Oct. 20, 1953 L. V. WHISTLER 2,655,995

MEANS FOR REGISTERING NONCYLINDRICAL PUNCHES AND DIES

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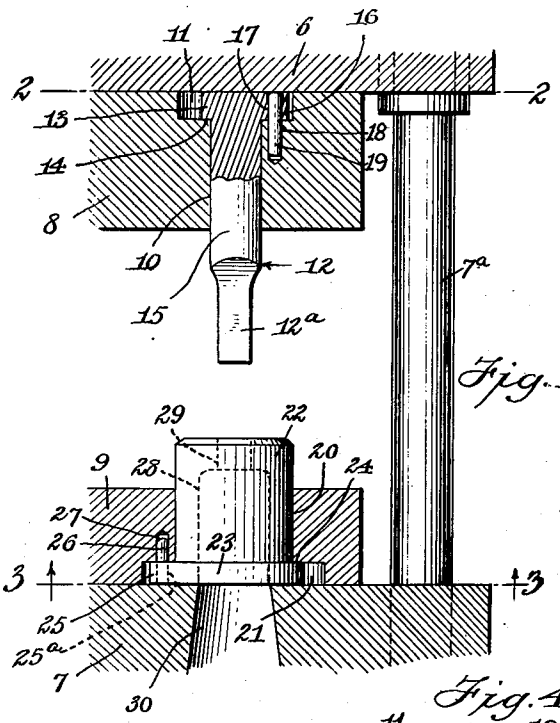


Fig. 1

Fig. 2

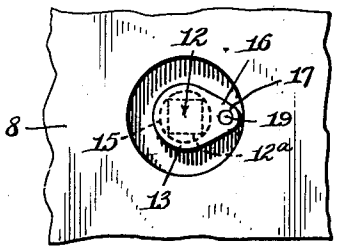


Fig. 3

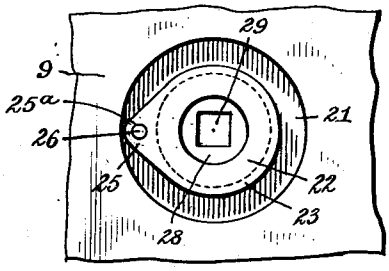


Fig. 4

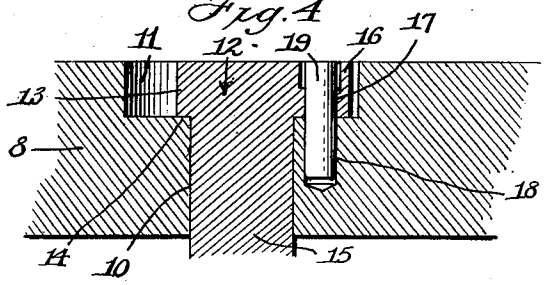
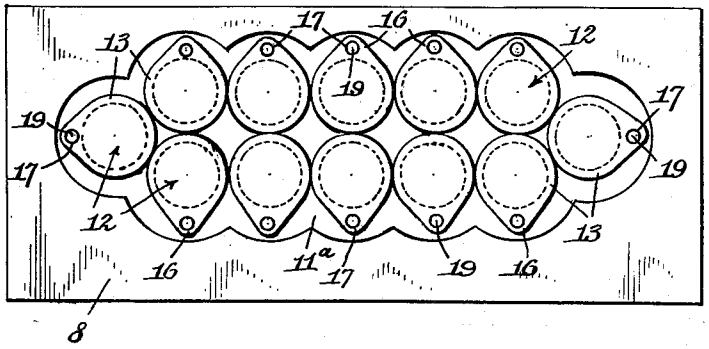


Fig. 5



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MEANS FOR REGISTERING NONCYLINDRICAL PUNCHES AND DIES

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7 Claims. (Cl. 164—118)

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My invention relates to punch and die assemblies, and more particularly to means for assuring registration of non-cylindrical punches and dies.

One of the objects of my invention is the production of punching or perforating means in which provision is made for the assembling of non-cylindrical punches and mating-dies or die bushings in a manner to assure perfect registration of the punches with respect to the punch-receiving openings in the dies or die-bushings, as the case may be.

