 22 preferably extends all the way through the plate 1, and the plate 2 provides the bottom of the bore against which the spring 23 may react. To limit the outward movement of the pin 21, the pin may have a recess 24 or groove in one side thereof and intermediate of its ends, and the metal of the plate 1, in the surface layer adjoining the bore 22, may be upset or displaced into the groove 24 as at 25, so as to form an overhanging abutment at the open end of the bore 22 which limits outward movement of the pin 21. To release the arm 17, it is merely necessary to push the pin 21 inwardly until it leaves the opening 20, and then the punch element may be rotated in the recess 6 so as to cam the key 8 aside, whereupon the punch element may be pulled endwise from recess 6.

A plurality of similar punch elements 11 are provided, and in order that they may all be properly positioned with respect to the cooperating die when inserted in recess 6 in succession, a jig 26 such as shown in Fig. 4 is provided. This jig includes a block or body having a cylindrical recess 27 identical with the recess 6, in which the shanks 10 of the punch elements 11 may be disposed in succession. When a punch element 11 is disposed in the recess 27, it is first rotated in the recess until some particular reference part of the punching end face 16 is aligned with some suitable part of the jig body. In this example of the invention, since the end face 16 of the punch is rectangular, the punch element is rotated in recess 27 until one of the sides or edges of the rectangular face 16, such as the edge 28, is disposed parallel to a machined end face 29 of the jig. This may be easily done with considerable accuracy by suitable tools, and after the punch element has been positioned in this manner, it is secured firmly in that position by tightening a set screw 30 which engages against the shank of the punch element.

The arms 17, when applied to the shanks of the punch elements, are positioned as accurately as possible with respect to the edges of the end face 16, so that when an element is placed in the jig, adjusted angularly, and secured in position by the screw 30, the arm 17 of it will be in approximately the same position on the upper face of the jig for every punch element. The jig is provided with a hole or passage 31 extending from face to face in a position such that the arm 17 in each punch element will be disposed thereover when the punch element is secured in the manner just explained in the jig body. A drill is then passed through the passage 31, and with the passage 31 serving as a guide the aperture or hole 20 is drilled in the arm 17.

Since all of the interchangeable punch elements have the apertures 20 prepared in this manner in the same jig, it follows that when they are successively placed in the recess 6, the apertures 20, when engaged over the pin 21, will automatically position the punch elements in the same relative alignment angularly about the axis

of the recess 6, and the non-circular end faces 16 of all the elements mounted in this manner will be in proper positions to enter the cooperating die opening 14. Thus after a plurality of punch elements have been prepared in this manner, it requires but a moment of time to remove a worn or broken punch element, or one which requires grinding, and replace it with a duplicate punch element that, by the mere fact of mounting in the recess 6, will be automatically and properly positioned for entry into the cooperating die. After an aperture 20 has been drilled in the arm 17 the punch element is removed from the jig.

In Fig. 5 a slight modification is illustrated in which the pin 21*a*, instead of being movable endwise, is fixed in the tool holder, and the arm 17 is bent outwardly into the dash line position shown when its punch element is to be removed from the holder.

In Figs. 6 and 7 a slight modification of the punch element 11 is illustrated, particularly as to the manner in which the arm 32, corresponding to the arm 17, is secured to the shank 10 of the punch element 11. In this embodiment of the invention the arm 32, instead of being shrunk over the shank 10 of the punch element, is provided with a reduced extension 33 which extends through a passage in the shank 10, and at its free end is upset as at 34 in order to anchor the arm 32 firmly to the shank 10.

To simplify the fitting of the arm 32 to the shank, a small, segmental kerf 35 may be cut across a peripheral portion of the shank 10, in which kerf a shoulder 36 of the arm 32 may be received. An aperture 37 will be provided in each arm while in the jig, such as in the manner disclosed in connection with Fig. 4. In fact the jig shown in Fig. 4 may be used. It will be noted, in this embodiment of the invention, that since the arm 32 does not encircle the shank 10, it does not increase the diameter of the shank, and therefore the punch elements may be grouped more closely together in an assembly that is possible where the lateral, positioning arms are shrunk over the shanks as in Figs. 1 to 4.

In Fig. 8 is illustrated a situation where a plurality of punch elements 38, 39 and 40, similar to the punch elements 11, are mounted in close proximity to each other in the holder, and where there may not be adequate space for all of the regular arms, such as the arm 17 of Figs. 1 to 4, or 32 of Fig. 6. In this example a rod 41 extends through the shank of the punch element 38, by a drive fit in a passage that extends diametrically through the shank of the element 38 and then in a suitable jig, similar to that shown in Fig. 4, the opposite side faces of the free end of the rod 41 are accurately machined, so that when this rod is disposed between the shanks of two other punch elements 39 and 40, those other punch elements will properly position the arm 41 angularly about the longitudinal axis of the punch element. Other punch elements (not shown) may prevent placing the punch arm 41 in any other angular position.

