Nov. 29, 1949 F. A. BOYLE 2,489,559

DIE UNIT FOR PUNCHING MACHINES

Filed Sept. 4, 1948

FIG. 1

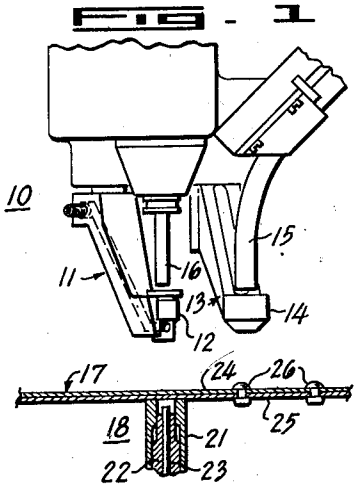


FIG. 2

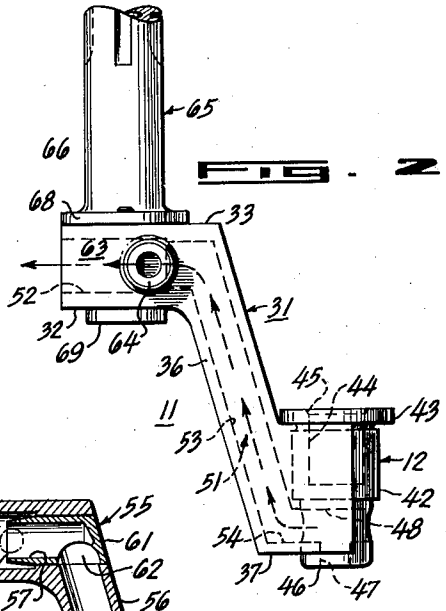


FIG. 3

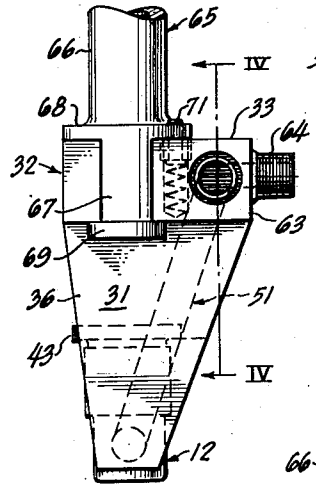


FIG. 4

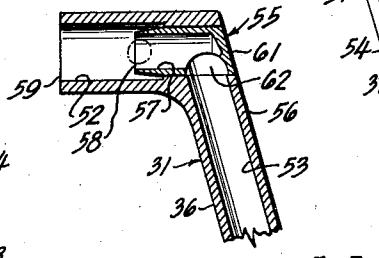


FIG. 5

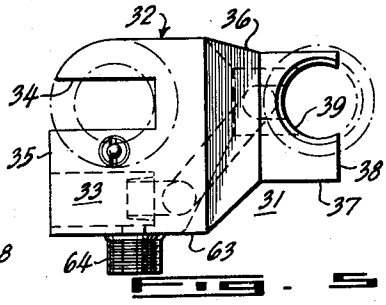


FIG. 6

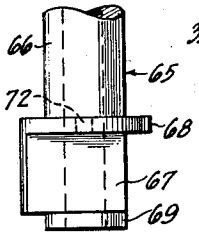


FIG. 8

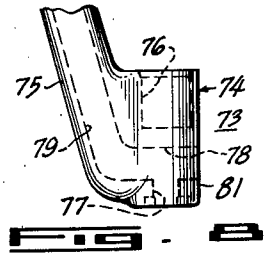
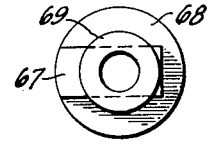


FIG. 7



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DIE UNIT FOR PUNCHING MACHINES

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9 Claims. (Cl. 164—118)

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This invention relates to punching machines for perforating sheet metal and other material and more particularly to an improved die unit utilized therewith.

