Dec. 12, 1944. L. V. WHISTLER ET AL 2,364,835

MEANS FOR SHEARING AND FORMING KNOCK-OUTS

Filed April 20, 1944 2 Sheets-Sheet 1

Fig. 1.

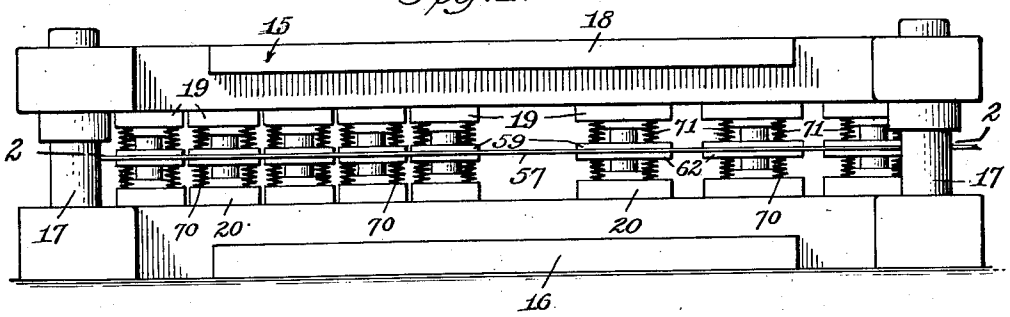


Fig. 2.

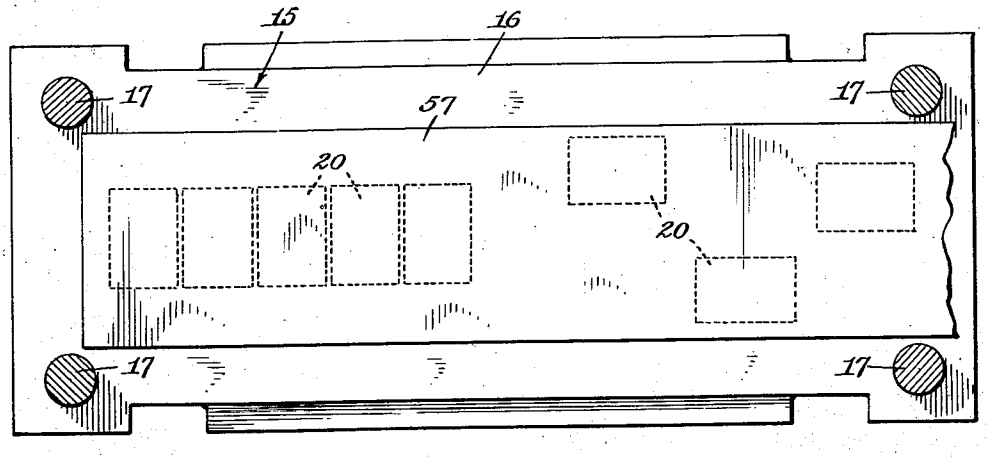


Fig. 3.

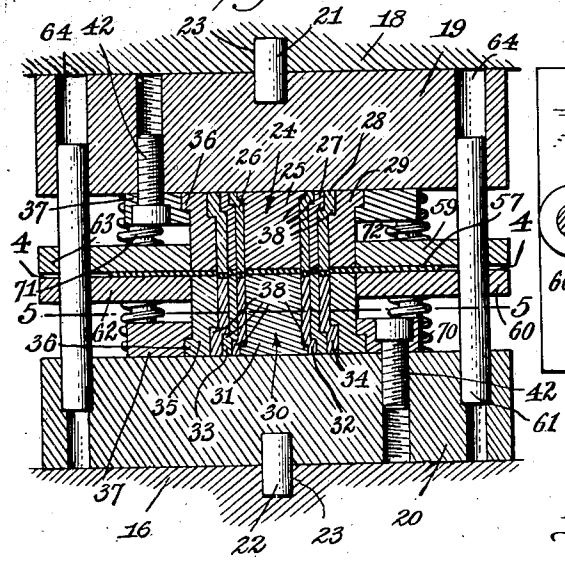
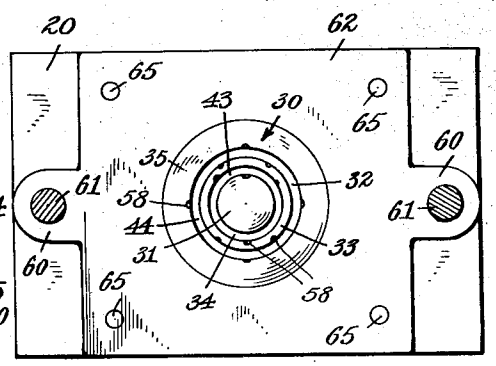


Fig. 4.



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Filed April 20, 1944 2 Sheets-Sheet 2

Fig. 5.

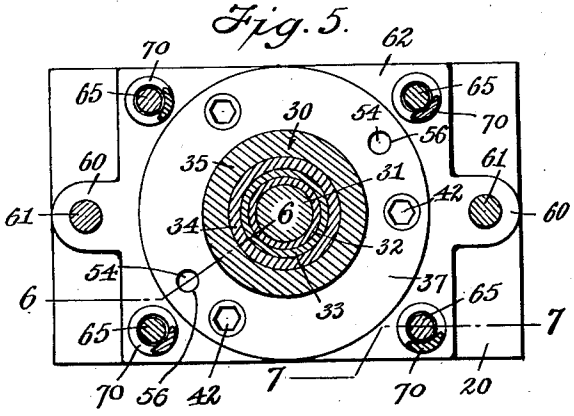


Fig. 6.

