July 27, 1943. H. F. TEMPLE 2,325,437

HOLE PUNCHING DIE

Filed July 22, 1942

Fig. 1

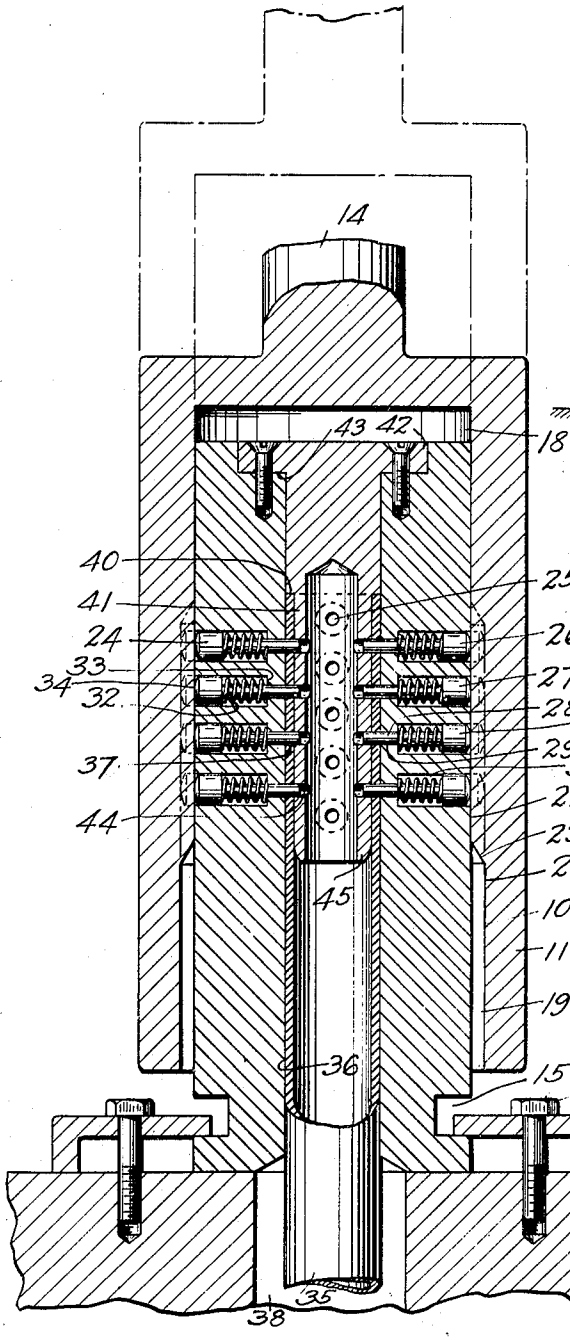


Fig. 2

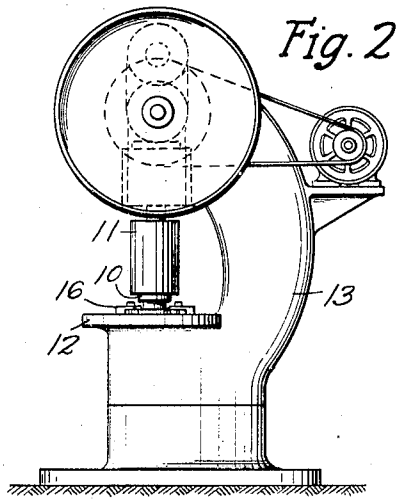


Fig. 3

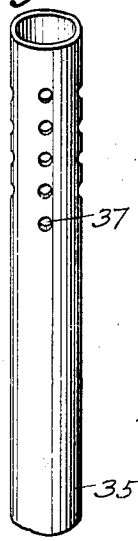
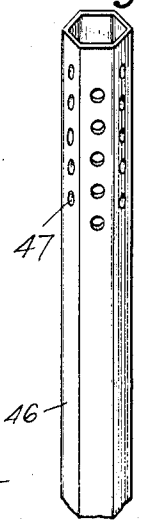


Fig. 4



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HOLE PUNCHING DIE

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8 Claims. (Cl. 164—108)

This invention relates to punching dies and particularly to dies used for the purpose of punching holes in the walls of tubes.

