Aug. 27, 1940. L. V. WHISTLER ET AL 2,212,678

PERFORATING PUNCH AND DIE ASSEMBLY

Filed April 14, 1939 3 Sheets-Sheet 1

Fig. 1.

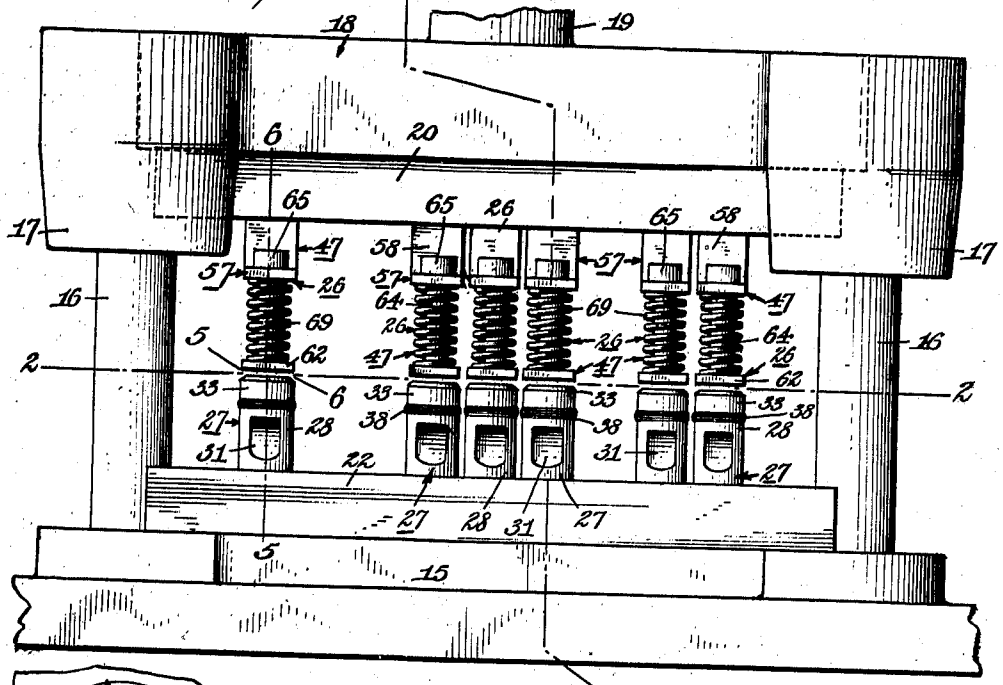
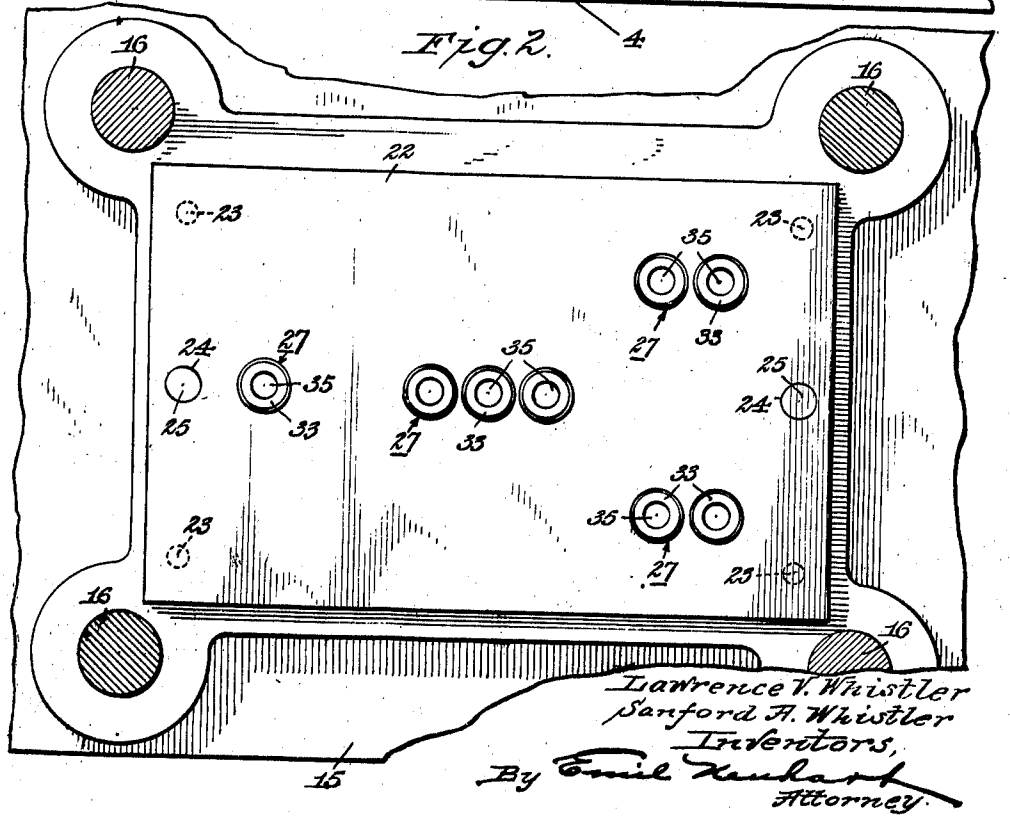