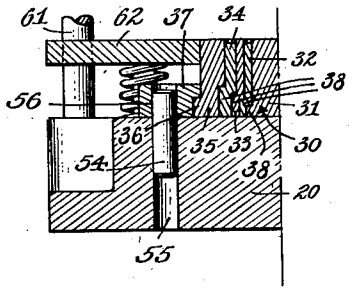


Fig. 7.

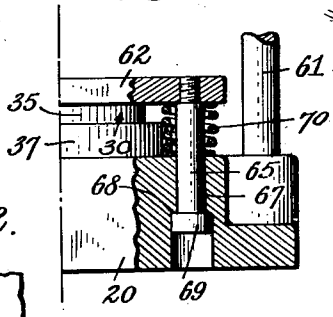


Fig. 8.

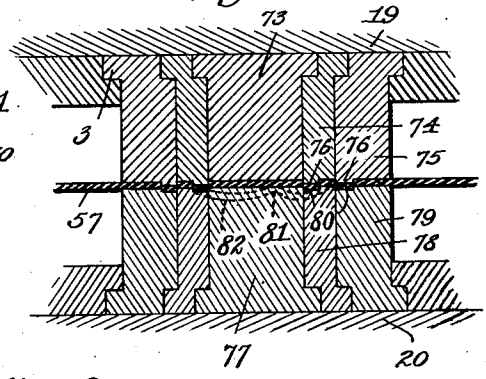


Fig. 12.



Fig. 9.

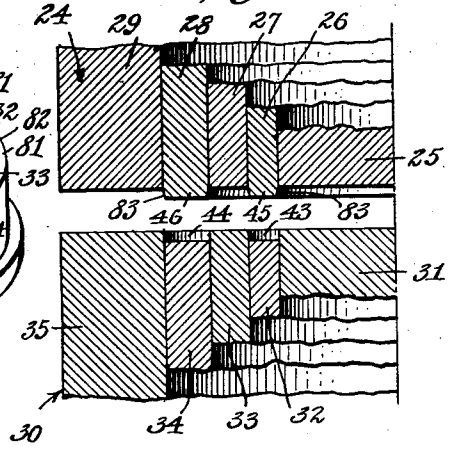


Fig. 10.

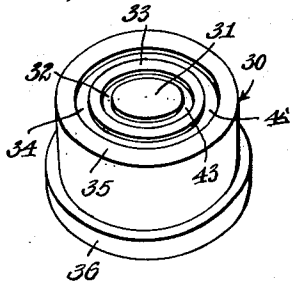
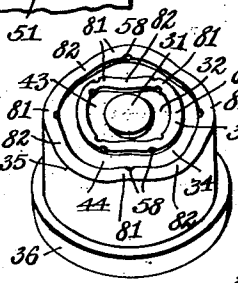


Fig. 11.



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UNITED STATES PATENT OFFICE

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MEANS FOR SHEARING AND FORMING KNOCKOUTS

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Continuation of application Serial No. 479,953, March 20, 1943. This application April 20, 1944, Serial No. 531,952

24 Claims. (Cl. 164—32)

Our invention relates to means for shearing and forming "knock-outs" in containers or in material from which containers are constructed; containers such as junction boxes or similar objects adapted to house electrical instrumentalities and having tubes or conduits connected thereto through which electrical circuit-wires are passed for connection to the electrical instrumentalities.

This application is a continuation of our application filed March 20, 1943, Serial No. 479,953, and allowed December 2, 1943.

The particular type of knock-out our invention is designed to produce comprises a plurality or series of knock-out regions or sections, one surrounding or practically surrounding another, such regions or sections being almost entirely severed one from another and all almost entirely severed from the container, box or other object in which the knock-out or knock-outs are formed.

In the particular application of our invention herein illustrated, each of the die-members for shearing or forming such knock-outs comprises a plurality or series of sections or elements, at least three in number, adapted to form a knock-out having a center section or element and one or more annular sections or elements, the latter surrounding the center section or element and all sections or elements being surrounded by the stock in which the knock-out is formed. In this manner a knock-out capable of accommodating either of two or more different sizes of pipes or conduits is provided.

We are aware of the fact that sectional knock-outs are now in common use and dies comprising a center section or element and one or more annular sections or elements are also in common use, but such die sections or elements are arranged for movement relatively one within another in the direction of the axes of the punch and die members and that where so used a single knock-out die mechanism is employed in a press and is centrally located therein, due to the fact that the relative movement of the die sections or elements of the punch and die members is effected by mechanism situated centrally in the press and operated by parts of the press, also centrally located therein. For this reason a sheet of metal designed to be fashioned into a junction box or similar object in which several knock-outs are to be formed requires a separate operation of the press for each knock-out to be stamped or formed in the sheet of metal.

It is one of the objects of our invention to provide die devices or mechanisms for simultaneously shearing or forming a plurality of knock-outs, limited in number only by the capacity of the die-set or press in which our improved die devices or mechanisms are used; any number of knock-outs being thus formed within a sheet of metal or directly in the wall of a junction box or other object under one operation of the press.

It is another object of our invention to provide a die device or mechanism in which both the punch-member and the die-member are formed of a plurality of sections nested one within the other wherein all sections are held against movement, at least in the direction of their lengths, a certain section or certain sections of both the punch-member and the die-member extending at its operating end or their operating ends, as the case may be, beyond the operating end or ends of an adjacent section or sections to establish shearing edges to sever the stock operated upon substantially circularly, or arcuately.

A further object of our invention is to provide a die-couple for shearing or forming sectional knock-outs in which each member of the die-couple comprises a center or core section and a plurality of annular sections arranged one within another and all around the center or core section; the operating ends of the sections forming each of said members being fashioned to provide annular grooves, and annular projections adapted to co-act with said grooves to lance or shear metal to form a knock-out having a circular center region or section and a plurality of annular surrounding regions or sections; said die-couple including means to form narrow tie-portions between the regions or sections of the knock-out and thus prevent complete severance of the sections one from the other and all from the stock in which the knock-out is formed.

