

July 8, 1947.

J. V. NELSON

2,423,791

DIES AND THE LIKE

Filed Oct. 4, 1945

5 Sheets-Sheet 1

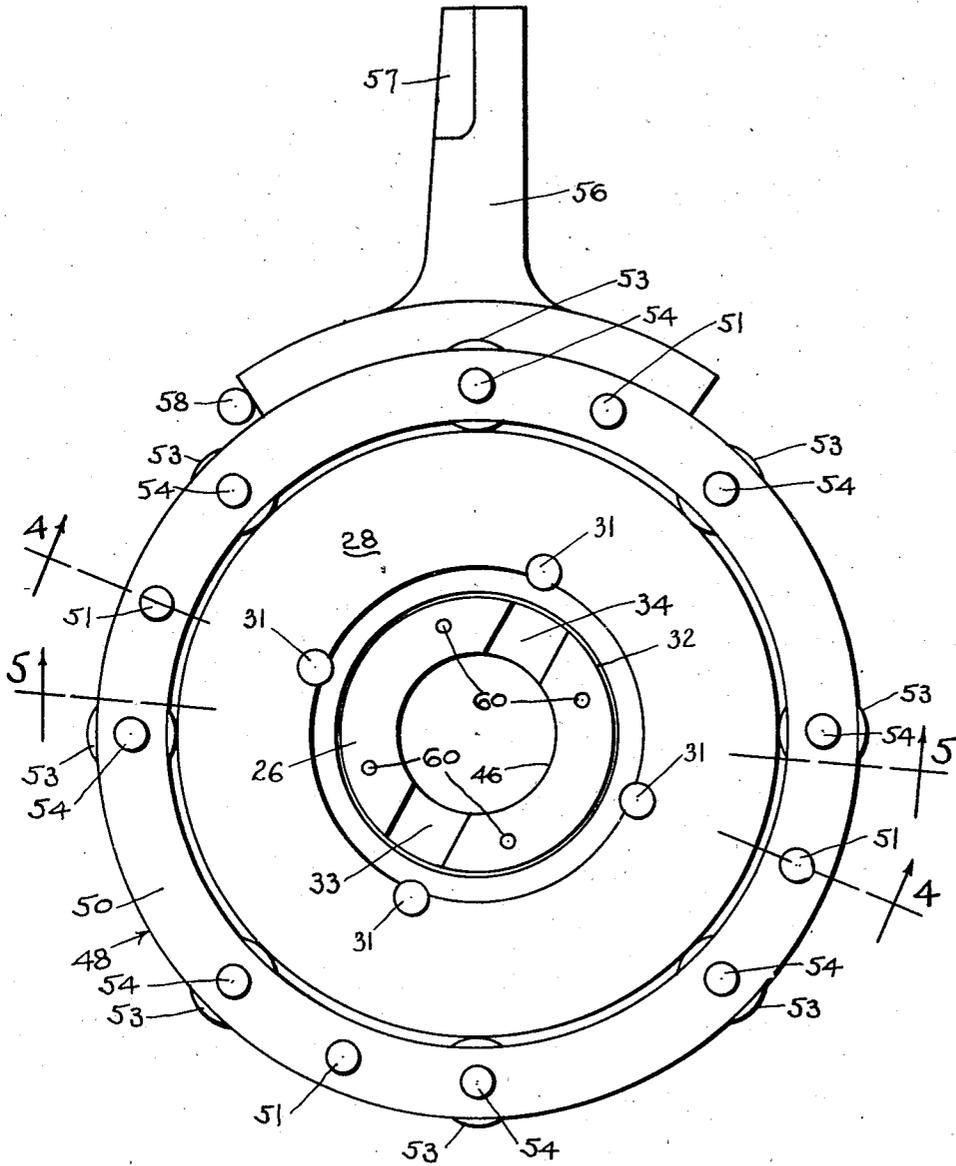


Fig. 1.