Fig. 2.



Lawrence V. Whistler
Sanford A. Whistler
Inventors,
By Emil Neubart
Attorney.

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Fig. 3.

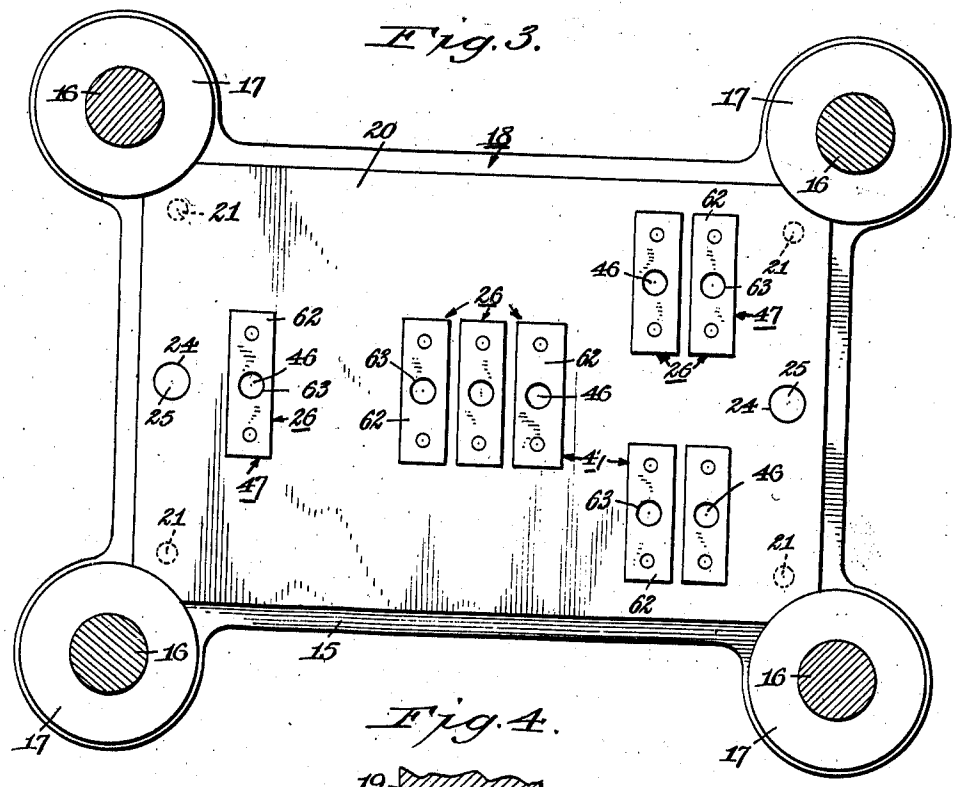
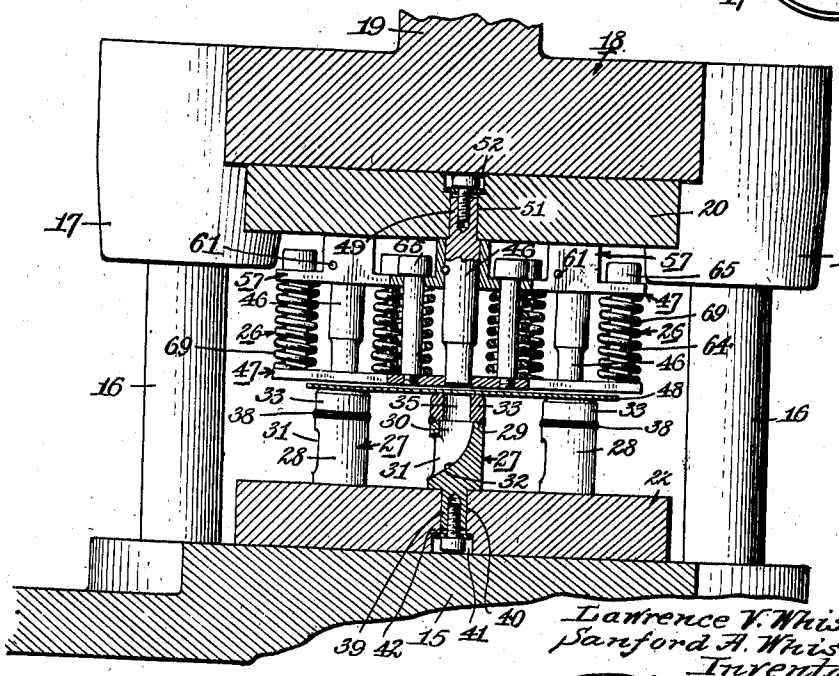