It is also a further object of our invention to provide solid foundations having a series of knock-out die-couples applied thereto; corresponding members of all die-couples utilizing the same foundation as their support and said foundations being applied to the relatively movable spaced-apart ram and shoe of a die-set under action of a press in which the die-set is arranged; thus permitting any number of knock-outs to be formed in sheet metal or the like under one operation of the press, within the capacity, of course, of the die-set in which the die-couples are arranged.

A still further object of our invention is to provide die mechanism for shearing or forming knock-outs in sheet metal or the like wherein one member of said die-couple is provided with an annular projection or projections on its op-

erating face and the other member is provided with an annular depression or depressions in its operating face concentric with said projection or projections and toward or into which said projection or projections are adapted to enter for forcing an annular region or regions of sheet metal or the like into said depressions; at least one of the peripheral faces of said annular projection or one of the peripheral faces of each of said annular projections being preferably slightly beveled.

With the above and other objects to appear hereinafter, we have illustrated our invention in a representative manner in the accompanying drawings, described the same in the specification, and particularly pointed out our invention in the the subjoined claims.

In the drawings:

Fig. 1 is a front elevation of a die-set having a plurality of our die-couples applied thereto and showing a sheet of metal between the members of the various die-couples for the purpose of simultaneously stamping a series of knock-outs in the metal under a single operation of the die-set; the die-set being adapted to be placed within a press, under the action of which the knock-outs are to be formed.

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

Fig. 3 is an enlarged vertical section through a die-couple, the means for holding the two members of the die-couple and the stripping mechanism associated therewith.

Fig. 4 is a horizontal section taken on line 4—4, Fig. 3 showing the lower or die-member of the die-couple and its associated stripping plate in plan view.

Fig. 5 is a horizontal section taken on line 5—5, Fig. 3.

Fig. 6 is a vertical section taken on line 6—6, Fig. 5.

Fig. 7 is a vertical section taken on line 7—7, Fig. 5.

Fig. 8 is a vertical section through a die-couple, portions of the foundations thereof, and portions of the securing annuli by means of which the members of the die-couple are secured to said foundations; the die-couple shown in this figure being one in which the metal between the tie-portions of the knock-out sections are bulged out of line and in which corresponding annular sections of the members of the die-couple are designed to operate on two annular regions of the metal and shear the same.

Fig. 9 is an exaggerated vertical section of the operating ends of a die-couple taken through one-half of its diameter and showing the peripheral faces of the projecting annular portions of one member of said die-couple slightly tapered.

Fig. 10 is a perspective view of the sectional assembly of one member of a die-couple adapted for shearing stock preparatory to bulging annular regions thereof when such bulging is to be effected as a separate operation, or when no bulging operation is required.

Fig. 11 is a detached perspective view of the sectional assembly of one member of a die-couple, the operating annular regions of which are shown undulating so that high and low regions are provided for the purpose of bulging the metal in each annular region or section of a knock-out between tie-portions thereof out of line with adjacent surrounded and surrounding portions of the metal.

Fig. 12 is a plan view of a piece of metal showing a sectional knock-out formed therein.

We desire to stress the fact that in our invention we are able to utilize a single die-couple or any number of die-couples within the areas of the ram and shoe of a die-set and that our invention therefore differs from other knock-out dies in that the latter are used singly in a press and because of the necessity of effecting the stamping or shearing operation through the medium of movable parts arranged centrally in the press and forming part thereof.

We also stress the difference existing between this invention and sectional dies of the general type utilized in this invention in that the sections of the knock-out making-devices now in use are relatively movable, whereas the sections in our invention are at all times maintained in assembled relation and expressly held against relative movement, such as usually provided for under present day methods of stamping knock-outs in sheet metal or similar material.

Having this in mind, it is the purpose of our invention to produce a simple and inexpensive knock-out device or mechanism which will occupy comparatively little space and enable a plurality of knock-outs to be closely arranged in walls of junction boxes or other objects in which electrical instrumentalities are to be confined.

Our knock-out making or die-device is particularly designed for use in connection with any commercial type of die-set and it is, therefore, entirely independent of any operating elements forming part of the press in which the shearing or stamping operations are effected. This therefore, enables the knock-out making or die-device to be secured to any region or regions of the ram and shoe of a die-set, regardless of the centering of such device or devices with respect to the center of the press, as is now found necesesary; and it might be stated that these devices can be secured directly to the ram and bed of a press in the event that a suitable die-set is not available, since the shoe and the ram of a die-set serve merely as foundations for the two members of each knock-out die-couple. It will be clear that where the die-couples are applied directly to the ram and bed of a press, such members of the press will serve as foundations for said die-devices or mechanisms the same as the ram and shoe of a die-set.

As we prefer to employ a die-set to be placed within a power press, we have in the application of our invention shown in the accompanying drawings designated the die-set by the numeral 15, and it comprises a die-shoe 16 from which guide-posts 17 extend on which the ram 18 of the die-set is vertically movable. It is, of course, understood that the die-shoe is fastened or otherwise applied to the bed of a press and the ram of the die-set to the ram of the press and is movable therewith. This arrangement may be varied so long as the shoe and ram of the die-set are relatively movable to enlarged and decrease the space between the two during each cycle of movement of the press.