An object of the present invention is to provide in a punching machine a die unit having a new and novel construction, which is readily mounted on the punching machine for reciprocating movement toward and away from the material to be perforated, and which is conveniently and readily removable.

Another object of the invention resides in the provision of a perforating die unit having an improved construction for the removal of the punchings or slugs from the die unit as a work-piece is perforated.

Another object of the invention lies in providing a perforating die unit of improved construction which may be employed in locations difficult to work with conventional die units.

Another object of the invention is the provision of a perforating die having a construction which results in a more efficient and effective device.

Other objects and features of the present invention will be readily apparent to those skilled in the art from the following specification and appended drawings wherein is illustrated a preferred form of the invention, and in which:

Figure 1 is a fragmentary front elevational view of a punching and riveting machine to which the present invention has been applied;

Figure 2 is a side elevational view of a perforating die unit in accordance with the present invention;

Figure 3 is a rear elevational view of the invention;

Figure 4 is a fragmentary sectional view taken on line IV—IV of Figure 3;

Figure 5 is a top plan view of the invention;

Figure 6 is a fragmentary elevational view of the shaft which mounts the perforating die unit;

Figure 7 is a bottom view of the shaft of Figure 6; and

Figure 8 is a fragmentary side elevational view of a modification of the invention.

Reference will now be had with greater particularity to the drawings wherein it is understood that like references have been utilized to indicate like parts in the various views.

The present invention is contemplated for use with machines adapted to perforate material such as aluminum or steel, primarily for preparation of such material for riveting thereof, and which

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machines conventionally employ punching mechanism having a reciprocating motion.

The die unit of the present invention, for the sake of illustration, is shown in the drawings as applied to a conventional punching and riveting machine, which machine serves first to perforate a work-piece and then to head the rivets which are automatically inserted by the machine into the perforations provided.

The punching and riveting machine used may be of any well known make, such as the Erco Automatic Punching and Riveting Machine, Model 1002 made by the Engineering and Research Corporation and utilizing the principles of U. S. Patents 1,990,998 and 2,056,559. Since it is understood that this machine is to be regarded merely as illustrative of the type of machine to which the present invention may be applied the machine is not shown in detail and will not be described in detail, but will be described only in such particularity as is necessary to an understanding of the invention.

In Figure 1 the numeral 10 designates generally a punching and riveting machine of the type above mentioned and with which the present invention is capable of being used. This machine 10 combines the operations of perforating the work to be riveted and automatically feeding rivets into the perforations formed and then heading such rivets, the various operations being performed without movement of the work-piece.

The machine 10 comprises, as its essential parts, a reciprocating die assembly 11 constructed in accordance with the present invention and having a die portion 12. A rivet holding assembly 13, suitably mounted for reciprocating movement, is positioned adjacent die assembly 11 and includes a rivet shoe 14 capable of receiving and supporting rivets provided by a rivet tube 15. As is well known in punching and riveting machines of the type herein employed both the die assembly 11 and the rivet holding assembly 13 are mounted by the machine 10 so as to reciprocate to perform the perforating and the riveting operations. In addition to having a reciprocating movement the die assembly 11 and the rivet holding assembly 13 are adapted to move pivotally and in unison on the completion of each perforating and each riveting operation, as will be discussed in more detail hereinafter.

In Figure 1 the die assembly 11 is shown positioned to locate the die portion 12 immediately beneath a shaft or plunger 16. This shaft or plunger 16 is suitably mounted by machine 10 to have a reciprocating movement, and in such

movement plunger 16 will engage and carry the die assembly 11 downwardly toward a work-piece 17 which is to be perforated. After the perforating operation both the plunger 16 and the die assembly 11 return to their original position of Figure 1, after which the die assembly 11 and the rivet holding assembly 13 swing or rotate in unison to exchange places to locate the rivet shoe 14 of the rivet holding assembly 13 below the plunger 16 and thereby provide a rivet for insertion into the work-piece 17. The rivet holding assembly 13 is now in position to be engaged by plunger 16 in its reciprocating movement and will be carried thereby toward the work-piece 17. Plunger 16 in this movement serves as a rivet set and causes the rivet to be inserted into its associated opening and then maintains a pressure upon the head thereof until the shank is worked. On completion of the riveting operation the rivet holding assembly 13 and rivet set or plunger 16 move upwardly and then the rivet holding assembly 13 and the die assembly 11 once again pivot to interchange positions and return to the locations illustrated in Figure 1, wherein the die assembly 11 is positioned for a perforating operation and the rivet holding assembly 13 is positioned to receive a rivet from the rivet tube 15.