The punch elements 39 and 40 may be made similarly to the construction shown in Figs. 6 and 7, with the arms extending away from the end of the rod 41. Various other arrangements and groupings of the punch elements may be made, but these examples will illustrate somewhat the manner in which this invention may be applied to meet different conditions.

In Figs. 9 and 10 another embodiment of the

invention is illustrated, where the punch element is of the type utilizing quill punches. In this example, the punch element 42 may have an arm 43 shrunk thereover in the manner explained in connection with Figs. 1 to 4, and a plurality of individual quill punches 44 are passed longitudinally through suitable passages endwise of the punch element 42, so as to extend downwardly from the lower end face 45 of the punch element. The group of projecting quill punches 44 provide the equivalent of a non-circular end face, and therefore when these punch elements need replacement, the new ones must be aligned or positioned angularly with reference to the cooperating die. This may be done in the manner explained in connection with Figs. 1 to 8 by using a jig similar to that shown in Fig. 4.

If the quill punches 44 become broken or worn, they may be replaced individually by driving them endwise out of their passages in the body of the element 42, and new quill punches may then be driven into the passages to replace the removed ones. In the examples of the invention shown in Figs. 6 to 10, the shank of each punch element is provided with the kerf 12 having the oblique side wall 13 similar to, and for the same purpose as, the oblique side wall 13 of kerf 12, explained in connection with Figs. 1 to 4.

Each of the punch elements may have a bevelled corner edge 46, in each example, to cam aside the key 8 when it is inserted endwise into the recess 6. Any suitable stripper means may be employed, that shown in Fig. 1 including the stripper bolts 47, stripper plate 48, and springs 49 as disclosed in my prior Patent No. 2,329,061. In Fig. 1, the blank which has just been punched is designated at 50.

The positioning of the punch elements in the holder has been explained in connection with the type of removable holder which was disclosed in my prior patents, in which the shank of each punch element is rotated in order to cam aside a holding key. In such cases the pin 21 is mounted to move endwise, so as to release the arm 17, or the arm 17 is bent, as shown in Fig. 5. If it is unnecessary to rotate the punch element in the socket in order to release it, then a fixed pin, such as 21*a* (Fig. 5) may be employed, and endwise movement of the punch element will release it from the pin during its removal from the holder. When applying a substitute punch element, the element is rotated in the recess 6 until the aperture in the laterally extending arm is aligned with the pin, and then the punch element is moved endwise fully into the socket.

Thus this invention is applicable not only to the mounting of prior types of punch elements where rotation of the punch element to release it may not be necessary, but aslo to the types shown in my prior patents where rotation of the punch element is required in order to release it from the holder. While reference marks on the arms of the punch elements, on the jig and on the holder may be used to obtain proper positioning of the punch elements in the recess 6, the aperture in each laterally extending arm that fits a pin on the holder, provides a very simple and rapid construction for that purpose.

It is believed that the construction and use will be clear from the foregoing description. It will be understood that various changes in the details and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. A tool set comprising a series of punch elements, a series of members each having an aperture from face to face, through which the shank of an element extends and which tightly fits the shank of that element, said shank having a cavity in the surface of the zone passing through said member, and said member having a portion of its material that is aligned with said cavity upset and displaced into said cavity to resist rotation of said member about said shank, said members on all of said elements having markings bearing the same definite, predetermined relation, angularly about the axis of the elements, to a corresponding part of the punching end of each element, whereby said elements may be successively and interchangeably secured in a common recess in a holder and each positioned similarly therein by turning said element in said recess until the marking on the member of that element bears the same predetermined relationship to said corresponding part of said holder as all of the others.

2. A tool comprising a punch element having an arm fixedly secured to and extending laterally from its shank, intermediate the ends of the element, said arm having, eccentric to said shank, an aperture having a predetermined position, angularly about the axis of the element, with reference to a selected part of the punching end face of the element, whereby when a plurality of said tools are interchangeably mounted in a recess of a holder, they may be rotated in the recess and similarly located with respect to their punching end faces, by similarly positioning said arms by reference to said apertures.

3. A tool holder having a cylindrical recess in a face in which punch elements may be interchangeably fitted, said holder having a cavity in its said face at one side of and spaced from said recess, a pin fitting and sliding endwise in said cavity in a direction parallel to the axis of said recess, said pin having, intermediate of its ends, a groove in its periphery which extends in a direction lengthwise of, but not for the full length of the pin, and said holder having a portion of its material at said face along the margin of said cavity displaced into said groove to limit the outward movement of said pin, and a spring in said cavity compressed between the inner end of said pin and the inner end of said cavity for urging said pin outwardly but yieldingly allowing inward movement of said pin.