We prefer to employ punch-holders 19 which are adapted to be fastened to the underside of the upper or ram member 18 of the die-set or to the ram of a punch or stamping press, and a die-holder 20 adapted to be fastened to the shoe of the die-set or to the bed of a press. These punch and die-holders are provided centrally with locating pins 21, 22, respectively, which are de-

signed to enter openings 23 in the ram and shoe of the die-set, or in any other foundation element to which the punch and die-holders are to be applied, regardless of whether such foundation elements are the ram and shoe of a die-set, the ram and bed of a press, or separate plates (not shown) which may be secured to the ram and shoe of the die-set or to the ram and bed of the press.

Although our invention is mainly designed to enable a plurality of knock-out devices or mechanisms to be employed in a die-set or press for simultaneously stamping a plurality of knock-outs, it is to be understood that even though reference is herein made to die-devices or mechanisms, there are occasions when a single die-device or mechanism may be employed and this may be positioned in the die-set or press without regard to the center of either. Invariably a die-set or any other means which will provide suitable foundations and supports for the two members of a die-couple is of a size to meet the particular requirements of the stamping operation to be effected regardless of the number of die-couples used.

The punch and die-members of each die-couple are co-axially arranged and the axes of these members are axially alined with the locating pins 21 and 22 projecting from the upper and lower faces, respectively, of the punch and die-holders. Where a plurality of die-devices or mechanisms are employed, the centers of the knock-outs to be formed in the wall of a box or a sheet of metal will be predetermined, and such centers determine the centers of the die-devices or mechanisms and are according to a pre-designed template. These centers can be fixed on the ram or shoe of a die-set, or the ram and bed of a press, or on foundation plates to be applied to such members of a die-set or press. Regardless of what the foundation elements may be, the centers thus established will permit the drilling or punching of the openings 23 to conform to the locating pins and thus it will be clear that the mere placement of the die-devices or mechanisms against their foundation or supporting elements will result in proper placement to punch the knock-outs in the stock or object operated upon with their centers at pre-determined points thereof.

Each punch-member and each die-member comprises several sections or parts, preferably cylindrical and these are nested one within another. In Fig. 3 of the drawings we have illustrated a punch-member 24 comprising five sections, one a center or core section 25, immediately surrounded by a sleeve-like section 26, which in turn is surrounded by a sleeve-like section 27. The section 27 is surrounded by a sleeve-like section 28 and this in turn is surrounded by a sleeve-like section 29. The sections 26, 27 and 28 may therefore be termed intermediate sleeve-like sections. The die-member 30 comprises similar co-acting members 31, 32, 33, 34 and 35; the center or core section 31 of the die-member corresponding in diameter to the center or core section 25 of the punch-member 24 while the sleeve-like sections 32, 33, 34 and 35 correspond in diameter to corresponding sleeve-like sections of the punch-member. The inner ends of the punch and die-members are flush and bear firmly against their respective foundation members, whether the ram and shoe of a die-set, the ram and bed of a press, or any other foundation element.

The outermost sleeve-like section of each member of the punch and die-device is provided at its inner end with an outstanding or peripheral flange 36 which is entered into a rabbeted portion of a retainer element or annulus 37 surrounding it. The inner peripheral face at the inner end of each sleeve-like section 26, 27, 28 and 29 of the punch-member and the inner peripheral face at the inner end of each sleeve-like section 32, 33, 34 and 35 of the die-member is rabbeted or counterbored to receive an alining flange 38 formed on the sleeve-like member which it immediately surrounds. Thus it will be noted that the retainer elements or annuli 37 engage the flanges 38 of the outermost sleeve-like section of each member and are employed to fasten the punch and die-members to their respective foundations or supports, while the alining flanges formed on the outer peripheral faces at the inner ends of the remaining sections prevent relative movement of all sections longitudinally or in the direction of their axes. Socketed securing screws 42 are passed through the retainer elements or annuli 37 and are threaded into the punch and die-holders 19 and 20; each punch-member and each die-member being in effect the same as an integral structure.

The sections of the punch and die-members vary alternately in length and in the particular illustration of our invention, the sections 32 and 34 of the die-member are somewhat shorter than the remaining sections thereof and thus form annular grooves 43 and 44, see Fig. 9. The co-acting sections 26 and 28 of the punch-member are somewhat longer than the remaining sections of said punch-member and form annular projections or ribs 45 and 46 which are adapted to enter the annular grooves or depressions 43 and 44 formed in the operating face of the die-member, or at least are designed to force stock into said annular grooves or depressions and shear or lance annular regions of the stock from adjacent regions and thus stamp or form the conventional sectional knock-out now in common use, but always sheared or stamped in the stock one at a time during each cycle of a press operation. Provision may be made in any suitable manner for preventing relative rotative movement of the sections forming the punch and die-members of our improved die-device or mechanism; but since such movement is not detrimental to the operation of our invention, such means is not shown and may not be required since these sections are micrometrically dimensioned and fit tightly one within the other.

A knock-out making-device or mechanism in which each punch-member and each die-member comprises five sections is designed to form a knock-out having four removable regions or sections, such as shown in Fig. 12 and designated by the numerals 47, 48, 49 and 50, respectively, any one or any number of which, as clearly understood by those familiar with the art to which this invention relates, can be punched out, depending on the size of the conduit to be employed in connection with the knock-out. Assuming a conduit conforming in diameter to the diameter of the center sections of the punch and die-members is to be used, force would only be applied to the center section 47 of the knock-out, which is invariably separated from the surrounding annular sections except for a short tie-portion or tie-portions 51 connecting the same with the surrounding sleeve-like section 48 and this is true of all annular regions or sections of the

knock-out, the tie-portions of which are designated by the numeral 52. Force applied to the center section only, results in said section yielding and forming an opening of the desired size. If an opening of larger size is required the force would be simultaneously applied to the combination of knock-out regions or sections matching the opening to be formed.