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5 Sheets-Sheet 2

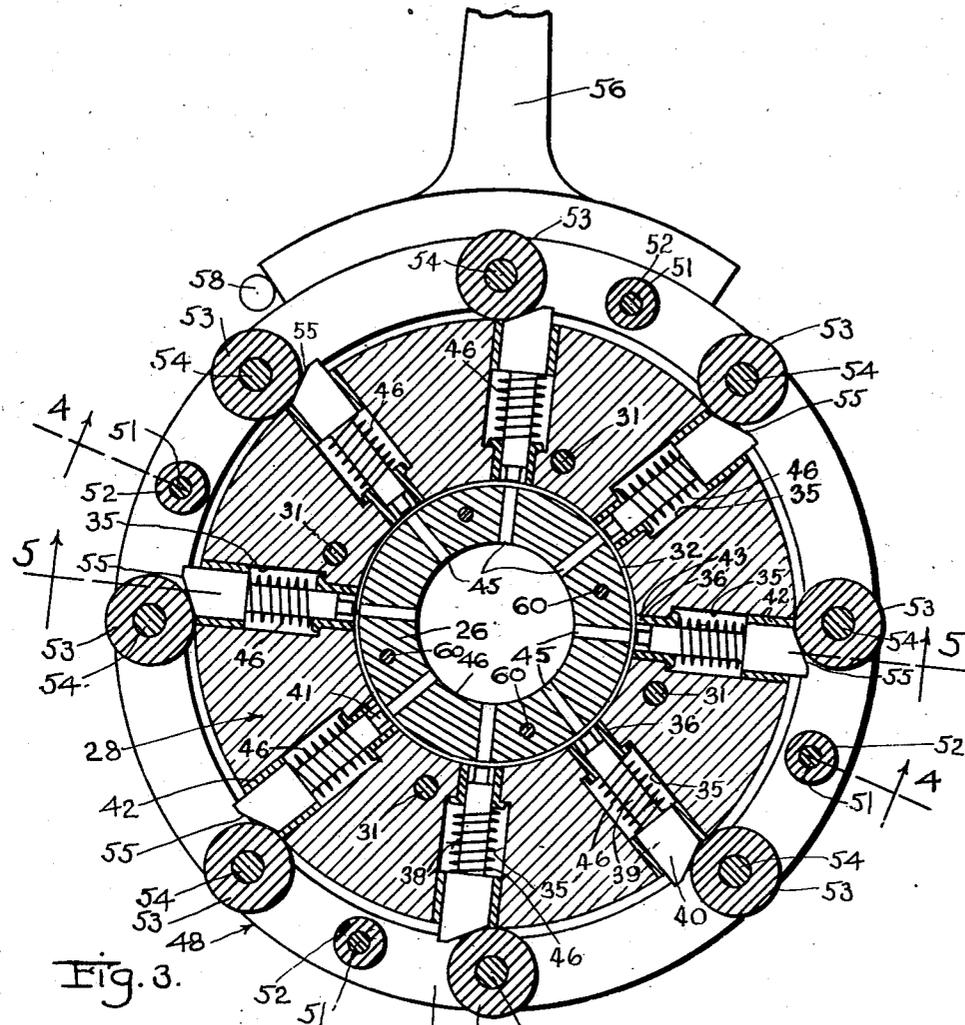


Fig. 3.

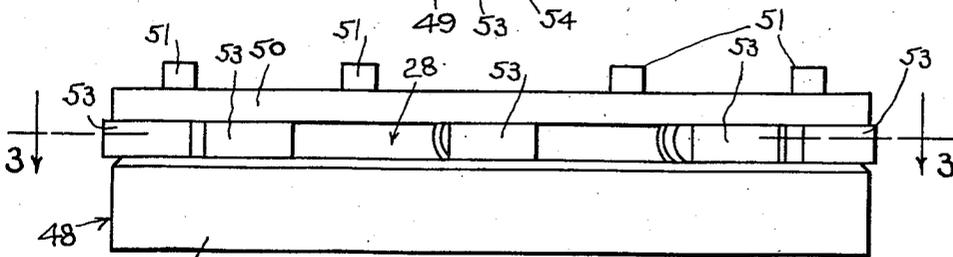


Fig. 2.