Fig. 4.



Lawrence V. Whistler
Sanford A. Whistler
Inventors,
By Emil Neubart
Attorney.

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Filed April 14, 1939 3 Sheets-Sheet 3

Fig. 5.

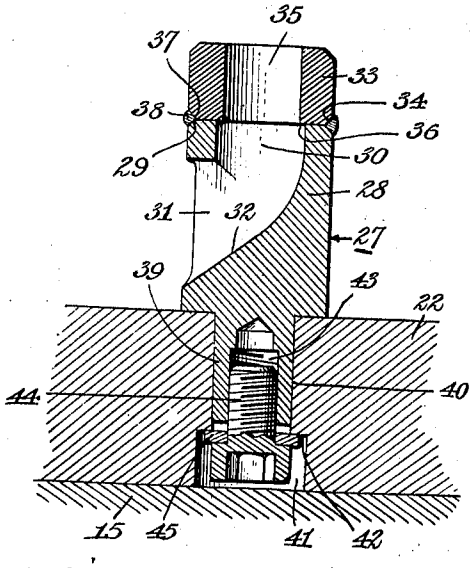


Fig. 6

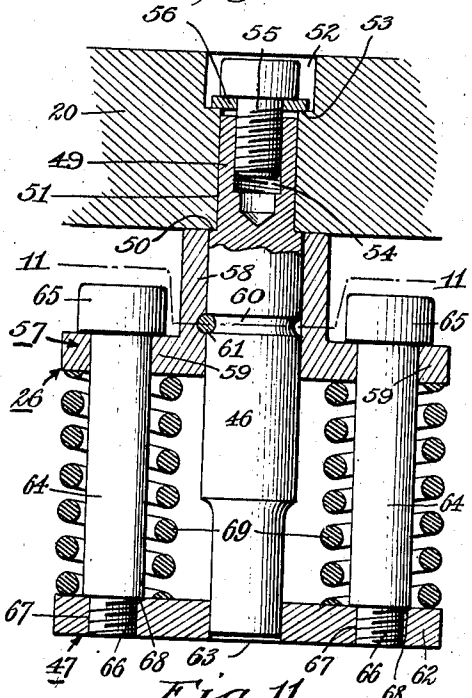


Fig. 7.

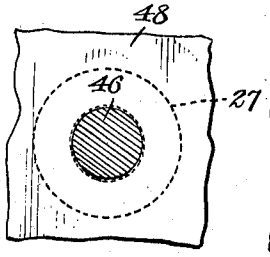


Fig. 9.

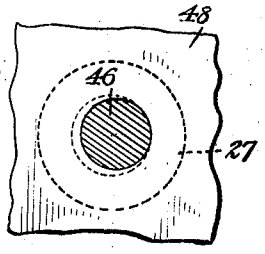


Fig. 11.

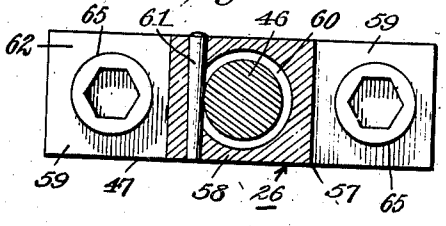


Fig. 8.

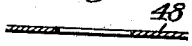


Fig. 10.

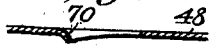
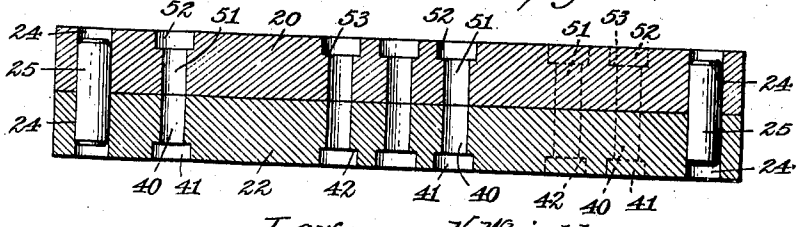


Fig. 12.