The retainer elements or annuli 37 have the securing screws 2 arranged at regular intervals around the same, as clearly shown in Fig. 5, and preparatory to fastening said retainer elements or annuli in place, dowel pins 54 are employed to properly position the same. These dowel pins are positioned at diametrically opposite points of the securing elements or annuli, as clearly shown in Fig. 5, the lower portions of those employed in conjunction with the die-member of the die-couple being driven into dowel openings 55 formed in the die-holder 20 while the upper portions thereof extend above the upper face of said die-holder and enter openings 56 formed in the retainer element or annulus 37 associated with the die-member. Similar dowel pins are employed for the retainer element or annulus used for securing the punch-member to the punch-holder 19. The underside or surface of the punch-member and upperside or surface of the die-member may be referred to as operating faces and more particularly as contacting or pressure faces designed to co-act upon a sheet of metal or upon the wall of a box or other object designated by the numeral 57.

The upper face of the die-member 30 is provided with one or more annular depressions or grooves, such as 43, 44, the number depending upon the particular knock-out to be formed in the metal, and while we have illustrated a knock-out making-device comprising several sections or parts for forming sectional knock-outs, it is to be understood that the punch and die-members of such devices may be constructed to form a knock-out having a single part without departing from the principle involved in this invention or the particular features of novelty embodied therein. In all cases however, upon insertion of a sheet of metal or a wall of a box or other structure between the two members of the punch and die-device, the closing or approaching movement of said members will cause portions of the metal or wall of the structure to be forced downwardly into the depression or depressions formed in the operating face of the die-member; thereby effecting a shearing or lancing of the metal or stock. For the purpose of forming the tie-portions 51 and 52 of the knock-outs, the inner or the outer peripheral wall of each annular concentric depression or groove in the operating face of one of the members of the die-couple is nicked, as at 58, and at points where these nicks are formed the tie-portions 51 and 52 are established in the knock-out.

A stripping plate 62 surrounds the upper end of the die-member 30 and it is provided at opposite ends with ears 60 having openings therein to fit guide-posts 61. A like stripping plate 59 surrounds the lower end of the punch-member 24 and it also has ears 63 provided with openings to receive the guide posts 61, said guide posts having their lower ends driven into the die-holder 30 and their upper ends slidable in openings 64 formed in the punch-holder. The said stripping plates are, therefore, guided for movement on the punch and die-members 24 and 30, respectively, and also on the guide posts 61; these guide posts providing a simple means to position the two members of the punch and die-device in axial alinement before securing them to their respective foundations or supports by means of the retainer elements or annuli 37, said guide posts having a definite relation to the locating pins 21 and 22 extending from the punch and die-holders 19 and 20, respectively. The guide posts 61 may be retained in their supporting position when a single knock-out is to be formed in a sheet of metal not wider than the space between the guide posts and while these guide posts maintain the punch and die-members of the punch and die-device in concentric or axial relationship, they may in some instances be dispensed with and are preferably dispensed with when a plurality of knock-outs are to be stamped in a sheet of metal or other stock, as clearly shown in Figs. 1 and 2 of the drawings. The stripping plate 62 has guide rods 65 fastened to its four corners and these extend downwardly and are entered in guide holes 67, see Fig. 7, to provide downwardly facing shoulders 68 against which enlargements or heads 69 at the lower ends of said guide rods normally bear. Surrounding each guide rod is a spiral spring 70, one end of which bears against the upper side of the die-holder 20 and the other end against the underside of the stripping-plate 62.

Similar springs 71 are provided between the stripping plate 59 of the punch-holder 19 and these are associated with guide rods 72 similar to and operating in the same manner as the guide rods 65. The guide rods 72 enter holes (not shown) in the punch-holder exactly like the guide-holes 66 in the die-holder 20. The springs 70 and 71 function to position the lower face of the punch stripping-plate 59 slightly below the lower or operating face of the punch-member 24 and the stripping-plate 62 its upper face slightly above the level or operating face of the die-member 30 so that when the punch and die-members are brought together and are under full pressure against the stock being operated upon, the opposing faces of the stripping plates may be in alinement with the true or operating faces of the punch and die-members and upon separating these members the stripping springs 70 and 71 will retrieve their normal positions and act to strip stock from the punch and die-members. This adjustment of the stripping plates may, of course, be modified so long as said plates function to strip the stock from the punch and die-members. When the stripping plates are in their normal positions, the heads of the guide rods 65 and 72 will be in firm contact with the shoulders in their respective guide holes. While we prefer making the punch and die-members cylindrical, it is apparent that the exterior formation of these members may be otherwise formed and yet permit the depressions and elevations of the two members of the punch and die-couple to be formed in or on the contact-pressure or operating faces of the same. It is also to be understood that the several parts or sections of the knock-out need not necessarily be concentric, since various sized openings may be provided in a knock-out without confining the product to a knock-out in which the regions or sections thereof are concentrically arranged.

The punch and die-members of our improved punch-and-die device, or knock-out making-device as it may be termed, have supporting or foundation elements as backings for the same and the superficial areas of such elements at all times conform to the number of punch and die

devices to be employed in stamping knock-outs in a workpiece. The punch and die-holders 19 and 20 serve as intermediate foundations or supports for the punches and dies and by reason of their upper and lower surfaces being flat they receive solid support from the foundation elements and in turn provide solid flat supporting surfaces for the inner ends of the punches and dies, or more particularly, the inner ends of the punch and die sections when such punches and dies are made sectional.

In the modification shown in Fig. 8 we employ three sections for each member of the die-device, although with such modified construction knock-outs having four selectively removable regions or sections are formed.