To assist the members above described in the performance of the perforating and riveting operations on the work-piece 17 there is provided spaced from plunger 16 and axially aligned therewith a usual tool arrangement 18 which during the perforating operation cooperates with the die assembly 11 and during the riveting operation co-acts with the rivet holding assembly 13. The tool arrangement 18 comprises a stripper member 21 of generally tubular form which supports the work-piece 17 as it is being perforated and which further serves to space the work-piece 17 a sufficient distance from an anvil 22 contained within the stripper member 21 to allow a rivet shank to extend thereinto its required distance below work-piece 17 before heading thereof. Within the anvil 22 is reciprocally mounted a punch 23 which during the perforating operation is projected beyond the top of anvil 22 and into and through the work-piece 17 to cooperate with die portion 12 to effect piercing of the work-piece 17, and during the riveting operation is retracted and serves as a portion of the anvil head to assist in heading the shank of the rivet.

Compressed air is used in machine 10 to provide the power for effecting the operation of the various parts of the machine 10 and is derived from a source not shown. It is, of course, expressly understood that the particular construction and cooperation of the means provided in machine 10 for effecting the reciprocating and swinging movements of the die assembly 11 and the rivet holding assembly 13 and the reciprocation of the plunger-rivet set 16 and the punch 23 form no part of the present invention and therefore no need is had for detailing the description thereof.

The work-piece 17 upon which the machine 10 acts may take the general form illustrated in Figure 1 wherein it is shown as comprising a pair of contiguous metal sheets 24 and 25. The plates 24 and 25 are shown in Figure 1 as being secured together by a plurality of conventional round head rivets 26. The rivets 26 are fitted into registering rivet receiving perforations formed in sheets 24 and 25 by the die assembly 11 and punch 23. Of course it is understood that rivets

having various types of heads may be used, such as brazier head, flat head or countersunk head. In the case of a countersunk head, utilized in flush riveting, an appropriate die portion can readily be provided to form the dimple or recess in the work-piece for reception of the countersunk head.

The die assembly 11 in the particular construction which is shown mounted on the machine 10 in Figure 1 and several views of which are illustrated by Figures 2 through 5 will now be described in detail. Die assembly 11 consists of a unitary body portion 31 of generally Z shape which comprises a generally rectangular block-like upper part 32 having a flat upper surface 33. As best shown in Figures 3 and 5 a generally rectangular slot 34 is cut into part 32 extending from the rear face 35 and for the full height of the part 32. Integral with block-like part 32 and extending downwardly therefrom and at an angle thereto is a leg portion 36. Formed on the lower end of leg portion 36 in a generally rectangular block-like part 37 which, as shown in Figure 5, has formed in the lateral face 38 thereof a vertical groove or concave recess 39.

Rigidly affixed to the body portion 31 is a usual die unit or die button 12. Die button 12 comprises a body portion 42 having an outwardly directed flange 43 at its upper end. Provided in the upper end of body portion 42 is an axially extending annular recess 44, the opening 45 to which is chamfered to compensate for any misalignment of plunger 16 which is adapted to be slidably received by recess 44 to effect engagement between the plunger 16 and the button 12 whereby the former in its downward movement carries the latter with it. The body portion 42 is of generally cylindrical conformation and is adapted to be disposed in vertical groove 39 and securely mounted upon block-like part 37 as by brazing.