Another object is to provide a punch having a non-cylindrical punch terminal capable of registration with a corresponding punch-receiving aperture in a die or die-bushing by the simple procedure of placing the punch in its punch-pad or holder according to pre-arranged relationship to the punch receiving aperture in the die or die-bushing.

A further object is to construct the punch-pad or holder so as to receive the head of a button-head or terminally-flanged punch, having a non-cylindrical punch terminal, in a predetermined position rotatively so that its punch terminal will register with its mating punch-receiving aperture in a die or die-bushing.

A further object is to provide a punch of the kind mentioned which is particularly adapted for heavy duty and high production work, due to the use of an enlarged abutment area provided for the same, the punch possessing the quality of precision accuracy so that when dull or otherwise rendered unserviceable, it can be easily replaced with assurance that the replacing punch will truly register with the punch-receiving hole in a mating die or die-bushing.

A still further object is to provide punch and die mechanism in which a punching-tool having a non-cylindrical hole-forming portion is secured in a fixed angular position to coact with a punching-tool having a cylindrical body-portion inserted in a cylindrical tool-receiving hole in a tool holder, said second-mentioned punching-tool having a non-cylindrical hole-forming portion at one end corresponding to the non-cylindrical hole-forming portion of said first-mentioned punching-tool and having a laterally-projecting extension at its other end in fixed angular position with relation to the non-cylindrical hole-forming portion thereof and in which said punching tool holder has a recess in its inner face to receive said laterally-projecting extension, positioned therein to enable it to be moved rotatably or in a circular path, means being provided to retain said laterally-projecting extension in any selected position within its range of movement determined by the angular position of the hole-forming portion of said first-mentioned punching-tool and in which said retaining means maintains its position so that replacing punching-tools which are exact counter-parts of a tool in use may be positioned in said punch holder without resorting to any adjusting operation.

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With the above and other objects in view to appear hereinafter, my invention consists in the novel features of construction, in the arrangement and combination of parts to be hereinafter described and in the method of assembling such parts, all as more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a sectional view showing a punch and die assembly within a die-set and having the punch and die or die-bushing constructed in accordance with my invention, one end only of the die-set being shown.

Fig. 2 is a section taken on line 2—2 Fig. 1.

Fig. 3 is a section taken on line 3—3 Fig. 1, looking up.

Fig. 4 is an enlarged section through the upper portion of a punch fitted into a punch-pad or holder.

Fig. 5 is a top plan view of a punch-pad or holder showing the manner in which punches may be assembled therein with the axes of the punches closely spaced apart.

Having reference to the drawings in detail, 6 designates a header-member, which may also be termed a tool-support or carrier, and in the drawings is illustrated as the ram of a punch press or die-set and which serves as an abutment for the punch or punches used in the punch and die assembly.

7 designates the bed-member of a punch-press or a die-set, which may also be termed a tool-support or carrier, said header-member and bed-member being relatively movable and guided for movement in the usual manner, for which purpose the bed-member may have guide posts 7a rising therefrom at or near each end on which the header-member 6 is slidably movable, only the guide post at one end of the press or die-set being shown.

8 designates the punch-pad or holder which is fastened to the under side of the header-member by means of retainer screws (not shown), common to punch and die assemblies of this general type; the punch-pad or holder being properly positioned in the usual manner by

means of dowel pins prior to fastening the same by means of the retainer screws.

9 designates the die-pad or holder which is positioned on the bed-member by means of dowel pins in the usual manner and fastened thereto by retainer screws (not shown) but commonly employed for this purpose, as will be understood by those schooled in the art.

When fastening the punch-pad or holder and the die-pad or holder to their respective carriers, the opposing faces thereof are held in firm contact with each other and such faces may be termed contacting faces.

The punch-pad or holder 8 has a cylindrical punch hole or opening 10 formed therethrough which is counter-bored, or at least laterally or radially enlarged, at its upper end to form a recess or depression 11 of a pre-determined depth. Since this invention relates to the registration of punches having non-cylindrical punch terminals with dies or die-bushings having correspondingly-shaped punch-receiving apertures, the lower portion or punch terminal of the punch is ground or otherwise shaped to conform to the outline of the opening to be punched in sheet metal or other sheet material placed between the punch and the die.