In this particular construction the center or core section of the punch-member, solid or otherwise, is designated by the numeral 73 and it is immediately surrounded by an annular or sleeve-like section 74, which in turn is surrounded by an outer annular section 75. Each of said annular sections 74 and 75 is provided with a stepped inner or operating end face so as to form an annular projection or rib 76 around the inner region of the same. The die-member comprises a center or core section 77 which is immediately surrounded by an annular or sleeve-like section 78; the latter being surrounded by an annular or sleeve-like section 79. The inner or operating end faces of the annular or sleeve-like sections 78 and 79 are also stepped to provide an annular rabbet or depression 80 around the inner region of each of said sections designed to match the projections 76 on the annular sections of the punch member. The core sections 73 and 77 of the punch and die members form the solid center of the knock-out, while the two intermediate annular or sleeve-like sections 74 and 78 form the next two annular regions or sections of the knock-out and the outer annular sections 75 and 79 of the punch and die members form the outermost annular region or section of the knock-out.

As clearly described in our allowed application identified hereinbefore, provision is made to assure a complete severance of the metal between tie-portions of the knock-out and, therefore, in some cases we provide means for off-setting or bulging the metal of the knock-out between the tie-portions which connect the sections of the knock-out together. This may be accomplished while shearing or lancing the metal or after having sheared or lanced the metal to define the outlines of the several sections of the knock-out. When using a knock-out making-device or punch and die mechanism such as shown in Figs. 2, 3, 4, 9 and 10, the operating or pressure end faces of the various sections of the devices or mechanism are all flat with the inner walls of the respective annular grooves parallel with the outer faces of the annular projections. When operating upon certain kinds of metal or other stock, the shearing or lancing operation is sometimes found to be incomplete, due to the fact that at regions other than the small tie-portions which are intended to serve as the sole means for tying such sections together, the metal is not completely sheared or lanced. This prevents a complete severance of a section or combination of sections from the knock-out and causes difficulty in forming the desired opening in the metal. For this reason, users of products in which knock-outs are called for demand that a complete severance of the metal in which the knock-out is formed be effected between tie-portions, and to assure this we have in some instances provided what may be termed forming, off-setting, or bulging dies with which knock-outs previously stamped, sheared, or lanced are operated upon so as to bulge or offset adjoining areas or sections of the knock-out out of complete alinement between the tie-portions connecting the sections so that light can be seen along the major portions of the circularly or arcuately sheared or lanced lines, as the case may be. Assurance will, therefore, be had that the solid center section of the knock-out will be completely severed from the annular section immediately surrounding it, except where a tie-portion or tie-portions, such as illustrated in Fig. 12 connect the two together; also that complete severance of the metal occurs between the several annular sections of the knock-out and between the outermost annular section and the body of the sheet in which the knock-out is formed, except where the tie-portions connecting such sections are formed. It is, therefore, to be understood that a rudimentarily formed knock-out is created under action of punch and die-members, such as illustrated in Fig. 10 and that the so rudimentarily created or formed knock-out is subjected to a second operation under action of punches and dies, such as shown in Fig. 11, which may be termed offsetting, or bulging punch and die-devices. The various sections of such an off-setting or bulging die-couple are in all respects similar to the sections of the shearing or lancing die-couples, such as shown in Fig. 10, except that the outer or operating end faces of the sleeve-like or annular sections are formed for off-setting or bulging the metal at regions between tie-portions, instead of shearing or lancing the metal. The outer operating end face of the two members of the die-couple shown in Fig. 11 are therefore designed for supplementary operation on the sheared or lanced knock-outs previously stamped by a shearing or lancing die-couple in the usual manner, for the purpose of positively separating the metal between the sections from tie-portion to tie-portion.

In Fig. 11 we have illustrated the die-member of an off-setting or bulging die-couple in which the solid center or core section is or may be an exact duplicate of the solid center or core section of the die-couples previously herein described. The intermediate annular section or sections, as the case may be, of each member of the die-couple have their end faces made undulating so as to provide high and low regions 81, 82, respectively, gradually merging one into the other.

It is, of course, to be understood that the two members of the dies having undulating annular projections and grooves may also be utilized to shear or lance the stock and simultaneously therewith cause the stock in one annular region to be bulged out of line with an adjoining portion of a surrounding or surrounded region or section of the knock-out. In such cases the high regions 81 of one of the punch and die-members have the nicks 51 formed therein so that the tie-portions are formed at spaced-apart points around the annular sections of the knock-out, and between these tie-portions the adjacent portions of adjoining sections of the knock-out are bulged out of line with each other so that along the arcuately lanced or severed lines, light can be seen between the tie-portions of the knock-out and assurance had of a complete severance of the metal between said tie-portions.

We particularly wish to stress the fact that the peripheral faces of the projecting portions of one of the members of each die and punch-device may be slightly beveled, as clearly shown in an exaggerated manner at 83 in Fig. 9. The bevel, or chamfer as it may be termed, being approximately one-half of one degree. This will assure a perfect shearing or lancing of the stock without the tendency of jamming the regions of the stock covered thereby into the co-acting annular depressions formed in the die-member of the punch and die-device.

From the foregoing it will be clear that when the punch and die-members or the various sections of such members are applied directly to the ram and shoe of a die-set or to the ram and bed of a press, or when used in conjunction with die-holders, as for example illustrated, flat foundation surfaces are provided for the inner ends of such members and that such punch and die-members may be applied selectively to any regions of such flat foundation so that a plurality or series of punch and die-devices may be used for simultaneously stamping or forming any number of knock-outs in a sheet of metal or other stock within the capacity of the die-set or press used in the stamping operation.