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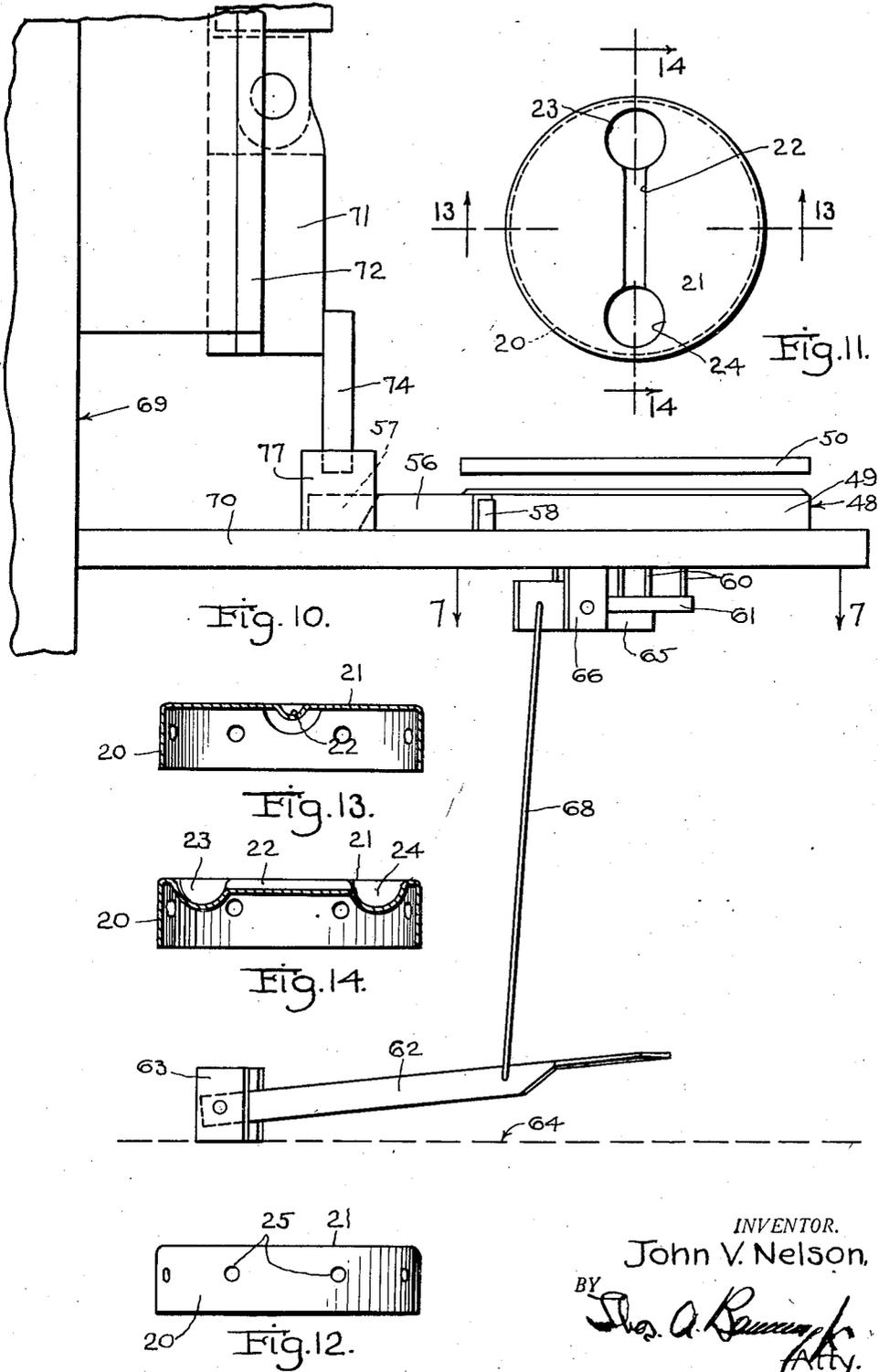
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DIES AND THE LIKE

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5 Sheets-Sheet 5



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DIES AND THE LIKE

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Application October 4, 1945, Serial No. 620,246

4 Claims. (Cl. 164—108)

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This invention relates to improvements in dies and the like. Specifically the embodiment of my present invention shown in the drawings and described in the present specification, is a punching die, but I do not intend to limit myself to this category of dies, except as I may do so in the claims to follow.