In the drawings I have shown the punch end or lower portion of the punch, designated 12, of square formation in cross section, but any other non-cylindrical shape may be given the punch, and under the method and arrangement of utilizing the punch and its mating die, a perfect registration of the punch terminal 12^a with the punch-receiving aperture in the die or die-bushing will be assured. For this purpose the punch is preferably provided at its upper end with a head which includes an outstanding flange 13 forming a downwardly-facing shoulder 14 on the punch which bears against the inner end or bottom wall of the recess or depression 11 formed in the punch-pad or holder 8. Punches having flanges at their upper ends are known in the art, and the punches so constructed are generally referred to as "button-head punches."

The height or thickness of the flange 13 corresponds exactly to the depth of the recess or depression 11 so that when a punch is inserted through the punch-pad or holder from the top, the flange 13 is clamped between the under face of the header-member 6 and the bottom or inner end wall of the recess or depression 11; thus axial movement of the punch is impossible after it is inserted in the punch-pad or holder and the latter fastened to the header-member. It is, of course, understood that by reason of both the hole or opening 10 in the punch-pad or holder and the body portion 15 of the punch being cylindrical, the punch may be rotated within the pad or holder prior to fastening the same in position in a manner to be hereinafter described.

In the preferred construction, the flange 13 is circumferential so as to form the shoulder 14 circular and it is preferably radially extended at one point in its circumference, as shown at 16. The recess, depression, or counter-bore 11 as it may be termed when machined for use with a single punch, is of a diameter somewhat larger than that of the outstanding flange 13 so that the radial extension 16 of said flange may be moved under rotative movement of the punch to any position within said recess or counter-bore. It will be understood, therefore, that if a counter-bore is resorted to, the radial extension 16, for which I prefer to use a more comprehensive term in the claims, and sometimes in the body of this specification, such for example as, "laterally-projecting extension" or "retainer part" can be moved rotatably or circularly through 360°. However since this recess can be otherwise formed, such as being disposed at one side of the axis of the punch, it may be in the form of a recess or depression in the inner face of the punch holder disposed at one side of a plane passing axially through the punch and intersecting the upper end of the punch-receiving hole in the punch holder; in which case the rotatable adjusting movement of the radial extension, or laterally-projecting extension as it may be termed, would be limited to 180°, which range of movement will be found necessary for adjusting most non-cylindrical terminals of punches with respect to the punch-receiving apertures in their mating dies.

While I have shown a flange extending outward circumferentially from the body portion of the punch at its upper end and referred to this flange as forming part of the head of the punch, the said flange could be dispensed with and the radial extension 16 formed directly on the body portion of the punch instead of on the flange 13 thereof, in which case the radial extension and the region of the punch from which it extends would be considered the head of the punch. However it is of advantage to provide the punch with an outstanding circumferential flange since the under side of this flange provides additional contact surface against the bottom or inner end wall of the recess or counter-bore and it also enlarges the area at the end of the punch contacting the header-member or carrier, so called because it carries the punch 12 through the medium of the punch holder 8. The last mentioned contacting portion serves more effectively to absorb the shock applied to the punch during the punching operation and thus enables efficient punching operations on heavier stock than would otherwise be possible; at the same time, the life of the punch is materially increased and wear on the contacting parts greatly diminished. It will be apparent therefore that the head of the punch is confined wholly within the punch holder and may, without departing from the spirit of my invention, be firmly clamped between the latter and the carrier to which said punch holder is secured; and without departing from the basic idea involved, advantages gained by such construction and arrangement may be realized in a measure by other means.

The recess 11 in each punch holder, formed as described, is closed by the carrier to which the holder is secured and therefore the face of the carrier and the inner wall of the recess confront each other.