Having thus described our invention what we claim is:

1. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising spaced-apart foundation surfaces, each of which has a given superficial area, a plurality of punch-holders secured to one of said foundation surfaces, a corresponding number of die-holders secured to the other of said surfaces, a punch member secured to each of said punch-holders, and having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, a die-member secured to each of said die-holders in axial alinement with a punch-member to form a punch and die couple and having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, the operating faces of said punch and die-members having mating annular depressions and elevations adapted to lance stock circularly and having means to form tie-portions at one or more points of the circularly-lanced lines in said stock.

2. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supports having flat opposing surfaces and being relatively movable in a plane at a right angle to such surfaces, a punch-member applied to any region of one of said supporting elements and having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, a die-member applied to the other of said supporting surfaces in axial alinement with said punch-member and having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, both said punch and die-members being formed to arcuately shear stock placed between the two and leave narrow unsheared tie-portions between the ends of the arcuately-sheared lines, the placing of said punch and die-members against any alined regions of said supports enabling the stamping or forming of a knock-out in sheet metal or other stock in any region of the latter.

3. Punch and die-mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements of considerable area and having flat surfaces facing each other, a plurality of punch-members applied selectively to any regions of one of said supporting elements, each punch member having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, and a plurality of die-members applied to the other of said supporting elements in axial alinement with said punch-members to form a plurality of punch and die-couples, each die member having a plurality of sections fitting one within another and immovable relatively in the direction of their axes, both members of each punch and die-couple being formed to arcuately lance sheet metal or other stock and leave narrow unsheared tie-portions between the ends of the arcuately-lanced portions, said die-couples being applied to said supporting elements in any desired spaced relation to stamp a plurality of knock-outs in the stock in accordingly-spaced relation.

4. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements having flat securing faces, a punch-member secured to one of said supporting elements, a die-member secured to the other of said supporting elements, each of said members having a plurality of sections nested one within the other and at least one of the sections of each of said members being longer than others to form an annular projection and an annular depression on its operating face, at least one of the peripheral walls of the annular projections of each member being slightly beveled and adapted for co-action with a peripheral wall of the annular depression of the other of said members.

5. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements having flat securing faces, a punch-member secured to the securing face of one of said supporting elements, a die member secured to the securing face of the other of said supporting elements, each of said members having a center or core section and annular surrounding sections, certain of said sections being longer than others to form annular projections, the annular projections of at least one of said members having their peripheral faces slightly beveled.

6. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements having flat securing faces, a punch-member secured to the securing face of one of said supporting elements, a die-member secured to the securing face of the other of said supporting elements, one of said members having an annular projection and the other having an annular depression adapted to receive said projection, the peripheral faces of said annular projection being slightly beveled.

7. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a punch-member and a die-member, each having a center section and an annular surrounding section, said sections being immovable relatively in the direction of their axes, the opposing operating faces of said annular surrounding sections being formed to lance or shear two sections of a knock-out lanced circularly except for at least one tie portion therebetween.

8. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a punch-member and a die-member,

each having a plurality of nested sections providing circular and annular operating faces designed to stamp circular and annular regions in sheet metal or the like, said sections being immovable relatively in the direction of their axes, the operating faces of certain corresponding sections of said members being stepped to shear or lance two annular sections of the knock-out in the stock being operated upon.

9. Punch and die mechanism for punching knock-outs in sheet metal or other flat material, comprising a punch-member and a die-member, each having a center or core section and a plurality of annular sections surrounding said center or core section, the operating faces of the center or core section of each member being in the same plane as the operating face of the outermost annular section of said member, the outermost section of one of said members having an annular projection around its inner region and the outermost annular section of the other member having an annular depression around its inner region for co-action with said annular projection, each of the remaining annular sections of said last-mentioned member being stepped annularly in its face to provide an annular depression around its inner region and an annular projection around its outer region while the corresponding section of the other member has its face stepped to provide an annular projection around its inner region and an annular depression around its outer region for co-action respectively with the annular depression and projection of its mating section.

10. Punch and die mechanism for punching sectional knock-outs in sheet metal or other stock, comprising a punch-member and a die-member each formed of a plurality of sections arranged one within the other, said sections having means to prevent relative movement in the direction of their axes and each member having an operating face conforming to the operating face of the other member to arcuately stamp, shear or lance the stock to form a sectional knock-out and to provide tie-portions at the end of the arcuately-sheared or lanced lines between the sections of the knock-out.

11. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements relatively movable toward and from one another, a plurality of punch holders secured to one of said elements, a corresponding number of die-holders secured to the other of said elements, a punch-member secured to each of said punch-holders, a die-member secured to each of said die-holders in axial alinement with a punch-member to form a punch-and-die couple therewith, one member of each punch-and-die couple having a circular depression in its operating face and the other member thereof having a circular projection on its operating face whose axis is coincident with the axis of said circular depression, said circular elevation being adapted to approach or enter said circular depression to shear the stock operated upon, each punch-and-die couple including means to maintain a narrow unsheared tie-portion or tie-portions in said stock between the sheared regions thereof, and means for stripping the material from said die-couples.

12. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart supporting elements relatively movable to enlarge or diminish the space between the two, a plurality of punch-members applied to selected regions of one of said supporting elements and a plurality of die-members similarly applied to the other of said supporting elements to form a plurality of punch-and-die couples, both members of each punch-and-die couple being designed to arcuately shear or lance the stock and leave narrow unsheared tie portions between the ends of the arcuately sheared portions, and a stripping-device surrounding each punch-member and die-member of each punch-and-die couple.