4. A tool comprising a tool holder having a cylindrical recess in a face in which punch elements may be interchangeably fitted, said holder having a cavity in its said face at one side of and spaced from said recess, a pin fitting and sliding endwise in said cavity in a direction parallel to the axis of said recess, said pin having, intermediate of its ends, a groove in its periphery which extends in a direction lengthwise of, but not for the full length of the pin, and said holder having a portion of its material at said face along the margin of said cavity displaced into said groove to limit the outward movement of said pin, a spring in said cavity compressed between the inner end of said pin and the inner end of said cavity for urging said pin outwardly but yieldingly allowing inward movement of said pin, a punch element having a shank rotatably received in said recess, an arm extending laterally from the shank of said element and having an aper-

ture of a size to receive the outer end of said pin, and disposed from the axis of the shank of the element a distance which corresponds to the distance of the axis of the pin to the axis of said recess, whereby said element may be angularly positioned in said recess by the engagement of said pin in said aperture.

5. A tool comprising a punch holder having a cylindrical recess in a face thereof, a punch element having a cylindrical shank received in and fitting said recess and rotatable therein about the axis of said recess, an arm fixed to and extending laterally from the shank of said element in proximity to the face of said holder, said arm and said holder having interengaging parts for locating said element angularly about the axis of the recess of the holder.

6. A tool comprising a holder having a recess in one surface thereof, a punch element detachably secured in said recess and having a non-circular punching face at its free end, a member fixed to the shank of said element and extending laterally therefrom in proximity to said surface of said holder having said recess, and a positioning part carried by said holder and having releasable, interengagement with said laterally extending member for always positioning said punch element at the proper angular position about the axis of said element.

7. A tool comprising a holder having a recess in one surface thereof, a punch element detachably secured in said recess and having a non-circular punching face at its free end, a member fixed to the shank of said element and extending laterally therefrom in proximity to said surface of said holder having said recess, and having an aperture therein located in a pre-selected position angularly about the axis of the punch element with respect to a side of said non-circular face, and a pin projecting from said holder into said aperture for locating said element in a pre-selected position angularly about the axis of said element.

8. A tool comprising a holder having a recess in one surface thereof, a punch element detachably secured in said recess and having a non-circular punching face at its free end, a member fixed to the shank of said element and extending laterally therefrom in proximity to said surface of said holder having said recess, and having an aperture therein located in a pre-selected position angularly about the axis of the punch element with respect to a side of said non-circular face, and a pin projecting from said holder into said aperture for locating said element in a pre-selected position angularly about the axis of said element, said pin being movable endwise to release said punch element for rotary movement about said axis.

9. A tool comprising a holder having a recess in one face thereof, a punch element detachably secured in said recess and having a non-circular punching face at its free end, the shank of said element having an outwardly projecting portion overlying said one face of said holder, with a machined wall positioned angularly and accurately with reference to said non-circular face, said holder having a reference part exposed at said one face and coacting with said wall on said projecting portion for locating the punch in said holder with said non-circular punching face in a predetermined angular position about the axis of said recess.

10. A tool comprising a punch element having a shank by which it may be mounted in a holder, and a non-circular punching face at its free end, said shank having an outwardly projecting portion that overlies a face of said holder when the element it attached thereto, with a machined wall positioned angularly and accurately about the axis of the shank, with respect to said non-circular face, whereby a plurality of said elements may be successively attached to a holder and by positioning said wall of successive elements in similar accurate positions with respect to a reference part exposed at the adjacent face of said holder, the non-circular faces will be similarly and accurately positioned on the holder.

11. A tool comprising a holder having a cylindrical recess in a face thereof, a punch element having a cylindrical shank received in and fitting said recess and rotatable therein about the axis of said recess, a member extending laterally from the shank of said element over and in proximity to said face of said holder, said member and holder having cooperating parts for locating said element angularly about the axis of the recess.

12. A tool comprising a punch element having at one end a shank by which it may be mounted in a holder, and at its other end a non-circular punching face, said shank having a laterally extending member in the portion which is not received in said holder, but positioned to overlie a face of said holder when the punch element is secured to the holder, said member having a reference portion positioned angularly and accurately, about the axis of the element, with respect to said non-circular face, whereby a plurality of said elements may be successively attached to a holder, and by positioning said reference portion on each element, as it is successively mounted on the holder, in a similar accurate position with respect to a cooperative reference part on the face of the holder, the non-circular faces of the elements will be similarly and accurately positioned on the holder.

JOHN F. KOPCZYNSKI.

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2,154,738	Fisher	Apr. 18, 1939
2,163,229	Knebel	June 20, 1939
2,329,061	Kopczynski	Sept. 7, 1943
2,371,565	Whistler	Mar. 13, 1945
2,373,962	Joachimi	