Lawrence V. Whistler
Sanford A. Whistler } Inventors,
By Emil Kuhnert
Attorney.

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UNITED STATES PATENT OFFICE

2,212,678

PERFORATING PUNCH AND DIE ASSEMBLY

Lawrence V. Whistler and Sanford A. Whistler,
Kenmore, N. Y.

Application April 14, 1939, Serial No. 267,810

8 Claims. (Cl. 164—118)

REISSUED
JAN 18 1943

This invention relates to a perforating punch and die set.

Heretofore it has been difficult to acquire perfect alinement of the die with respect to the punch, with the result that the proper concentric clearance between the punch and die could not be assured. Such clearance to be effective should approximate seven to eight per cent of metal thickness, and a variation in the axes of the punch and die of one half of such clearance would result in the punch contacting with the wall of the die, thereby causing friction which would wear out the punch and die cutting-edges and also cause undesirable burs to be formed on the stock being perforated.

Having in mind to overcome such objectionable features, it is one of the objects of our invention to provide a die and punch device in which the axis of the punch is assured coincidence with the axis of the die, with the result that the punch will enter the die with exactly the same clearance between the cutting-edge of the punch and the cutting-edge of the die at all points in the circumference of the punch.

Another object of our invention is to simplify the making of perforating dies from a cost standpoint with the assurance otherwise impossible to obtain of establishing axial or concentric alinement between the two, and also to avoid wearing out of the punch and die cutting-edges under friction, now so common in the operation of punch and die devices.

Another object of our invention is to provide securing shanks for the punch and die, whereby it is possible to provide perfectly coinciding shank-receiving openings in the punch and die holder plates of a punch and die-device capable of being formed therein while such plates are maintained in the registering relation in which they would be used in the act of punching metallic sheets or other stock material.

It is also an object of our invention to have the securing shanks of the punch and die of the same diameter so that the shank-receiving openings in the punch and die holder plates can be formed with a single drilling and boring or forming operation.

It is also an object of our invention to provide a die-device comprising two metallic parts of different densities or hardness, one of which serves as the body portion or foundation of the die device and the other as the die proper, or die-bushing as it may be termed, the foundation or body portion, or the die holder as it may be termed, being utilizable with die-bushings having punch-receiving holes of different diameters so that die-bushings can be applied to standard foundations or body portions in conformity with the punches to be used in connection therewith. It is thus of advantage to use as the foundation or body portion a malleable or other casting or a machined part and suitably connect therewith a steel or other hardened die-bushing of desired size, the punch hole in the die-bushing having in all instances a diameter which does not exceed that of the plug passage formed through the foundation or body portion and invariably having its punch hole of smaller diameter than said plug passage.

A further object of our invention is to cast the foundation or body portion of malleable or other comparatively soft iron or machine the same from bar stock while the die-bushing or die proper is formed of tool-steel or other hardened metal and brazed, hydrogen-welded, or any other means employed for securing the die-bushing to the foundation or body portion to make the die-bushing substantially an integral part thereof.

With the above and other objects in view to appear hereinafter, our invention consists in the novel features of construction and in the arrangement and combination of parts to be hereinafter described and more particularly pointed out in the subjoined claims.

The invention also consists in the novel method of preparing the set-up for the punch and die set, including punch and die holder plates adapted to respectively receive the securing shanks of the punch and die and thus assure coaxial alinement between the two.

Referring to the figures of the drawings,

Fig. 1 is a front elevation of a punch and die set shown in association with a portion of a press of the conventional type, the press having a die shoe and a punch holder adapted to be mounted on or secured to the table and the ram of the press, respectively.

Fig. 2 is a horizontal section taken on line 2—2, Fig. 1, looking down.

Fig. 3 is a similar horizontal section, looking up.

Fig. 4 is a vertical section taken on line 4—4, Fig. 1, looking to the right, part of the die shoe being broken away.

Fig. 5 is an enlarged vertical section taken on line 5—5, Fig. 1.

Fig. 6 is an enlarged vertical section taken on line 6—6, Fig. 1.

Fig. 7 is a diagrammatic view, including a sec-

tion of a punch, a portion of a piece of sheet-metal to be punched thereby, and showing in dotted lines the die underneath the sheet-metal and its true relation to said punch as provided for under our improved method of setting up the punch and die device.