A principal object of my present invention is to provide a punching die which may be power operated by such a machine tool as a punch press, but to so arrange the die elements themselves, and to so interengage them with the press head of the punch press that the punching operations themselves are performed at a location well removed from the movements of the press head, thereby greatly reducing the dangers heretofore incident to punching operations as heretofore performed by press head operated dies. Heretofore the male and female dies used in connection with punch presses have been located substantially in alignment with the line of travel of the press head itself, so that the operator has heretofore found it necessary to place and remove the work onto and from such dies by dangerous operations, frequently resulting in injuries of more or less serious nature to the operator. According to this principal object of my present invention I have so devised and designed my die elements that the entire die unit may be set well forward on the table from the line of travel of the press head, and I have also so arranged these parts that the up and down movements of the press head or element connected thereto will be properly communicated to the die elements to cause these elements to perform their intended functions. With this arrangement, also, I have so devised and designed these die elements that the work may be readily inserted into and removed from these die elements without the need of reaching into the line of travel of the press head at any stage of the operations.

In connection with the foregoing, it is a further object of the invention to provide a self contained punching die device which may be readily operated by a simple movement of an actuating element, specifically, by a rocking movement thereof. It is a further object of the invention to so arrange this rocking element that the required rocking movement thereof may be produced by the downward movement of the press head, thus converting the said downward press head movement into the required movement of the male die element of the die unit itself.

It is a further and more specific object of the invention to provide a die unit for punching or

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forming a work object by male die movements more or less radially of a flange or other like portion of said work object. As an illustration of such a work object of flanged form I have hereinafter shown and described such an object, but in so doing I wish it understood that I do not intend to limit the usefulness or scope of the present invention to dies intended for treatment of such objects, except as I may do so in the claims to follow.

In connection with the foregoing it is an object of the invention to produce a die unit capable of simultaneously punching or forming a number of holes or semi-perforations in such flanged portion or ring like portion, by the single rocking movement of the actuating element of the die unit.

In connection with the foregoing it is a further object of the invention to so design and arrange the parts that the same rocking element may be used interchangeably with various sets of male and female die elements, thus greatly expanding the usefulness of the invention, and reducing the cost of equipment needed for performing various punching or forming operations.

A further feature of the invention relates to the provision of simple means to eject the work from the die set. In the particular embodiment herein illustrated said means is manually or pedally operated, but I also contemplate other means for performing such operations, such as automatic means therefor.

In carrying into effect the features of my present invention I have provided a cam element connected to the actuating element of the die unit, and I have also provided a companion cam element secured or attached to the press head of the punch press or other machine tool with which my improved die unit is used. These two cam elements are so related that when the press head is forced down or is actuated for a normal operation the actuating element of the die unit is moved to cause the male dies to properly function. By this means I am enabled to place the die unit completely outside of the range of press head movements, and am able to bring said die unit to a position on the work table or other support, in which position the operator is able to perform his necessary manual movements of placing and removing the work units into the die set, without said operator having to move his hands or fingers at any time into a dangerous position with respect to said press head. My improvements are therefore calculated to greatly reduce injuries from such causes.

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It is a further object of the present invention to provide a die unit of very simple design, comprising relatively few parts of simple form, and capable of being produced at low cost.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

Figure 1 shows a plan view of the assembled die set or unit, together with the actuating cam of said set or unit;

Figure 2 shows a front elevation of the die unit of Figure 1;

Figure 3 shows a horizontal section on the lines 3—3 of Figures 2, 4 and 5, looking in the direction of the arrows;

Figure 4 shows a vertical transverse section on the lines 4—4 of Figures 1 and 3, looking in the direction of the arrows, but on enlarged scale as compared to Figures 1, 2 and 3;

Figure 5 shows a vertical transverse section on the lines 5—5 of Figures 1, 2 and 3, looking in the directions of the arrows, and on the same scale as is used in Figure 4;

Figure 6 shows a front elevation of a portion of a typical punch press having the die unit of the present invention set into place on the work table thereof, and properly connected up for normal working operations, and it shows a simple form of foot or pedal operated ejector for discharging the work from the die set either partially or wholly from said die set; and Figure 6 is on reduced scale as compared to the other previously described figures;

Figure 7 is a fragmentary horizontal section on the lines 7—7 of Figures 6 and 10, looking in the directions of the arrows;

Figure 8 shows a vertical transverse section through the ejector ring, being a section on the line 8—8 of Figure 9, looking in the direction of the arrows; and Figure 8 is on the same scale as Figures 1, 2 and 3;