Extending upwardly from the bottom face 46 of the body portion 42 of die button 12 is an axial bore 47 which cooperates with the punch 23 of tool arrangement 18 to effect the perforation of the work-piece 17 and upwardly through which bore pass the punchings or slugs removed from the work-piece by the piercing punch 23. The axial bore 47 connects with a transverse bore 48 which latter bore passes at right angles to bore 47 and extends completely through the body portion 42.

The slugs or punchings passed through axial bore 47 enter transverse bore 48 and are removed therefrom by way of the passage 51 provided in unitary body portion 31. Passage 51 comprises a horizontal annular bore 52 which extends through the upper block-like part 32 and connects to a continuous annular bore 53 extending the length of leg portion 36. The lower end of continuous bore 53 communicates with a horizontal annular bore 54 in the lower block-like part 37, and the latter bore 54 opens into the transverse bore 48 in die button 12.

To drag or pull the slugs or punchings punched by lower plunger 23 from the die button 12 there is provided in upper block 32 adjacent horizontal bore 52 means for creating a suction force which acts within passage 51. These means include a cylindrical or tubular member 55 which is inserted through an opening in forward wall 56 of the body portion 31 to lie disposed in bore 52 and coaxially aligned therewith, and which member 55 is rigidly held in place as by welding. The tubular member 55 has a longitudinal bore 57

with the mouth 58 thereof opening in the direction of the opening 59 of horizontal bore 52. The cylindrical or tubular member 55 has a base portion 61 which is adapted to lie in the forward wall 56 of body portion 31.

An opening 62 in a side wall of tubular member 55 connects bore 57 with the continuous bore 53 in the inclined leg 36 whereby slugs or punchings are passed into tubular member 55.

Into a suitable opening in the side wall 63 of upper block 32 is inserted a usual fitting 64 by means of which air under pressure, from a suitable source not shown, may be introduced into bore 52. The fitting 64 opens into bore 52 adjacent the mouth 58 of tubular member 55 so that upon the directing of a blast of air across the mouth 58 air is aspirated from bore 57 to create a suction force acting in bore 57 and the connecting bores 53 and 54 to die button 12. This suction force is adapted to draw the slugs or punchings from transverse bore 48 in die button 12 up through the bore 53 in leg portion 36 and through tubular member 55 to be ejected out the opening 59 of horizontal bore 52 to be collected in suitable manner.

Die assembly 11 is affixed to a reciprocating shaft 65 provided by the punching and riveting machine 10. The shaft 65 as best shown in Figures 3, 6 and 7 comprises a cylindrical portion 66 and a generally rectangular portion 67 disposed between an upper annular flange 68 and an annular flange 69 located at the lower end of the shaft 65. The rectangular portion 67 of shaft 65 is adapted to be closely received by slot 34 in block 32 to dispose the annular flanges 68 and 69 on either side of the block 32. The rectangular portion 67 and the flanges 68 and 69 serve to prevent any sidewise or tilting movements of the die assembly 11 relative to shaft 65.

To prevent the block 32 from inadvertently slipping or being disengaged from the end of shaft 65 there is carried by the block 32 a spring biased locking pin 71 suitably mounted in a recess in block 32. The locking pin 71 is adapted to be received by an opening 72 drilled in upper annular flange 68 when the block 32 has been fitted upon the rectangular portion 67 and thereby prevents removal of the die assembly 11 from shaft 65 until pin 71 is made to move out of the opening 72 by the use of an appropriate tool.

In the operation of the invention the die assembly 11 is attached to the end of its reciprocating shaft 65 in the manner described and the die button 12 is positioned below the plunger 16. An air line, not shown, is connected to fitting 64. With rectilinear movement of the plunger 16, the end of plunger 16 enters recess 44 in die button 12 and bottoms therein to effect engagement between the plunger 16 and the die assembly 11 whereby the former can effect movement of the die assembly 11 downwardly and upon the workpiece 17 where the die button 12 can cooperate with the punch 23 to pierce the work-piece to provide a rivet receiving perforation. The slug or disc effected by the piercing operation will be drawn by suction force through transverse bore 48 into aligned communicating bore 54 and then upwardly through bore 53 to be passed through tubular member 55 and out of the die assembly 11 by way of the opening 59. The rivet holding assembly 13 while the perforating operation is occurring accepts a rivet from the rivet tube 15 in readiness for the next operation. The plunger 16 after the perforating operation returns to its upper position as does the die assembly 11 under the action of suitable means, not shown, provided by the machine 10. Die assembly 11 and rivet holding assembly 13 then exchange places and plunger 16 on its next downward movement carries the rivet holding assembly 13 with it to effect the riveting operation.