Fig. 8 is a sectional view of the piece of metal shown in Fig. 7 after punching the same under the relationship provided between the punch and die illustrated in said figure.

Fig. 9 is a view similar to Fig. 7 showing the relationship between the punch and die often existing under present-day punch and die sets or devices, showing the punch and die out of true coincidence and according to which the punch is forced into the die-bushing off center.

Fig. 10 is a sectional view of the piece of metal shown in Fig. 9 after punching the same under the relationship existing between the punch and die illustrated in said figure and showing a burr formed on the sheet-metal around one-half of the wall of the punch hole therein.

Fig. 11 is a horizontal section taken on line 11—11, Fig. 6.

Fig. 12 is a view of the punch and die plates assembled and retained in proper relation by dowel pins, such as employed for properly positioning the said plates within the press and showing the method of forming the shank-receiving openings in said plates whereby the shanks of the punch and die are assured true coinciding relationship to the end that the length of the life of the punch and die will be greatly augmented and all burrs usually formed on metal punched will be eliminated.

Now referring to the drawings in detail, the reference numeral 15 designates the die-shoe of a press which may be secured to the bed or table of the latter, and which has rising therefrom several guide rods 16 over which ride guide bosses 17 formed on a punch holder 18 fastened by means of a stud 19 or otherwise into the ram of a press arranged to reciprocate toward and from the bed or table of the press.

Fastened to the under side of the punch holder 18 is a punch holder-plate 20; screws, bolts, or other fastening means for this purpose being shown in dotted lines at 21, Fig. 3. A die holder-plate 22 is mounted on the die shoe 15 and this is also fastened in place by means of screws, bolts, or other fastening devices indicated by dotted lines 23 in Fig. 2.

We have shown the punch holder-plate and the die holder-plate of exactly like dimensions so that these may be placed one over the other with their edges in perfect registration. Dowel pin openings 24 may be formed in these plates while one surmounts the other, or these openings may be formed under other conditions; and registering openings are formed in the punch holder and die shoe so that dowel pins 25 may be driven through the punch and die holder-plates and enter the punch holder and the die shoe, respectively. It is of course, necessary to have the dowel pin openings 24 in the punch and die holder-plates register with openings in the punch holder and die shoe so that these plates may be positioned properly before securing them in place. We prefer to form the dowel pin openings 24 in the punch and die holder-plates when they are mounted one on the other, as shown in Fig. 12, so that two of the dowel pins 25 may be driven into said openings 24 for positioning the plates in registering relation.

26 designates the punch devices, considered as a whole, and 27 the die devices. Each die-device 27 comprises a die-holder or body portion 28 cast of malleable or other durable and inexpensive material, it being preferably cylindrical in cross section and chamfered at its upper edge, as at 29. Said die-holder or body portion has a cylindrical slug-receiving opening 30 formed therein from its top and a lateral slug-discharge opening 31 intersecting said cylindrical opening and having an inclined rider wall 32 merging into the cylindrical wall of the slug-receiving opening 30.

33 designates the die-bushing or die proper which is formed of steel or other hard material, and it is externally chamfered at its lower edge, as at 34 (see Fig. 5). This die-bushing has a punch hole 35 formed axially therein which, if cylindrical, does not exceed in diameter that of the cylindrical slug-receiving opening 30 in the die-holder 28 and invariably is smaller in diameter so that a portion of the die-bushing overhangs the said cylindrical slug-receiving openings 30, as at 36.

When mounting the die-bushing 33 on the die-holder or body portion 28 of the die-device with the axes of both coincident, a V-shaped external groove is formed at the parting line, designated 37, Fig. 5, into which welding flux 38 may be placed while in the act of welding the anterior regions of the die-holder and die-bushing together. In this manner the die-bushing and die-holder or body portion of the die-device are made practically integral; but any other manner of rigidly connecting the die-bushing to the die-holder or body portion may be employed, even though all of the advantages of hydrogen-welding are not thus retained.