Figure 9 shows a plan view of the ejector ring, being on the same scale as Figure 8;

Figure 10 shows a side elevation corresponding to Figure 6, and on the same scale as Figure 6;

Figure 11 shows a plan view of a typical work unit which may be punched laterally in the die unit herein disclosed; being on the same scale as Figures 1, 2 and 3;

Figure 12 shows a side elevation corresponding to Figure 11;

Figure 13 shows a vertical transverse section on the line 13—13 of Figure 11, looking in the direction of the arrows; and

Figure 14 shows a vertical transverse section on the line 14—14 of Figure 11, looking in the direction of the arrows.

Referring first to Figures 1 to 5, inclusive, I shall describe the die unit proper, and shall thereafter disclose and describe a typical use thereof with a typical punch press and the press head and table thereof.

The die set herein illustrated is intended for punching the flange of a cup shaped unit of work, and is illustrated for example only. This unit of work is shown in Figures 11, 12, 13 and 14. It comprises a sheet metal blank formed to provide the edge flange 20, the top face 21, and the cross-wise extending groove 22 in said top face, said groove being also provided with the two enlargements 23 and 24. All these formations are produced in a die set or sets; and the

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die set or unit which comprises the subject-matter of the present application is for the purpose of producing a series of holes 25 around the flange 20.

The die set or unit includes the interior female die element 26 of circular form to seat into the work unit, and having the outwardly extending flange 27. This female die element is intended to seat on a suitable table or other support. Surrounding this female die element there is a ring shaped element 28 having the outwardly extending upper portion 29 which extends outwardly in the general plane of the working portion of the female die element; and this male die element also includes a central ring shaped portion 30 which sets down onto the flange 27 of the female die element already referred to. A series of through bolts or screws 31 is passed down through both the male die element and the flange 27 of the female die element and secured into the table or support to which the die set is connected. Thus both the male and female die elements are securely retained in position with respect to each other, and are also secured to such table or support.

It is here noted that the body of the female die element is of proper size to set into or receive the work unit, and the body portion of the male die element is of proper size to set over the flange of such work unit; and when these two die elements are set and secured together as shown in Figures 4 and 5, there is provided the annular slotted opening 32 between them, which opening is of correct radial dimension to snugly receive the flange 20 of the work unit, which work unit is set down over the female die for the punching operation. When so set into place the flange 20 fully occupies this annular slotted opening 32 and the top 21 of the work unit sets down onto the top face of the female die element. The top face of the female die element is also provided with the depressions 33 and 34 (see Figure 1) to receive the depressed enlargements 23 and 24 of the work unit, so that said work unit may be snugly and evenly set into working position over the female die.

The male die unit is provided with a series of radially extending bores 35 corresponding to the various perforations 25 which are to be punched into the flange of the work unit; and these bores extend completely through said male die unit as shown in Figures 3, 4 and 5. These bores are of reduced diameter in their inner or small radius portion, as shown at 36, thus producing the outwardly facing shoulders 37. Into each of these bores is set a male die plunger 38. The body portion 39 of this plunger is of reduced size, as compared to the outer end portion thereof, 40; and the extreme inner end portion 41 of such plunger is of a still smaller size, being the size of the hole which is to be perforated in the flange of the work unit. Preferably a bushing 42 is set into the outer end portion of the bore 35 to nicely receive the larger end portion 40 of the plunger, and another smaller bushing 43 is set into the bore to nicely receive the small, or reduced portion, 39, of the plunger. This latter bushing is provided with the outwardly extending flange 44 which sets against the inner end of the larger portion 35 of the bore. By these means the plunger is compelled to move nicely back and forth through the bore.

The female die element 26 is provided with the female die openings 45 which are in alignment with the respective male die plungers, so that

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when the several plungers are forced inwardly by suitable means, their inner die ends 41 will punch the flange of the work unit, and the cut-out material will be forced into the female die openings. Since both of the die elements 26 and 28 are secured together by the through bolts 31, and by the manner in which the lower portion of the male die element sets down over the female die element, as well shown in Figures 4 and 5, it follows that the plungers and the female die openings 45 are retained in exact alignment at all times, so that very accurate punching operations will be assured.