When perforating the end portions of tubes made of comparatively soft metal such as aluminum or the like, it has heretofore been customary to drill the desired holes in the tube by means of drills, particularly in those cases where the holes are spaced longitudinally different distances from each other or are arranged in staggered circumferential relation or are otherwise irregularly distributed or arranged. Because of the comparative softness and thinness of the metal from which the tube is made, the pressure incident to the drilling operations indents or depresses the material of the tube wall surrounding the drilled hole, resulting in a deformation of the tube and an undesirable reduction in the cross-sectional area of the passage therein. Furthermore, the drilling operations are in the greater part carried out manually and consequently necessarily slow.

The present invention therefore contemplates the provision of an automatically operable tool or die for punching substantially simultaneously or in a single operation all of the holes desired in the tube regardless of the irregular spacing or staggered relation of the holes, and regardless of the cross-sectional shape or size of the tube.

The invention further contemplates the provision of such one-operation tool or die which adequately supports the tube in a manner preventing any material indentation of the tube wall during the hole-punching operation and thereby preserving the original shape of said wall.

The invention further contemplates the provision of a punching die designed to be secured in and operated by a power press of any well-known type.

The various objects of the invention will be clear from the description which follows and from the drawing, in which,

Fig. 1 is a vertical section of my improved die showing the parts in the positions assumed thereby just after the completion of the punching operation and showing the retracted positions of the parts in dash-dot lines.

Fig. 2 is a more or less diagrammatic side view of a typical punch press in which the die has been secured and by means of which it is automatically and rapidly operated.

Fig. 3 is a perspective view of a cylindrical tube with staggered rows of perforations therein showing the work performed by means of my improved die.

Fig. 4 is a similar view of a tube of hexagonal cross-section also showing typical irregularly arranged perforations made by my improved die.

In the practical embodiment of the invention shown by way of example, the punching die comprises the relatively fixed support member 10 and the reciprocatory control member 11 made in the general form of a sleeve. The member 10 is designed to be fixed to the bed as 12 of a reciprocating power press as 13, while the control member 11 is intended to be secured to and reciprocated by the reciprocating cross-head or other reciprocating member of the press. While said press 13 has been illustrated as having a horizontal bed and a vertically reciprocating cross-head, it will be understood that the bed may be inclined, and the cross-head may reciprocate in an inclined path perpendicular to the bed for the purpose of permitting easy insertion of the work into the die member 10 in a manner which is well understood and hence need not be shown nor further described. The extension 14 of the control member is suitably shaped as in the form of a cylinder or the like for connection to the cross-head of the press, while the support member is provided with a suitable annular or circumferential groove 15 near its base, adapted to receive the clamps 16 bolted to the bed of the press as by the bolts 17, whereby the member may be fixed in place.

At the lower portion of the control member, the opening 18 therein is enlarged in diameter as at 19 to provide a preferably, though not necessarily, cylindrical inner cam surface 20 of greater diameter than the remainder 21 of the interior surface of said member, said surfaces being connected by the conical surface 23. The control member surrounds and reciprocates axially on the support member, the surface 21 being in contact with the outer surface of the support member.

The support member 10 carries the rows 24, 25, 26 and the like of punches 27 in a manner permitting the reciprocation thereof toward and from and substantially perpendicularly to the axis of the member. The reduced cutting shank 28 of each punch reciprocates in the radial hole 29 therefor in the support member 10, while the enlarged head 30 of the punch reciprocates in the hole 31 which is of sufficient length and diameter for that purpose. The spring 32 abutting at one end against the head 30 and at its other end against the wall or shoulder 33 at the inner end of the hole 31, urges the punch radially outwardly until the rounded outer surface 34 of

the head 30 engages the cylindrical wall 21 in the full-line position of the control member shown in Fig. 1, or until the head engages the surface 20 in the dash-dot line position of the control member shown. It will be understood that when the control member is lowered during the operation of the press, the corresponding or coplanar plungers of the various rows are moved inwardly simultaneously by the conical surface 23 to perform their work and that when said member is raised, the springs 32 urge said plungers outwardly to withdraw the plungers from the work.