It will be apparent from the foregoing that the die-holder may, within certain limits, serve as a foundation or base for die-bushings having punch openings of various sizes or outlines so that die-bushings, regardless of the type of punch-holes therein, may be secured to body portions which do not vary from each other in any respect or any dimensions at any point, even though the die-bushings are of like or different sizes internally and to an extent externally. The die-holder or body portion 28 is reduced in diameter at its lower end to form a securing shank 39, and this snugly fits into a bore 40 formed in the die holder-plate 22. The bore 40 is counterbored at its lower end or at the bottom of the die holder-plate, as at 41, thereby forming a downwardly-facing shoulder 42. The smaller portion of the bore 40 is slightly longer than the shank 39 of the die device, and said shank is provided with an axial screw-threaded bore 43 into which is threaded a cap screw 44. Between the head of said cap screw and the shoulder 42, a washer 45 is placed which, when the screw is tightened, is forced firmly against said shoulder, thus causing the shank 39 to be tightly threaded within the bore 40 and the bottom of the die-holder or body portion 28 to be drawn tightly against the upper surface of the die holder-plate. It is to be noted that the shank 39 is coaxial with the punch opening 35 in the die-bushing 33.

Cooperating with the die-device is the punch device 26 which comprises a punch 46 and stripper means 47 whereby the sheet-metal to be punched, designated by the numeral 48, is stripped from the punch after being perforated by the latter. This punch is in the form of an elongated cylindrical member reduced in di-

ameter at its upper end to form a securing shank **49** and also along its lower portion, if desired, to conform in diameter to the punch opening **35** in the die-bushing **33** cooperating therewith; sufficient clearance of course being provided by infinitesimal variation in the diameters of said punch opening and punch. By reducing the upper end of this punch an upwardly-facing shoulder **50** is formed thereon. The punch holderplate **20** is provided with a bore **51** counterbored at its upper end, as at **52**, to form an upwardly-facing shoulder **53**, the length of the smaller portion of the bore **51** being somewhat greater than the shank **49**. The shank is provided with a threaded bore **54** adapted to receive a cap screw **55** between the head of which and said shoulder **53** a washer **56** is arranged. Upon tightening said cap screw, the punch will be drawn firmly up into the bore of the punch-holding plate until the shoulder **50** of the punch bears tightly against the under side of said plate.

The stripper means **47** comprises a head **57** having a sleeve **58**, from the lower end of which arms **59** project radially in opposite directions, said sleeve being positioned on the punch and fastened thereto in any suitable manner. We, however, have shown the punch provided with a circumferential groove **60** into which is fitted a pin **61** driven through said sleeve, the fastening means comprising said groove and pin enabling the pin to be passed through the sleeve and entered in the groove regardless of the rotary position of said punch or the stripper means.

Associated with said stripper head **57** is a stripper bar **62** which is spaced from and arranged parallel with said head and it is provided centrally between its ends with an opening **63** in which the lower or punch end of the punch is normally retained. Slidably arranged in the arms **59** of the stripper head are combined retainer and guide-pins **64** having heads **65** at their upper ends. Said pins are reduced in diameter at their lower ends and threaded, as at **66**, into threaded openings **67** formed in the stripper bar. The shoulders **68** formed by reducing the lower ends of the said combined retainer and guide-pins bear against the upper side of the stripper bar. Surrounding each of these pins are spiral springs **69** which exert their force against the under side of the stripper head **57** and the upper side of the stripper bar **62**, the heads **65** of said pins serving as stops to limit the downward movement of the stripper bar.

It will be apparent that by reason of the shank of the punch **49** and the shank of the die being of equal diameter, the bores receiving them can be formed in one operation by mounting the punch holder-plate on the die holder-plate, or reversely; this being accomplished by forming the counterbored portions of said bores from the opposite exposed faces of said plates and then continuing the normal size of the bores in which the shanks of the punch and die are to be fitted, or this can be accomplished in any other approved manner, so long as both shank-receiving bores are drilled or otherwise formed while said plates are placed together, as clearly shown in Fig. 12. It will of course be of advantage to first drill or otherwise form the dowel pin openings **24** in the plates, after which the plates may be retained in their superimposed positions by means of the dowel pins **25**, used for that purpose, or by having other dowel pins of the same diameter for preventing movement laterally or endwise of said plates while superimposed. In the drawings we have shown the punch holder-plate and the die holder-plate of exactly the same dimensions, but where the dimensions differ in one plate from that of the other they may be mounted one on the other and so retained in any approved manner, so long as the shank openings **24** in the plates are drilled or otherwise formed through both plates while so maintained. The shank-receiving bores for the punch and die devices are therefore of the same diameter in both plates, and since the shanks of both the punch and die devices are of like diameter and fit snugly into the shank-receiving bores, assurance is had that when placing said plates within the press or other machine employed for punching sheet-metal or other similar stock, a true and perfect alinement of the punches and dies will be had, it of course being understood that the punch holes in the die-bushings have their axes in true alinement with the axes of the shanks of the die-devices of which said die-bushings form part. It may also be stated that by reason of the lateral opening formed in each of the die-devices the slugs or other elements punched from the sheet-metal or other stock being operated upon, are delivered onto the die holder-plate and can be easily removed as they accumulate.

