United States Patent

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[54] **PUNCH AND DIE ASSEMBLY**
8 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **83/22,** 83/24, 83/99, 83/123, 83/685, 83/691, 83/695
[51] **Int. Cl.** **B26d 7/18**
[50] **Field of Search** 83/22, 24, 98, 111, 99, 123, 685, 691, 695

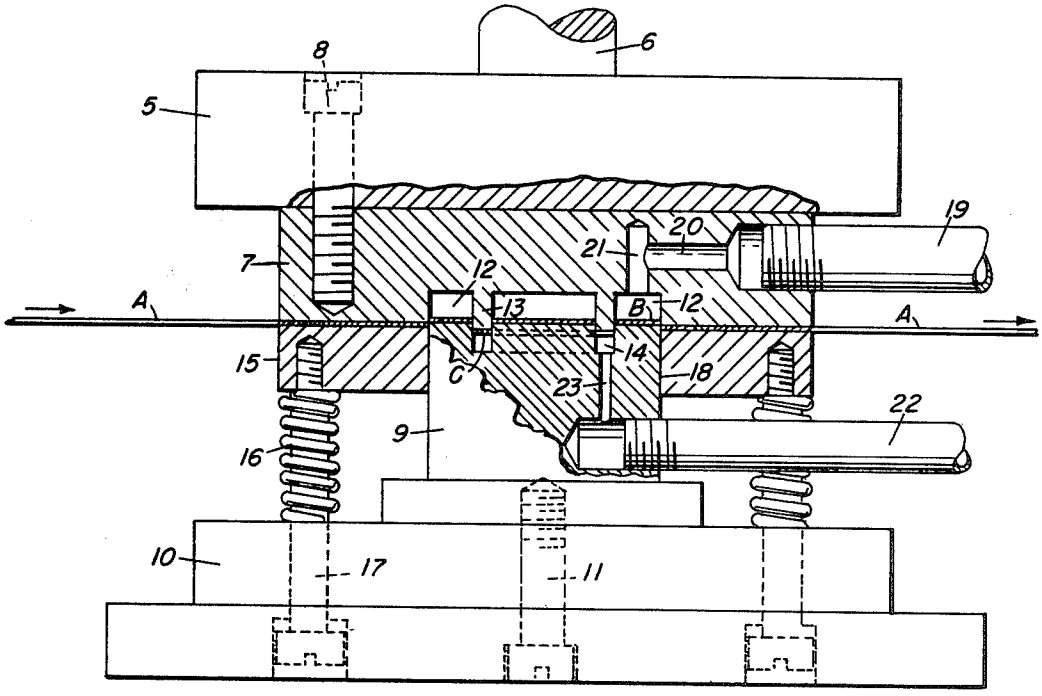
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ABSTRACT: A punch and die press for producing stampings of irregular contours from a blank of relatively thin material. The male and female elements of the press are provided with cavities behind the parts being stamped from the blank, which cavities are connected with source of hydraulic pressure and have valve means automatically timed by the operation of the press to build up pressure in the cavities to force the parts being stamped against the faces of the complementary elements during stamping to maintain the parts in flat condition and to eject the parts from the respective cavities when stamping is completed.



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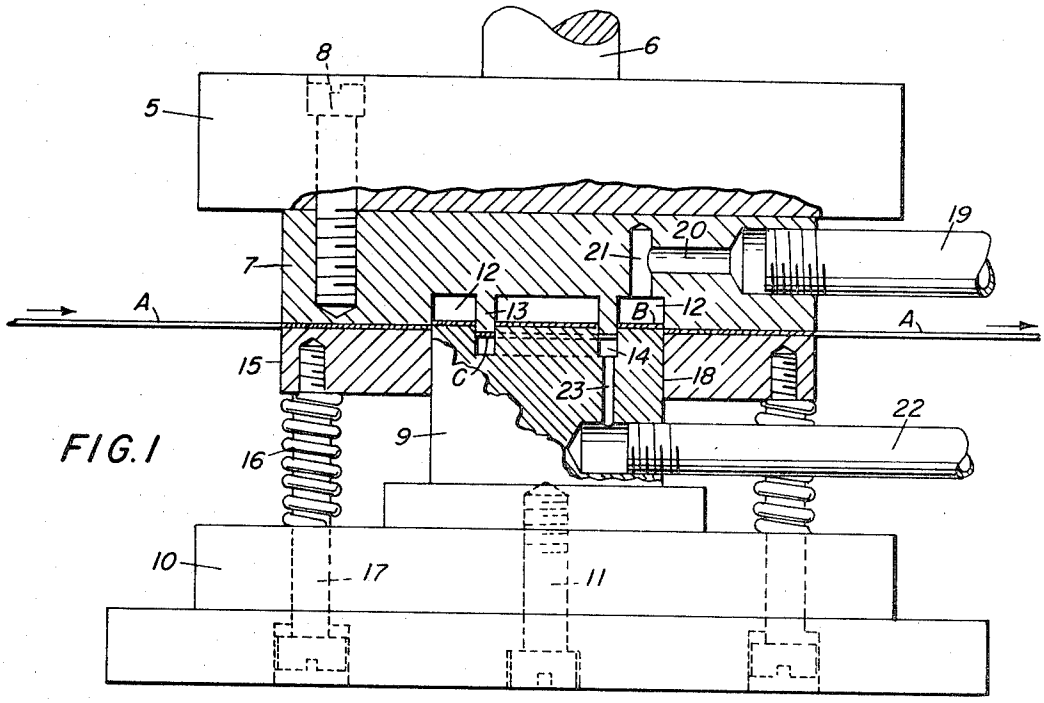