The number and arrangement of the rows of plungers may be varied to any desired extent, so that while the rows 24, 25, 26 and a fourth row not shown may be spaced uniformly around the circumference of the work 35, they may if desired be variably spaced, and the number of rows may be increased or decreased as desired, the extent of such variation being limited only by the relative dimensions of the parts. Similarly, the individual plungers of each row need not be aligned in a plane parallel to the axis of the support or in any other plane, but may be staggered as desired, and they need not be of the same diameters or of the same diameter as the plungers of other rows, but may be designed to punch holes of different diameters as may be found desirable.

The support member 10 is made with a central hole 36 therethrough to permit the insertion thereinto of the tubular workpiece 35 in position to have the holes 37 punched therein. The bed 12 is also provided with an opening 38 therethrough, through which opening the work 35 is passed into the die until the end of the work is stopped by the shoulder 40 formed on the anvil 41. Said anvil is provided with a flange 42 fitted into the recess 43 in the upper end of the member 10 and removably secured thereto by suitable screws or bolts. The upper part of the anvil fills and fits into the upper part of the opening 36 of the support member, but the lower part 45 is preferably made hollow and is sufficiently reduced in thickness to provide an annular space between it and the wall of the opening 36 just sufficient to receive the workpiece snugly. The wall of said workpiece is thereby adequately supported by the anvil against indentation or deformation during the punching operation. A radial hole as 44 in alignment with the plunger hole 29 is provided in the anvil for the reception of the corresponding plunger when said plunger is in its innermost position. The waste disc stamped or punched out of the wall of the work by the plunger is carried thereby into the interior of the anvil and drops through the work out of the machine.

In view of the cylindrical or prismatic character of the support member and the corresponding shape of the control member, it will be obvious that regardless of the staggered or variable spacing of the plungers vertically, circumferentially or in any other direction, and regardless of whether the plungers are of uniform or different sizes, all of the plungers are operated practically simultaneously or in immediate succession on the downward reciprocation of the control member to punch all of the holes in the work in a single operation.

It will be seen that by varying the shape of the outer wall of the lower anvil part 45 and that of the wall surrounding the opening 36, tubular work of cross-sectional shapes other than circular may be operated upon efficiently, so that holes 47 in hexagonal or the like tubes as 46 may be punched in one operation by replacing the anvil 41 by another of the proper shape and size.

In the operation of the die, the control member 11 having been secured to a reciprocating part of the press 13 and the support member having been bolted to the bed 12, the press is operated to raise the member 11 thereby to retract the surface 21 from the outer ends of the plungers. The springs 32 thereby become operative to move the plungers outwardly until the outer ends thereof engage the surface 20. The tube 35 or 46 is then passed upwardly through the opening 36 until the tube end engages the shoulder 40. Continued operation of the press lowers the member 11, the conical surface 23 of the member first engaging the outer ends of all of the uppermost plungers or those of the uppermost row, then the next row and so on in rapid succession to move the plungers inwardly against the action of the springs 32. Such inward movement first causes the inner or cutting ends of the plungers to cooperate with the perforated anvil part 45 to shear or punch holes in the tube, the plungers entering the holes 29 and carrying the punched waste discs into the interior of the tube through which they fall. On the upward stroke of the press and the consequent lifting of the member 11, the plungers are retracted by their springs, the work is freed of the plungers and withdrawn downwardly out of the die and a new piece of work inserted into the die ready for the repetition of the operation.

It will be seen that I have provided a simple but efficient die for punching a number of holes of any desired sizes, arrangement and spacing in tubular work rapidly and in a single operation, and have therefore provided means well designed to achieve the intended purposes of the invention.

Any variation of modification of the invention described above not departing from the spirit of the invention is intended to be included within the scope of the appended claims.

I claim:

1. In a tube punching die, a relatively fixed support having an annular axially arranged space therein for the reception of the end portion of a tube, a series of substantially vertical rows of spring-pulled punching plungers mounted in the support for reciprocation therein perpendicularly to the axis of the support and normally projecting outwardly beyond the support, and a reciprocating control sleeve surrounding the support and having a cam surface successively engaging the outer ends of the respective plungers in the rows and simultaneously engaging all of those plungers arranged in the same relative positions in the rows to operate the plungers on the reciprocation of the sleeve.