With this invention assurance is had that each punch will be concentric to the punch hole in the die-device with which the punch cooperates, as clearly shown in Fig. 7, and for a clean-cut and perfect punch operation—say for example in punching $^{5}/_{1000}$ steel—clearance between the punches and dies should approximate $^{3}/_{1000}$ of an inch. Holes punched through suck stock will have clean-cut walls without any burrs or other rough edges being formed, and this is clearly illustrated in Fig. 8.

In Fig. 9 we have illustrated a condition commonly existing in punch presses by reason of the fact that the punch has its axis slightly out of alinement with the axis of the die cooperating therewith. This results in the punch entering the die off center, oftentimes with the punch coming in contact with the wall of the punch hole in the die at one side of its center, while the clearance at the other side of the center is increased to $^{6}/_{1000}$ of an inch, thereby causing rubbing action or friction between the punch and die wall. The punch and die cutting edges become worn away under such conditions, causing a rough wall to be formed in the punched hole at one side of its center. When punches and dies so mutilated are used, the sheet-metal is pressed downwardly at the other side of the center where the increased clearance space is provided and causes a burr to be formed, as clearly shown at **70**, Fig. 10. This results in imperfect work, calls for frequent replacement of punches and dies, and necessitates further operations on the punched sheet-metal or other stock in order to dispose of the burrs projecting from the punched holes therein.

For accurate work such punched material is not acceptable, even though the burrs be finally reduced or eliminated by hammering or other operations, since such operations would not assure perfect outlines for the punch holes in the metal. It will be clear that any attempt to straighten out burrs on the wall of a round punched opening in sheet-metal by a hammering operation would result in an opening being formed that would be more or less oval, and in

any event would not be truly circular, and this distortion of the punch hole would occur regardless of the cross sectional formation of the punch and the punch hole in the die-bushing, since the same difficulty would be encountered with any other form of punched hole formed under like circumstances.

We regard the formation of securing shanks of like diameters on the punch and die of marked importance in a punch and die assembly or mechanism for the reason that the holder-plates, carrying members, or parts of the punch and die assembly receiving said securing shanks can be drilled or otherwise manipulated to form the receiving openings for said shanks with one operation of a drill or other suitable tool, and thus assurance be had of so positioning the punch and die that the axes of both are coincident and that the clearance between the punch and the punch hole in the die-device will be the same at every point of the circumference of the cutting edges of both the punch and the die-device.

We further regard the employment of a die-holder or body portion for the die-device constructed of any suitable metal for use in connection with die-bushings of various sized punch holes as of considerable importance, since it enables various sizes of punches to be used in connection with mating die-bushings on a die-holder or body portion having a definite size and shape. This is particularly true in view of the provision made for securely fastening the die-bushing to the die-holder or body portion of the die-device, especially when the die-bushing is brazed, welded, or otherwise permanently connected together; thereby providing means to make the die-bushing a rigid part of or substantially integral with the die-holder or body portion of the die-device.

We also wish to stress the fact that by reason of merging the wall of the lateral opening in the body portion or die-holder with the peripheral wall of the cylindrical axial opening in the upper end thereof, the inclined rider face so formed will prevent clogging of the slugs cut from the sheet-metal or other stock within the body portion or die-holder. This rider face, as is clearly shown in Fig. 5, is formed in an arc of a circle at least along a portion of its length, so that when the slugs drop thereon, diametrically opposite points of the slugs contact the concaved wall and thus minimize the friction between said wall and the slugs. Free sliding motion for the slugs through the lateral discharge provided therefor is assured. Moreover, the particular arrangement of the punch and die device shown and described enables punch openings to be formed in sheet-metal or other sheet material with much closer centers than heretofore possible.

The lateral discharge opening provided in the body portion or die holder of each die-device, whereby the punched out slugs are delivered laterally onto the die holder-plate, eliminates the slug passages usually formed through said plate and also through the die shoe and the table of the press, depending on the type of press employed. It will therefore be apparent that a die holder-plate for one job may serve for all other jobs within a given area, since the form of shank-receiving openings therein will not, in most cases, interfere with forming other shank openings in the die holder-plate, while absolutely no openings will at any time be necessary in the die shoe and the bed or table of the press.

By providing the punches and die devices with axial securing shanks and fitting them into axial alined openings in the punch and die holder members, all outstanding flanges usually employed on punches and die devices are dispensed with and the punches and die devices in any desired member may be secured to the punch and die holder members in considerably closer relation to each other than has heretofore been possible.