The term "radial extension" as used in this specification is intended to mean any extension projecting peripherally or outwardly from the punch or a portion formed on the punch, regardless of whether its longitudinal axis is truly radially-disposed, and it has an opening or cylindrical hole 17 preferably formed therethrough which may be referred to as a drill hole, which extension or the flange from which said extension projects and the said drill hole therein serve as a drill-jig. The drill hole is slightly enlarged at its upper end, as shown more particularly in Fig. 4 of the drawing, the axis of this hole being a definite distance from the axis of the punch and parallel therewith. At a predetermined point in the punch-pad or holder, depending on

the registration of the punch terminal 12a with its mating die supported on the bed-member 7, a pin-hole 18 is drilled by using the button head and the drill hole 17 in the button head, or more particularly in the extension 16, as a drill-jig, and a dowel or retainer pin 19 is driven thereinto so that its upper portion extends into the recess 11, or so that said dowel or retainer pin may be passed through the hole 17 in the extension 16 and be forced into the hole 18 in the punch holder. In order to replace a punch and position the same so that its punch terminal or work end registers with the punch-receiving aperture in its mating die, it is only necessary to rotate the punch until the non-cylindrical punch terminal thereof registers with the correspondingly-shaped punch-receiving aperture in the mating die, after which the said drilling operation may be effected or until the opening or drill hole 17 in the radial extension 16 is brought in axial alinement with the dowel or retainer pin 19 previously fitted into the hole 18 to have its upper portion, which then projects upwardly from the bottom or inner wall of the recess 11, extend into the hole 17 entered in the drilled button head of the punch or more particularly into the extension 16 thereof, when the punch will descend and the dowel or retainer pin enter the opening 17.

The registration of the punch with the punch-receiving aperture in the die or die-bushing may be effected regardless of the manner in which the die or die-bushing is secured to the bed member 7, but I prefer to utilize the same means for such purpose as I employ in positioning and fastening the punch in place, and with this in mind the die-pad or holder 9 has a cylindrical opening 20 formed therethrough, the lower end of which is counter-bored or otherwise enlarged, as at 21, to form a downwardly opening recess. In the opening 20, a die-bushing 22 is fitted, this bushing having an outstanding flange 23 at its lower end of a height or thickness exactly conforming to the depth of the recess 21 and this flange has an upwardly-facing shoulder 24 which bears against the upper or inner end wall of said recess, while the under side of the die-bushing, including the outstanding flange 23 thereof, bears against the upper face of the bed member or carrier 7. Thus when fastening the die-pad or holder to said bed member, the outstanding flange 23 will be securely clamped between the die-pad or holder and said bed member or carrier.

The outstanding flange 23 of this die-bushing is also provided with a radial or laterally-projecting extension, designated by the numeral 25, and like the extension 16 forming part of the punch, it also has an opening or drill hole 25a therethrough which is utilized as a part of a drill-jig, similar to a like part of the punch 12. A dowel or retainer pin 26 is passed through the drill hole 25a of this drill-jig and is driven or otherwise forced into a pin hole 27 drilled in the die-pad or holder and extending downwardly a distance from the upper or inner end wall of the recess or counter-bore 21.

When using the radial extension and pin arrangement, or the pin-and-hole anchoring means as it may be termed, on both the punch and die-bushing, either may be used as a means for positively positioning the same angularly and retaining such part in position, while the other may be employed as a means for both effecting registration with the first-mentioned part and for fastening said other part in position when employing a die-bushing, such as the bushing 22, or the like. The punch and the die or die bushing form a punching couple, and each may be termed a punch tool or member, or in a broader sense, a tool. The die-bushing 22 is provided with an axial bore 28 extending upwardly from its lower end to within a short distance of its upper surface and with a punch-receiving aperture 29 extending from the upper end of said bushing downwardly to the upper end of the bore 28; the punch-receiving aperture in the case shown being of square formation, since the punch terminal 12a of the punch is shown as being so formed. However, the punch terminal and the punch-receiving aperture in the die may be of oval shape, diamond shape, or any irregular or other non-cylindrical or non-circular shape. If desired, a die may be employed which is capable of being attached directly to the bed member or carrier 7, in which case the die-pad or holder 9 may be dispensed with, but in all instances a slug opening 30 is formed through the bed member or carrier and located to register with the punch-receiving aperture 29, whether formed in a die-bushing, or in a die fastened directly to the bed member or carrier 7.

It will be apparent that upon lowering the punch-holder with its punch or punches therein, the thrust exerted against the under end face of the punch terminal or terminals 12a, as the case may be, will be imparted to the punch throughout the full length of the same and the force thereof transferred directly to the header member or carrier.