2. In a tube punching die, a series of circumferentially and laterally spaced reciprocatory punching plungers, a spring for each plunger urging the plunger outwardly, a relatively fixed support for the plungers, the outer ends of the plungers normally extending beyond the outer face of the support, anvil means arranged axially of the support to engage the inner face of a tube inserted into the support in position to have holes punched therein by the plungers, said anvil means having holes therein aligned respectively with the plungers, and control means for controlling the position of the plungers in the support comprising a sleeve

having an inner cam surface engaging the outer ends of the plungers and reciprocating on the outer surface of the support, said sleeve having an outer surface of greater diameter than the cam surface and said outer surface normally limiting the outward movement of the plungers under the action of said springs.

3. A die for punching a series of holes in predetermined relation in the wall of a tube comprising a tube supporting member having an annular axial space therein for receiving the end portion of the tube, an anvil on the inner side of said space adapted to engage and support the inner face of the tube wall, said anvil having holes therein corresponding in size and relative position to the holes to be punched, a series of punching plungers carried by the supporting member in respective alignment with the holes of the anvil and on the other side of said space, a spring for each plunger urging the plunger outwardly to project beyond the outer surface of the support member and a control member surrounding the supporting member and adapted to reciprocate therein, said control member having an inner surface having a first part engaging the outer surface of the supporting member and having a second part enlarged to a greater diameter than that of said first part.

4. In a die of the character described, a pair of relatively reciprocating members arranged in coaxial relation and one outside of the other, the outer member having an inner cam surface in part of one diameter and in part of a large diameter, a series of punching plungers carried by the inner member to reciprocate therein substantially perpendicularly to the axis thereof, and springs urging the outermost ends of the plungers into engagement with said cam surface.

5. In a die of the character described, an anvil having spaced holes therein in circumferential and axial spaced relation, an outwardly spring-pressed plunger aligned with each hole, and means for successively pressing the axially spaced plungers into the holes and for simultaneously pressing the coplanar plungers arranged in a plane perpendicular to the axis of the anvil into the holes, said means comprising a reciprocatory sleeve having an inner cam surface engaging the outer ends of the plungers, the axis of said sleeve being substantially perpendicular to the axes of the plungers, said sleeve having means thereon limiting the extent of the outward movement of the plungers under the spring pressure thereon.

6. In a die of the character described, a series of reciprocatory hole punching plungers, a support carrying the plungers and having a central opening therein, the axis of the opening being substantially perpendicular to the axes of the plungers, an anvil removably secured in the opening and perforated for the reception of the inner ends of the plungers when the plungers are moved inwardly, springs urging the outer ends of the plungers outwardly beyond the outer surface of the support, and a sleeve having an inner cam surface engaging the outer ends of the plungers, said sleeve being reciprocatingly mounted on the outer surface of the support with part of the cam surface engaging said outer surface of the support.

7. In a die of the character described, a series of axially spaced sets of coplanar punching plungers radiating from a given axis, a fixed support for the plungers, springs urging the plungers outwardly beyond the support, means reciprocating on the support in a direction parallel to the axis for simultaneously moving all of said coplanar plungers of one set inwardly and for successively moving the spaced sets inwardly during a single stroke in a direction perpendicular to the axis, and an anvil adapted to enter and brace a tube to be punched by said plungers, said anvil being arranged in inward spaced relation to the plungers in that position of the plungers wherein said plungers are retracted by the springs, said anvil having radial holes therein to receive the inner ends of the plungers when the plungers are moved by said means.

8. In a die of the character described, a support having a central longitudinal opening therein, a hollow anvil of lesser outer diameter than the diameter of the opening arranged in the opening, said anvil having circumferentially and longitudinally spaced radial holes in the wall thereof, said support having radial holes therein in alignment with the respective holes of the anvil, a plunger reciprocatingly mounted in each hole of the support, a spring urging each plunger outwardly beyond the outer face of the support, and an enclosing sleeve for the support reciprocatingly mounted on the support for movement thereon perpendicular to the plungers and having an inner cam surface engaging the ends of the plungers and adapted to move the plungers inwardly on the reciprocation of the sleeve.

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