Having thus described our invention, what we claim is:

1. In a punch and die assembly, a punch holder-plate having an opening therein, a die holder-plate spaced from said punch holder-plate and having an opening therein in axial alinement with and of a diameter corresponding to the opening in said punch holder-plate, a punch having a shank fitted into the opening in said punch holder-plate with its axis coincident with that of said opening, a die-device having a shank fitted into the opening of said die holder-plate and of a diameter corresponding to the diameter of the shank of said punch, said die-device having a slug-discharge opening to deliver slugs therefrom punched from sheet-stock, and means axially engaging and securing the shanks of said punch and said die-device in said openings.

2. In a punch and die assembly, spaced apart punch and die holder-members provided with vertical axially-alined openings of like diameter permitting both openings to be formed simultaneously when placing one of said members against the other, means for securing said holder members in operative separated positions and in which said openings are retained vertically axially alined, punch and die devices having securing shanks of like diameters and corresponding in diameter to that of the openings in said punch and die holder-members, said securing means for said holder-members being independent of said punch and die devices, said shanks having axial screw-threaded bores, a securing screw threaded into the shank of said punch device from the upperside of said punch holder-member, and a securing screw threaded into the shank of said die device from the under side of said die holder-member, said die-device having a slug-discharge opening to deliver slugs therefrom punched from sheet-stock.

3. In a punch and die assembly, a punch holder-plate adapted to bear with its upper side against a punch shoe and having an opening bored therethrough counterbored at its upper end to form an upwardly-facing shoulder in said bore, a punch having its upper end reduced in diameter to form a securing shank and to provide an upwardly-facing shoulder at the base of said securing shank, said shank being fitted in said opening and having an axial threaded bore formed therein opening at the upper end of said shank, a washer in the counterbored portion of said opening bearing against the upwardly-facing shoulder therein, and a cap screw passed through said washer and threaded into the bore of said shank, said cap screw having its head bearing against said washer and being wholly within the counterbored portion of said opening.

4. In a punch and die assembly, a die holder-plate adapted to bear with its under side against a die-shoe and having an opening bored therethrough counterbored at its lower end to form a downwardly-facing shoulder, a die-device having its lower end reduced in diameter to form a

securing shank and to provide a downwardly-facing shoulder at the upper end of said securing shank, said shank being fitted in said opening and having an axial threaded bore formed therein opening at the lower end of said shank, a washer in the counterbored portion of said opening bearing against the downwardly-facing shoulder therein, and a cap screw passed through said washer and threaded into the bore of said shank, said cap screw having its head bearing against said washer and being wholly within the counterbored portion of said opening, said die-device having a slug-discharge opening to deliver slugs therefrom punched from sheet-stock.

5. A die-device comprising a body portion of cast metal having a slug opening extending downwardly from its upper end and continued laterally to one side of said body portion, a die-bushing of hardened metal mounted on said body portion and peripherally welded thereto to form a substantially integral device constructed of two different metals.

6. A die-device comprising a body portion of cast metal having a slug opening extending downwardly from its upper end and continued laterally to one side of said body portion, said body portion having means to axially secure the same within a die holder-plate, and a die-bushing of hardened metal mounted on said body portion and welded thereto to form a substantially integral device constructed from different metals.

7. In a punch and die assembly, co-operating punch and die holder members normally spaced apart and having co-axial openings therein of a given diameter and adapted to interchangeably receive correspondingly formed and sized parts of punch and die devices of varying sizes, combined with a punch device having a punch of selected size provided with a shank secured in and of a size to fit the opening in said punch holder member, a die device having a die provided with a punch hole serving as a mate to said punch and provided with a shank secured in and of a size to fit the opening in said die holder member, means axially securing the shank of said punch from the upper side of said punch holder member, and means axially securing the shank of said die device from the under side of said die holder member, said axial securing means being wholly within said punch and die holder members to enable said members to bear fully against parts to which they may be fastened.

8. A die device comprising a body portion having a slug passage therethrough from its upper surface and provided with a peripherally chamfered upper end, a die bushing of hardened metal mounted on said body portion and provided with a peripherally chamfered lower end co-operating with the chamfered portion of said body portion to form a peripheral V-shaped groove in the plane of the contacting surfaces of said body portion and die bushing, and welding flux applied in said V-shaped groove to secure said die bushing to said body portion.

LAWRENCE V. WHISTLER.
SANFORD A. WHISTLER.