Springs 46 of suitable strength are set into the several bores 35 and around the several plungers therein. Each spring has its outer end bearing against the shoulder which exists at the plane of joinder of the larger outer end portion 40 of such plunger and the central portion 39 of such plunger; and the inner end of such spring bears against the flange 44 of the bushing 43 already referred to. These springs therefore serve to force the respective plungers outwardly, drawing the several male die cutting ends 41 out and away from the female die openings 45, and releasing the work unit. The cut-out material will be forced step-by-step inwardly along the several die openings 45, and may discharge downwardly through a central opening 46 of the female die element. This opening may in turn communicate with the opening 47 in the supporting table or other support.

Surrounding the male die element is an annular actuating element, 48. This element comprises the lower and upper rings 49 and 50, respectively; the ring 49 surrounding the base portions of the male and female dies where they come together; and examination of Figures 4 and 5 will clearly show that when these male and female die elements are locked together by the through bolts 31, this lower ring element 49 is also locked between the table or other support and the over-hanging portion of the male die element, so that said ring is held against unintentional removal from the two die elements.

Above and separated from the ring 49 is another ring 50, already mentioned. These two rings are secured together by the studs 51, and the spacing collars 52, located on these studs, serve to accurately space the rings from each other, and at the same time these rings will rock back and forth as a unit. Set between these rings 49 and 50 are the cam rollers 53 corresponding to the several plungers 38. Each of these cam rollers is journaled on a stud 54 extending between the rings 49 and 50; and these studs and cam rollers are spaced at spacings corresponding to the spacings of the several plungers. The outer end portion 55 of each plunger is bevelled or cam formed as shown in Figure 3, and the several parts are so proportioned that when the actuating element is permitted to rock back into such a position as shown in Figure 3 with each cam roller offset sidewise from its plunger element, said plunger element is permitted to shift outwardly to its completely disengaged position with respect to the work unit and the female die element; whereas by rocking the actuating member clockwise from its position of Figure 3 each plunger will be forced inwardly by its cam roller, and compelled to perform its punching operation. The several cam surfaces and cam rollers are properly proportioned to ensure complete

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punching action, and to also permit such complete disengagement of the parts at the proper time.

This ring shaped actuating element may be rocked in any convenient manner, either manually or by power means. For this purpose there is provided the radially extending cam arm 56 connected to the lower ring element 49. The outer end portion of this arm 56 is provided with the lateral cam surface 57, so that by forcing a suitable cam element downwardly adjacent to this cam surface the arm and the ring shaped actuating member will be rocked clockwise for the desired punching operation. A stop pin 58 is provided to limit the returning or counterclockwise movement of the actuating member.

It will be noted that the springs 46 which tend to force the several plungers outwardly will retain the outer ends of said plungers always in engagement with the several cam rollers of the ring shaped actuating element. Due to the cam form of the outer ends of these plungers there will be exerted a lateral or rocking force against the ring shaped actuating element, and this force will act in direction tending to restore said actuating element to its normal position, and with the radial arm 56 in engagement with the stop pin 58. Thus the required restoring force for returning the parts to normal or initial position is provided by these springs 46.

In order to permit of complete restoring movement of the several plungers outwardly it may sometimes be found necessary to provide slight relieves such as shown at 59 in one or the other of the rings 49 and 50, as well shown in Figure 5.

In order to facilitate removal of the punched work unit from this die set I have provided the female die element with a series of vertical through openings which receive the vertically movable pins 60 (see Figures 1 and 3). These pins are carried by a ring member 61 located beneath the die set and beneath the table on which said die set is carried, so that by forcing this ring upwardly at the proper time the pins are forced to project beyond the top face of the female die and thus raise the work unit from said die so that said work unit may then be readily removed from the die set. Then the ring member 61 may be lowered to bring said pins below the top surface of the female die element, and ready for the reception of a fresh unpunched work unit. In the scheme shown in Figures 6 and 10 this ring 61 is raised by a foot pedal 62 conveniently pivoted to a bracket 63 extending up from the floor 64. A lever arm 65 is pivoted to the bracket 66 extending down from the table whereon the die set is carried; and the free end of this lever is provided with a cross pin 67 beneath and supporting the ring 61. A rod link 68 connects the foot pedal and this lever arm so that by depressing the foot pedal the ring 61 is raised to project the pins 60 upwardly and thus eject the punched work unit. Restoration of the foot pedal and lever element and the ring 61 to their normal positions will occur when the pedal is released, such restoration usually being effected by gravity.