13. Punch and die mechanism for simultaneously punching a plurality of knock-outs in spaced-apart relation in sheet metal or other flat stock, comprising a plurality of punch-and-die couples, each member of each of said couples being formed of a plurality of sections arranged one within another and the sections of each member being immovable relatively in the direction of their axes, a pair of spaced-apart supporting elements to one of which the punch-member of each of said punch-and-die couples is applied and to the other of which the die-member of each of said punch-and-die couples is applied, the co-acting faces of each punch-and-die couple being designed to shear the stock so as to form a sectional knock-out, and stripping means applied to each punch-and-die couple.

14. Punch and die mechanism for simultaneously punching a plurality of knock-outs in closely spaced-apart relation in sheet metal or other flat stock, comprising a plurality of punch-and-die couples, a pair of spaced-apart supporting elements to one of which the punches of said punch-and-die couples are applied and to the other of which the dies of said punch-and-die couples are applied, the co-acting faces of each punch-and-die couple being designed to shear the stock so as to form a sectional knock-out, a stripping device surrounding the punch of each punch-and-die couple, and a stripping-device surrounding the die of each punch-and-die couple, said stripping-devices being secured to said supporting elements.

15. Punch and die mechanism for simultaneously punching a plurality of knock-outs in spaced-apart relation in sheet metal or other flat stock, comprising a plurality of punch-and-die couples, each of said couples comprising a punch-member and a die-member axially alined and designed to form a sectional knock-out, each of said members being formed of a plurality of sections arranged one within another and the sections of each member being immovable relatively in the direction of their axes, a pair of flat supporting elements to one of which one member of each punch-and-die couple is applied and to the other of which the other member of each punch-and-die couple is applied, and a stripping-element applied to at least one member of each punch-and-die couple.

16. Punch and die mechanism for punching knock-outs in sheet metal, comprising a die-set having spaced apart supporting elements, and a plurality of punch-and-die couples, each punch-and-die couple having a sectional punch-member and a sectional die-member, the sections of each of said members being relatively immovable and the sections of both members having unyielding bearing against said supporting elements to enable the centers of said punch-and-die couples to be located at any selected points of said supporting members according to a pre-determined layout and to enable all knock-outs in such layout to be stamped in one operation.

17. Punch and die mechanism for punching

knock-outs in sheet-metal, comprising two spaced-apart solid foundation members presenting opposing supporting faces and being relatively movable in a plane at a right-angle to said supporting faces, a plurality of punch and die-couples, each having a sectional punch-member and a sectional die-member, the punch members being applied to selective regions of one of said supporting faces and the die-members to corresponding regions of the other supporting face, the sections of each member being immovable relatively and each punch-member being axially alined with a die-member.

18. Punch and die mechanism for punching knock-outs in sheet-metal, comprising a plurality of knock-out making-devices, each having two members and each member having a center or core section and a plurality of sleeve-like sections, one sleeve-like section surrounding another and all surrounding said center or core section, the sections of each member having means to prevent lengthwise movement thereof, and suitable supports for said plurality of knock-out making-devices of sufficient areas to enable said devices to be applied to selectively spaced-apart regions thereof with one member of each device in axial alinement with the other member thereof, and means for moving said supports to place said knock-out making-devices into and out of stamping operation.

19. A knock-out making-device comprising two members adapted for co-action to stamp or shear sectional knock-outs, each member comprising a center section and a plurality of surrounding sections, said sections being arranged with their operating ends in different and unchanging planes, and means for preventing relative movement of the sections of each member in the direction of the axis of such member.

20. Punch and die mechanism for punching knock-outs in sheet metal, comprising a knock-out making-device, having two members and each member having a center or core section and at least a sleeve-like section surrounding said center or core section, the sections of each member having means to prevent lengthwise movement thereof in one direction, a rigid backing for the sections of each member preventing movement of said sections in an opposite direction, and means to secure said members to said backings.

21. Punch and die mechanism for punching knock-outs in sheet-metal, comprising a plurality of knock-out making-devices, each having two members and each member having a center or core section and a plurality of sleeve-like sections, one sleeve-like section surrounding another and all surrounding said center or core section, means to prevent lengthwise movement of the sections of each member including a rigid element against which the inner ends of said sections bear, suitable supports for said plurality of knock-out making-devices of sufficient areas to enable said devices to be applied to selectively spaced-apart regions thereof with one member of each device in axial alinement with the other member thereof, and means for securing said rigid elements to said supports.

22. Punch and die mechanism for punching knock-outs, comprising a plurality of knock-out making-devices, each having two members and each member having a plurality of concentric interfitting sections, rigid spaced-apart supports to one of which corresponding members of said knock-out making devices are secured and to the other of which mating members of said knock-out making-devices are paired in axial alinement therewith, and means for securing said members to said supports to prevent relative movement of the sections of each member axially in one directions and co-acting means for the sections of each member to prevent movement thereof axially in an opposite direction.

23. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart rigid supporting elements having flat securing faces, a punch member secured to the securing face of one of said supporting elements, a die member secured to the securing face of the other of said supporting elements, each of said members having a plurality of sections nested one within another and at least one of the sections of each of said members being longer than the others to form an annular projection and an annular depression on its operating face, all sections of each of said members receiving non-yielding support from the supporting element to which they are secured so as to prevent movement of said sections relatively in the direction of their axes during the act of shearing or lancing stock.

24. Punch and die mechanism for punching knock-outs in sheet metal or other flat stock, comprising a pair of spaced-apart rigid supporting elements having flat securing faces, a punch member secured to the securing face of one of said supporting elements, a die member secured to the securing face of the other of said supporting elements, each of said members having a plurality of sections nested one within another and at least one of the sections of each of said members being longer than the others to form an annular projection and an annular depression on its operating face, the sections of each of said members receiving non-yielding support from the supporting element to which they are secured so as to prevent axial movement relatively in one direction, said sections having co-acting means to prevent axial movement relatively in an opposite direction.

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