To those familiar with the art, it will be understood that each punch, or if desired any series of punches, will be associated with a stripping device (not shown) and that during the stripping action, which occurs during the upward movement of the header member or ram 6, a downward pulling force is exerted on the punch or punches, and such force is resisted by the downwardly-facing shoulder 14 on the punch and the inner face of the laterally-projecting extension 16, thus assuring a free stripping action of the perforated or punched sheet from the punch or punches. Assurance is therefore had that the stock operated upon will be retained in its normally flat condition.

Assuming that the die-bushing is secured in position on or in the die-pad or holder by the means shown and described in this application, or in any other manner, or assuming that the die with its punch-receiving aperture is fastened directly to the bed member 7, and further assuming that the punch-receiving aperture in the die or die-bushing is square with two walls of the opening disposed exactly parallel with the longitudinal center of the bed member 7 and two walls at a right angle to said longitudinal center, the method of procedure to follow would be to position the punch and fasten the same to the punch-pad or holder with assurance of a proper registration with the punch-receiving aperture in the die or die-bushing, as follows: The cylindrical punch-receiving hole 10 having been drilled through the punch-pad or holder in the usual manner and this hole counter-bored at its upper end or radially enlarged, at least at one point, to the proper depth to receive the outstanding flange 13 or the extension 16 at the upper end of the punch, the punch-pad or holder will be placed on parallels of the proper height which rest upon the die-pad or holder, after which the punch-pad or holder is moved to aline

the punch with the punch-receiving aperture and to effect the registration of the punch terminal with said aperture. The usual method of providing proper clearance between the wall or walls of the punch-receiving aperture and the sides of the punch terminal are then resorted to; namely, by inserting small pieces of shim stock of the desired thickness at all sides of the punch-receiving aperture between the walls thereof and the punch terminal. With the shim stock so positioned between the sides of the punch terminal and the wall or walls of the punch-receiving aperture in the die or die-bushing, the bed member or carrier, die-pad or holder with the die therein and the parallels and punch-pad or holder with the punch therein will be moved intact to a drill press or other suitable machine to enable the previously formed pin hole in the extension 16 of the punch to be used as a drill jig to drill and ream a hole, such as 18, in a fixed location in the punch-pad or holder, or more particularly in the inner end wall of the recess 11. It is, of course, understood that the hole in the extension 16 is orbitally movable around the axis of the punch and this hole is ground in a definite relation to the axis of the punch and consequently the hole drilled in the punch-pad or holder, by using the hole in the extension as a drill jig, will have exactly the same relation to the axis of the punch as the hole in the extension. After driving the retainer pin 19 through the registering holes in the extension 16 of the punch and the punch-pad or holder, the latter is secured to the under side of the header-member or carrier by using the usual dowel pins (not shown) and two or more retainer screws commonly employed for such purposes. It is to be understood that while the retainer pin 19 has a driving fit in the hole 18 in the punch pad, it is only slidingly but snugly fitted into the opening or hole 17 of the extension 16.

So applied, punches can be easily interchanged since it is only necessary to remove the punch-pad from the header member or carrier, after which the punch may be withdrawn from the punch-pad or holder and a new punch, which is an exact counter-part of the replaced punch, substituted with assurance that a perfect registration with the punch-receiving aperture in the mating die or die-bushing will take place without resorting to any adjusting of the parts, regardless of the angular position the replaced punch may have had and the mating position of the coacting die thereto. It is, of course, understood that all punches are micrometrically sized insofar as the body portions thereof and the location of the openings 17 in the punch extensions are concerned, so that once a punch-pad or holder is machined with its punch-receiving hole 10 and pin-opening 18 formed therein and the retainer pin 19 driven into the latter while passing the pin through the drill hole 17, punches designed for correspondingly-sized punch-receiving holes in punch-pads or holders may be substituted one for another, regardless of the formation of the punch terminals thereof, or their angular disposition with relation to the hole drilled in the punch holder to receive the retainer pin 19.

It may here be stated that the cylindrical body portion of the punch, or the die as the case may be, fits into its holder with what is known as a press-fit, by which is meant a snug fit requiring at least finger pressure in order to axially move and/or rotate the same within its punch-receiving hole.