FIG. 1

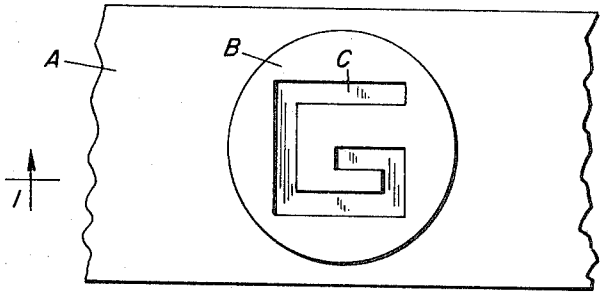


FIG. 2

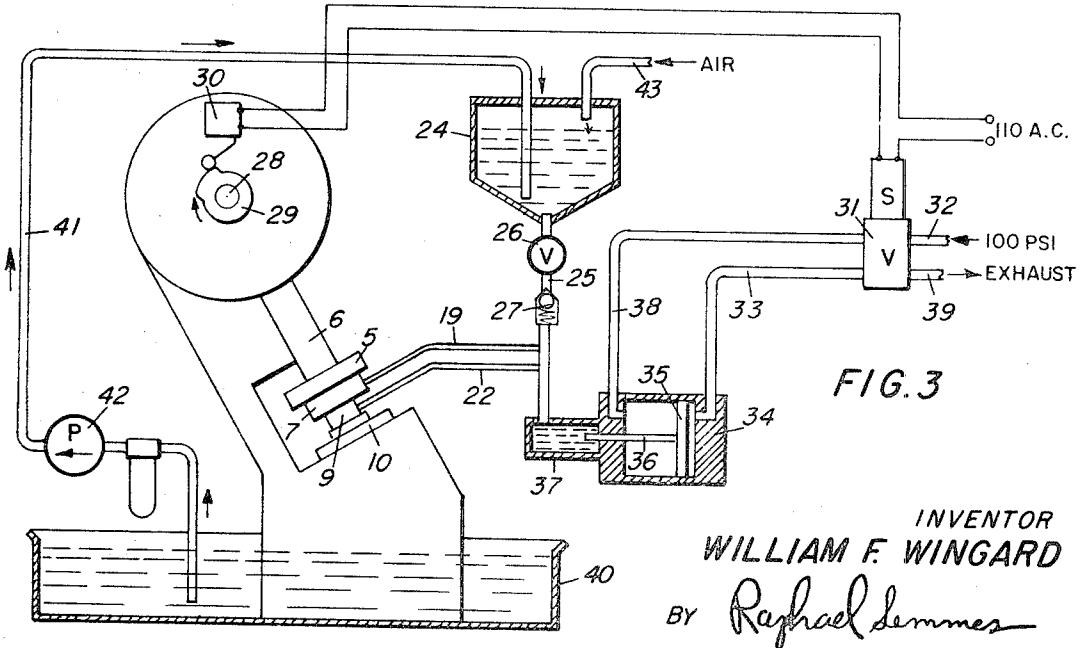


FIG. 3

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PUNCH AND DIE ASSEMBLY

BACKGROUND OF INVENTION

In conventional punch and die assemblies, the stamping of small parts, particularly those of irregular contours, from relatively thin blanks has been extremely difficult because of the necessity of employing mechanical or spring strippers for ejecting or removing the stamped parts from the punch and die. Often, because of the thin sections of material being stamped and the sharp corners of irregular contours, the process has required several widely spaced operations before completely removing the stampings from the press. As a rule, even when stamping circular parts, the holes to be stamped must not be closer than twice the metal thickness of the blank, and sharp corners should be avoided where possible to prevent concentrated stresses.

When a part is blanked from a metal sheet, it is pushed into the female die and the remaining metal sticks around the male punch. Normally, the part stamped is either returned to the surface by a mechanical stripper or the part is pushed out by means of a through-hole. The remaining material is usually pushed off of the punch by mechanical means or sometimes sheared by a knife so that it can be removed from the punch. The mechanical stripper requires a deeper and weaker die and a through-hole results in weakness.