Figure 8 illustrates a modified form of die assembly 73. In this modification the die assembly has a generally Z-shaped body portion similar to body portion 31 of die assembly 11 but will differ therefrom in that the die portion 74 is formed integral with the inclined leg 75 rather than including a die button such as 12 which is welded in position. As shown in Figure 8 the die portion 74 has a recess or well 76 in its upper end for the reception of the plunger 16 whereby downward movement of the die assembly may be effected. An axial bore 77 leads upwardly from the bottom surface of die portion 74 and connects to a transverse bore 78 which in turn communicates with a passage 79 in inclined leg 75 to afford the escape route for the slugs punched out of the work-piece. It is understood that the aspirating means for providing the suction force for effecting ejection of the slugs is similar to that utilized in the first embodiment and will include a tubular member similar to tubular member 55 across the mouth of which air is directed through a fitting such as fitting 64.

The die portion 74 has a forward lateral face 81 which is a plane surface. It should be noted that the distance between this flat outer surface and the interior wall surface of the recess 76 is much less than that within the exterior wall surface of body portion 42 of die button 12 and the interior wall surface of its recess 44. Possession of a flat surface 81 located as described enables the die assembly to be moved closer to any upstanding wall surface that may exist on work-pieces than could a die assembly having a conventional die button such as die button 12 with its upper flange 43 and relatively enlarged cylindrical body 42.

The die assembly 73 in operation will be engaged by plunger 16 to effect downward movement thereof to carry it to the work-piece to coact with the punch 23 to effect the piercing operation.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

I claim:

1. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a body member having a mounting portion whereby it may be secured to the punching machine, a die means provided on said body member, said die means having an axial bore therein and a transverse bore therethrough in communication with said axial bore, said mounting portion having a bore therein, said body member having a passageway interconnecting said bore in said mounting portion with said transverse and axial bores in said die means, and aspirating means carried by said body member and connected to said bore in said mounting portion to effect discharge of punchings from the body member.

2. A perforating unit for use in connection with a punching machine having a punch to co-

operate with the perforating unit to perform hole forming operations, comprising a body member having a mounting portion whereby it may be secured to the punching machine and a supporting portion, a die member carried by said supporting portion, said die member having an axial bore therein and a transverse bore therethrough in communication with said axial bore, said mounting portion having a bore therein, said body member having a passageway interconnecting said bore in said mounting portion with said transverse and axial bores in said die member, and aspirating means carried by said body member and connected to said bore in said mounting portion to effect discharge of punchings from the body member.

3. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped body member having an upper portion adapted to be secured to the punching machine, said body member being provided with a die portion having a work engaging face, said die portion having an axial bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said axial bore, said upper portion having a bore therein, said body member having a passageway interconnecting said bore in said upper portion with said transverse and axial bores in said die portion and aspirating means carried by said body member within said upper portion to effect discharge of punchings from the body member.

4. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped member having a slotted upper portion whereby it may be secured to the punching machine, a die member carried by a lower portion of the body member, said die member having an axial bore therein and a transverse bore therethrough in communication with said axial bore, said upper portion having a bore therein, said body member having a passageway interconnecting said bore in said upper portion with said transverse and axial bores in said die member, and aspirating means carried by said body member to effect discharge of punchings from the body member, said aspirating means comprising a tubular member having an opening in the wall thereof in communication with said passageway.

5. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped body member having a generally rectangular upper portion with a vertical slot therein whereby the body member may be secured to the punching machine, said body member having a generally rectangular lower portion and a leg portion interconnecting said upper and lower portions, a die portion on the lower rectangular portion, a work engaging face on said die portion, said die portion having an axial bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said axial bore, said upper portion having a bore therein, said interconnecting leg portion having a passageway therethrough joining said bore in said upper portion with said transverse and axial bores in said die portion, and aspirating means carried by said body member

to effect discharge of punchings from the body member, said aspirating means comprising a tubular member disposed within said bore in said upper portion having an opening in the wall thereof in communication with said passageway in said interconnecting leg portion.

6. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a body member having a mounting portion whereby it may be carried by the punching machine, locking means provided by said mounting portion to maintain said body member in mounted position on said punching machine, said die portion having an axial bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said axial bore, said mounting portion having a bore therein, said body member having a passageway interconnecting said bore in said mounting portion with said transverse and axial bores in said die member, and aspirating means carried by said body member to effect discharge of punchings from the body member, said aspirating means comprising a tubular member disposed within said bore in said mounting portion and communicating with said passageway in said body member.

7. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped unitary body member having a generally rectangular horizontally directed mounting portion whereby it may be mounted upon the punching machine, locking means provided by said mounting portion to maintain said body member in mounted position on said punching machine, said body member having a generally rectangular horizontally directed supporting portion and an inclined portion interconnecting said mounting and supporting portions, a die member carried by said supporting portion, a work engaging face on said die portion, said die member having an axial bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said axial bore, said mounting portion having a bore therein, said inclined portion having a passageway interconnecting said bore in said mounting portion with said transverse and axial bores in said die member, and aspirating means carried by said body member to effect discharge of punchings from the body member, said aspirating means comprising a tubular member disposed within said bore in said mounting portion and having an opening in the wall thereof communicating with said passageway in said inclined portion of the body member.

8. A perforating unit for use in connection with a punching machine providing a punch to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped body member having a generally rectangular horizontally directed mounting portion with a vertical slot therein whereby the body member may be secured to the punching machine, said body member having a die portion integral therewith and a leg portion interconnecting said mounting portion and said die portion, a work engaging face on said die portion, a flat vertical face provided on said die portion, said die portion having a vertical bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said vertical bore,

said mounting portion having a bore therein, said interconnecting leg portion having a passageway therethrough joining said bore in said mounting portion with said transverse and vertical bores in said die portion, and aspirating means carried by said body member to effect discharge of punchings from the body member, said aspirating means comprising a tubular member disposed within said said bore in said mounting portion in coaxial alignment therewith and having an opening in the wall thereof in communication with said passageway in said interconnecting leg portion.

9. A perforating unit for use in connection with a punching machine having a punch which is adapted to cooperate with the perforating unit to perform hole forming operations, comprising a generally Z-shaped unitary body member having a generally rectangular horizontally directed mounting portion with a vertical slot therein whereby the body member may be secured to the punching machine, spring biased locking means carried by said mounting portion for retaining said body member in mounted position on said punching machine, said body member having a die portion and an inclined leg portion, which latter portion interconnects said die portion and said mounting portion and is integral therewith, a work engaging face on said die portion at one

end thereof, said die portion having a vertical bore therein terminating in said work engaging face and a transverse bore therethrough in communication with said vertical bore, said die portion having a second vertical bore extending inwardly from the upper end thereof for the reception of an actuating tool, said mounting portion having a bore therein, said inclined leg portion having a passageway interconnecting said bore in said mounting portion with said transverse bore and said first vertical bore in said die member, aspirating means carried by said body member to effect discharge of punchings from the body member, said aspirating means comprising a tubular member disposed within said bore in said mounting portion in coaxial alignment therewith and having an opening in the wall thereof in communication with said passageway in said inclined leg portion and through which tubular member the punchings are adapted to pass on ejection from the body member, and a fitting mounted on said mounting portion and adjacent the opening of said tubular means for introducing air thereacross.

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No references cited.