It will further be understood, in the event that a plurality of punches and dies are employed, the same method of assuring registration between the punches and dies is carried out as described with reference to the registration of a single punch with its mating die.

A flanged punch, for example, such as described, has decided advantages over punches with straight shanks or punch bodies from end to end and held in place by means of screws, balls and other fastening means, in that for high production work and particularly for piercing holes in material more than one-eighth of an inch in thickness, the enlarged abutting area at the upper end of the punch, more effectively resists the upward thrusts occasioned when forcing the punches through the material being punched and the shoulder provided as an incident to the enlarging of the punch at its upper end prevents the punches from falling out of their pads or holders, and further provides an ample wall to counteract the effect of the stripper when stripping the material from the punch after the hole has been formed therein.

It is to be noted in Fig. 5 of the drawings that punches and dies constructed in accordance with this invention can be closely centered so that openings may be punched in material in close relation one to another and in such cases a recess 11a common to all punches may be provided, the punches being rotatably adjusted so that the extension 16 on the flange 13 of any punch does not contact a flange or extension of an adjoining punch and only the flanges 13 lie in contact one with another.

The term non-cylindrical punch is to be construed as meaning a punch having a punch terminal other than cylindrical or circular, and may also be referred to as an "irregular" punch. Punches of the type referred to may be of various cross-sectional formations between their ends, but in order that they may be rotatively adjustable, that portion of the body portion of each punch fitted in the small lower end of the opening 10 of the punch pad or holder is cylindrical and, therefore, where reference is made in the claims hereof to a cylindrical body portion, I interpret such term to mean a body portion or punch shank cylindrical at least along a portion of its length; and by the term "body portion" or "punch-shank" I include that portion of the punch above its non-cylindrical punch terminal, which latter and the correspondingly-shaped punch-receiving opening in its mating die may be broadly termed hole-forming portions.

The word tool as herein used refers to a punch for coaction with a die, or to a die for coaction with a punch, and the non-cylindrical or non-circular punch terminal of the punch and the mating non-cylindrical or non-circular punch-receiving aperture in the die may be referred to as hole-forming portions of a punch and die couple. It is my intention to apply to the term recess or depression a meaning to which the term "chamber" could be applied for the reason that the recess or depression in a broader sense includes a space to receive the button head and/or the laterally-projecting extension 16 of the punch.

Where in the claims reference is made to supporting members, I mean the header and bed members of a press or die-set and I also desire

to stress the point that the punch is locked against rotative movement by the dowel pin 19 when entered in the opening 17 of the extension 16 of the punch, and that in the broader aspect of this invention the radial extension 16 at the upper end of the punch may be considered as part of the flange 13, or it may extend directly from the body portion of the punch or the die bushing.

Having thus described my invention, what I claim is:

1. Punch and die mechanism for punching non-cylindrical holes in a sheet of metal or other like work-piece, comprising spaced-apart tool carriers movable relatively toward and from each other, a tool holder secured to one of said carriers and having a cylindrical tool-receiving hole therethrough perpendicular to the outer face thereof enlarged at its inner end to form a recess in the inner face of said tool holder, an integral punching-tool having a cylindrical body-portion rotatably adjustable with a press-fit in said tool-receiving hole and having a non-cylindrical hole-forming portion at one end and a laterally-projecting extension at its other end entered in said recess and rotatably adjustable therein through an arc of a circle when rotatably adjusting said cylindrical body-portion in said tool holder, said other end being in contact with said carrier, means to hold said laterally projecting extension from rotatable movement in a horizontal plane after being rotatably adjusted, and a second punching-tool secured to the other of said tool carriers and having a non-cylindrical hole-forming portion for mating coaction with the hole-forming portion of said first-mentioned punching-tool, said laterally-projecting extension contacting the inner end wall of said recess and the inner end face of said punching-tool contacting the tool carrier to which said tool holder is secured, whereby said first-mentioned punching-tool will be held against axial movement and the non-cylindrical hole-forming portion thereof be brought into registration with the hole-forming portion of said second punching-tool so as to effect a punching operation in a work-piece interposed between said punching tools.