Evidently this die set is of such design and construction that the force needed to operate the male die is delivered to the die set at the position of the cam surface 57, which surface is located completely outside the confines of the die set itself. Furthermore, the operating force transmitted to this cam surface 57 is in a vertical direction, but the operations of inserting and removing

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the work units into and from the die set are performed completely in front of, or outside the line of travel of, any required power element to engage the cam surface 57. Generally said arm 56 will reach to the rear of the die set, that is, extend backwardly, so that the operator will be in front of the die set, observing it as in the showing of Figure 6. Thus I have provided a die set of such form, and of such power actuation that dangers attendant on the normal work operations are reduced to a minimum.

In the arrangement shown in Figures 6, 7 and 10 I have provided for attachment of this die set to a simple form of punch press and for actuation by the downward movements of the press head thereof. In these figures the frame of this punch press is shown at 69, the work table at 70, and the vertically movable press head at 71. This press head is forced down in the usual manner by a suitable form of cam or other operating element, and effects a specified down stroke, followed by a corresponding up stroke; and the press head is shown as being guided by the edge guides 72 and 73 of usual form.

To the lower end of this press head I attach in suitable manner the cam plate 74. Such attachment is shown as being effected by the screws 75. The lower portion of this cam plate 74 is provided with the cam edge 76 which will engage the cam surface 57 of the arm 56 to rock the actuating element when the press head is forced down. A lateral supporting block 77 may be secured to the table 70 in position to prevent any lateral movement of the cam plate 74 during the down movement thereof and under the camming action which occurs between the parts. The parts are so proportioned that the desired rocking movement of the actuating element is produced by the downward movement of the press head and cam plate.

Examination of Figure 10, in particular shows the fact that by this improved arrangement the operator is able to carry on his work completely in front of the line of travel of the press head and cam plate, so that the work units may be set into and removed from the die set in complete safety, and with a minimum amount of danger to the operator.

It is noted that the cam surfaces on the ends of the plungers are planar, so that line contacts are produced with the rollers of the rockable actuating element. Due to this fact also it is generally unnecessary to make special provision for preventing the rotation of the plungers in the bores of the ring shaped element 49. It is also noted that the stop pin 58, while being so placed as to limit the returning movement of the actuating member at or slightly past the position at which the male dies are released from the work flange, nevertheless said stop pin 58 limits the returning movement of the rockable actuating member at a point where each roller overlies the corresponding plunger element sufficiently to prevent any disengagement of such plunger from the male die element.

I claim:

1. A die set and means to operate the same

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comprising a central female die element having a plurality of female die openings, and a male die element surrounding said female die element and including a plurality of radially movable male die elements for co-operation with said female die openings, and an actuating element surrounding said male die element and including means to force the male die elements inwardly for co-operation with the female die openings, together with a punch press having a work table whereon said die set is secured, a radially extending cam element connected to said actuating element and extending radially rearward to a position beneath the press head of the punch press, said die set being supported on said work table at a position in advance of said press head and said cam element, together with a cam element connected to said press head and movable downwardly with said press head to engagement with said radially extending cam element of the actuating element.

2. Die means and means to operate the same as defined in claim 1, wherein said die set on said work table occupies a position completely in advance of the vertical path of travel of the press head of said punch press.

3. Die means and means to operate the same as defined in claim 1, together with means to eject work upwardly from said die set comprising an ejector pin extending through the male die element from a position beneath the work table, and foot pedal means in conjunction with said ejector pin effectively to raise said pin when said foot pedal is depressed.

4. A die comprising a female die and a co-operating male die element, said female die having a suitably formed die opening for reception of said male die, together with means to actuate the male die comprising a rockably mounted actuating element in proximity to said male die element, co-operating cam surfaces on said parts, effective to force the male die in working direction when said actuating element is rocked in one direction, and means to effect such rocking of said actuating element comprising a cam element in connection with the actuating element, and a co-operating cam element, and means to force said last named cam element downwardly for the actuation function, said forcing means being located completely to the rear of the die set.

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