2. Punch and die mechanism for punching non-cylindrical holes in a sheet of metal or other like work-piece, comprising spaced-apart tool carriers movable relatively toward and from each other, a die holder secured to one of said tool carriers and having a cylindrical die-receiving hole therethrough perpendicular to the outer face thereof enlarged at its inner end to form a recess in the inner face of said die holder, an integral die-bushing having a cylindrical body portion rotatably adjustable with a press-fit in said die-receiving hole and having a non-cylindrical punch-receiving aperture extending at least partly therethrough from its upper end and a laterally-projecting extension at its lower end entered in said recess and rotatably adjustable therein with the axis of said die-bushing as its center, a punch carried by the other of said tool carriers and having a non-cylindrical punch terminal corresponding with the punch-receiving aperture in said die, said laterally-projecting extension contacting the inner end wall of said recess and having a pin hole therethrough parallel with the axis of said die and the lower end face of said die-bushing contacting the carrier to which said die holder is secured, a pin secured in the inner end wall of said recess at any selective point determined by the rotatable adjustment of said die-bushing when registering the non-cylindrical punch-receiving aperture thereof with the correspondingly-shaped punch terminal of said punch, whereby said die will be held against axial movement and the non-cylindrical punch-receiving aperture therein be brought into registration with the correspondingly-shaped terminal of said punch.

3. Punch and die mechanism for punching non-cylindrical holes in a sheet of metal or other like work-piece, comprising spaced-apart tool carriers movable relatively toward and from each other, a tool holder secured to one of said carriers and having a cylindrical tool-receiving hole therethrough perpendicular to its face enlarged at its inner end to form a recess in the inner face of said tool holder, an integral punching-tool having a cylindrical body-portion rotatably adjustable in said cylindrical tool-receiving hole and having a non-cylindrical hole-forming portion at one end thereof and a laterally-projecting extension at its other end entered in said recess and rotatably adjustable therein with the axis of said cylindrical body-portion as its center, said punching tool having said other end in contact with said carrier, a mating punching-tool carried by the other of said tool carriers and having a predetermined fixed angular disposition, and means to retain the laterally-projecting extension of said first-mentioned punching tool in any adjusted position within said recess, said laterally-projecting extension lying in contact with the inner end wall of said recess and said other end of said first-mentioned punching-tool contacting the carrier to which said tool holder is secured, whereby said first-mentioned punching-tool is held against axial movement and the registration of said punching-tools effected under relative rotatable movement thereof regardless of the angular disposition in which said mating tool may be fixed.

4. Punch and die mechanism for punching non-cylindrical holes in a sheet of metal or other like work-piece, comprising spaced-apart tool carriers movable relatively toward and from each other, a punch holder secured to one of said tool carriers and having a cylindrical punch-receiving hole therethrough perpendicular to the outer face thereof enlarged at its inner end to form a recess in the inner face of said tool holder, an integral punch having a cylindrical body-portion rotatably adjustable with a press-fit in said die-receiving hole and having a non-cylindrical punch terminal at its lower end and a laterally-projecting extension at its upper end rotatably adjustable in said recess when rotatably adjusting said cylindrical body-portion in said punch holder, and a die carried by the other of said tool carriers and provided with a non-cylindrical punch-receiving aperture corresponding to the shape of the non-cylindrical punch terminal of said punch, said laterally-projecting extension having a pin hole therethrough parallel with the axis of said punch, and a pin secured in the inner end wall of said recess at any point determined by the rotatable adjustment required of said punch to cause the non-cylindrical punch terminal thereof to register with the correspondingly-shaped punch-receiving aperture in said die, said pin being entered in the pin hole in said laterally-projecting extension, whereby said punch will be held against axial and rotatable movement and may be brought in a position to

register with the mating hole in said die and be so maintained.

5. A punch and die assembly for punching non-cylindrical holes in a sheet of metal or other like work-piece, comprising a punch carrier, a punch holder secured to the under side of said punch carrier and having a cylindrical punch-receiving hole therethrough perpendicular to its outer face and having also a recess in its inner face opening into the upper end of said cylindrical hole, an integral punch having a cylindrical body-portion entered in said cylindrical punch-receiving hole with a press-fit permitting snug rotatable adjustment therein, said punch having a non-cylindrical punch terminal at its lower end, a laterally-projecting extension at its upper end rotatably adjustable through an arc of a circle up to at least 180° when rotatably adjusting said punch in its punch-receiving hole, means interposed between said laterally-projecting extension and a wall of said recess to hold said punch and the said laterally-projecting extension thereof in any adjusted position, a die for mating coaction with said punch disposed axially therewith, said laterally-projecting extension bearing against the bottom of said recess and the upper end face of said punch being in contact with said tool carrier, whereby a punch may be maintained in adjusted position within said punch holder, a counter-part of said punch substituted for a damaged, dull or broken punch, the substitute punch held against axial movement and assurance had that it will be in perfect registration with said die and whereby said substitute punch will be held against rotatable movement so as to maintain the non-cylindrical punch terminal thereof in registration with said die.

6. Punch and die mechanism for punching non-cylindrical holes or openings in sheet metal or like work-pieces and in which spaced-apart tool carriers are movable relatively toward and from each other, a tool holder detachably secured to one of said tool carriers and having a cylindrical tool-receiving hole therein perpendicular to its outer face and enlarged at its inner end to form a recess in the inner face thereof closed by the carrier to which said tool holder is secured, an integral punching-tool having a cylindrical body portion snugly fitted but rotatably adjustable in said tool-receiving hole and having a non-cylindrical hole-forming portion at its outer end and a laterally-projecting extension at its inner end provided with a pin hole whose axis is parallel with that of said body portion and has fixed angular relation to said non-cylindrical hole-forming portion, the inner end wall of said recess having a hole drilled therein at a selective point determined by the position of said pin hole after swinging said laterally-projecting extension circularly and rotatably adjusting said cylindrical body-portion within its punch-receiving hole, a pin entered in said drilled hole and projecting into said pin hole, and a second punching-tool having a non-cylindrical hole-forming portion corresponding to the non-cylindrical hole-forming portion of said first-mentioned punching-tool, whereby the hole-forming portion of said first-mentioned punching-tool will have a fixed angular relation to the pin hole in said laterally-projecting extension regardless of the angular disposition which the hole in the work-piece is to have, and whereby the said laterally-projecting extension is utilized to determine the point along a circular path at which said extension is to be anchored, and the pin projecting from said drilled hole and entered into the pin hole in said laterally-projecting extension serves as the sole means to retain said first-mentioned tool in adjusted position, while permitting adjustment of the latter circularly through 360° or less preparatory to anchoring said laterally-projecting extension by means of said pin.

7. Punch and die mechanism for punching non-cylindrical holes or openings in sheet metal or other like work-pieces and in which spaced-apart tool carriers are movable relatively in a given plane, a punching-tool having a non-cylindrical hole-forming portion and being secured to one of said tool carriers, a tool holder secured to the other of said tool carriers and having a cylindrical tool-receiving hole therethrough perpendicular to the face of its carrier, said tool-receiving hole being enlarged at its inner end to form a recess in the inner face of said tool holder closed by said second-mentioned carrier, a second punching-tool having a cylindrical body-portion inserted by press-fit in said cylindrical tool-receiving hole from the inner end thereof and having a non-cylindrical hole-forming portion to mate with the non-cylindrical hole-forming portion of said first-mentioned punching-tool, a laterally-projecting extension at the inner end of said second punching-tool, said laterally-projecting extension being integral with said second punching-tool and having a fixed angular position with relation to the non-cylindrical hole-forming portion thereof, and retaining-means in said recess selectively positioned therein by adjusting said laterally-projecting extension, said means engaging said laterally-projecting extension and retaining said second punching-tool in angularly adjusted position, whereby said second punching-tool may be brought into registration with said first-mentioned punching-tool, said second punching-tool be held in adjusted position, and a replacing tool substituted in which the laterally-projecting extension and the hole-forming portion thereof are in the same angular relation as disposed in the replaced tool, thus enabling any dull, broken or damaged tool to be replaced without relocating or adjusting the retaining means within said recess provided for coaction with said laterally-projecting extension.

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