SUMMARY OF INVENTION

The present invention is designed to overcome the difficulties encountered with conventional presses in stamping parts from a relatively thin sheet of metal or the like, where the parts are intricate in contour and require tight tolerances. The primary object of the invention is to provide means for ejecting the stamped parts from the die by the use of hydraulic pressure introduced into the cavities of the die behind the parts being stamped, thus eliminating the need of mechanical strippers for ejecting such parts.

Another object of the invention is to provide a die assembly wherein the parts can be stamped in one operation as distinguished from several operations, as with conventional dies.

Still another object of the invention is to utilize the hydraulic pressure used for the eventual ejection of the stamped parts for maintaining the parts flat against the face of the punch during the stamping operation.

A further object of the invention is to provide a punch and die assembly which may operate with extremely thin material, and wherein the depth of the die and the length of the punch need be only a few thousandths of an inch more than a stock thickness. As a result, much stronger die members are available, and parts with more intricate and thinner sections can be blanked from the sheet.

A still further object is to provide a punch and die assembly, as above referred to, having means associated therewith for introducing into the die cavities a constant, relatively low, hydraulic pressure to remove as much air as possible, which pressure is automatically increased to relatively high pressures at the proper time at the conclusion of the stroke of the press.

With the above and other objects in view which will appear as the description proceeds, the invention consists in the novel features herein set forth, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

THE DRAWINGS

Referring to the drawings in which numerals of like character designate similar parts throughout the several views:

FIG. 1 is a cross-sectional view through the assembly, taken on line 1–1 of FIG. 2, with the die shown at the bottom or dead center of the stroke;

FIG. 2 is a plan view of the main blank showing the completed stamping severed from the supplementary blank which is simultaneously stamped from the main blank; and

FIG. 3 is a diagrammatic illustration of one form of hydraulic control mechanism for regulating the application of pressure to the die cavities.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. 1 of the drawings, 5 represents a more or less conventional punch holder which is reciprocated by a vertically extending shaft or bar 6 connected to a source of power (not shown). The upper member 7 of the die assembly is secured to the punch holder 5 by means of screws 8. 9 represents the bottom member of the die assembly which is secured to a conventional die holder 10 by means of screws 11. Dowel pins (not shown) may be used to locate the screws 8 and 11, as in conventional practice.

The bottom or blank-engaging face of the upper member 7 is provided with a composite punch and die cavity 12, the outer boundary of which is contoured to receive, with a close fit, the bottom member 9 of the assembly to stamp the supplemental blank B from the main blank A. Within its boundaries, the cavity 12 is provided with a depending male member 13 of a configuration to correspond with the shape of the final part C to be stamped from the supplemental blank B upon the completion of the downstroke of the die assembly. The upper or blank-engaging face of the bottom member 9 is recessed within its boundaries, providing a cavity 14 to receive the male projection 13 of the upper member 7, thus forming a composite punch and die arrangement cooperating with the upper member to stamp the supplemental blank B and simultaneously the final blank C from the main blank A. The depth of the female portions of the upper and lower members 7 and 9 and the length of the male member thereof need be only a few thousandths of an inch greater than the stock thickness of the main blank A.

A standard stripper plate 15, urged upwardly into contact with the lower surface of the main blank A by coil springs 16 on bolts 17, acts to maintain the stock A in contact with the bottom face of the upper member 7, as is more or less conventional practice, it being understood that the lower member 9 slidably engages a complementary opening 18 in the stripper plate 15. Thus, during the operation of the assembly, the main blank A is maintained in flat condition against the bottom of the upper member 7 as the blank A passes through the assembly and during the stamping operation.

The essence of the invention resides in the application of hydraulic pressure to the cavities 12 and 14 behind the supplemental blank B in cavity 12 and the final part or blank C in the cavity 14. This is accomplished by connecting a pressure pipe 19 leading from a suitable source of hydraulic pressure to the upper member 7, said pressure pipe communicating with cavity 12 behind the supplemental blank B through passageways 20 and 21. Similarly, a pressure pipe 22 leading from the same source of pressure communicates through passageway 23 in the lower member 9 with the cavity 14 behind the final part C to be produced from supplemental blank B. As previously indicated, upon completion of the downstroke or dead center of the press stroke, the coaction of the composite punch and die stamping cavities of the upper and lower members 7 and 10, respectively, simultaneously produce the supplemental blank B and the final stamping C. The pressure applied to these cavities behind the parts to be stamped maintains the blanks in flat engagement with the male parts of the upper and lower members, and, at the conclusion of the operation, ejects the parts from their respective cavities.

Any suitable means may be employed for controlling the application of hydraulic pressure to the cavities of the assembly. One such means is diagrammatically illustrated in FIG. 3 of the drawings, where it will be seen that an oil reservoir 24, normally maintained under relatively low pressure above atmospheric, communicates through pipe 25, controlled by valve 26, with the pressure pipes 19 and 22 leading to the die assembly. A check valve 27, to be later referred to, permits low pressure fluid to be constantly fed through pipes 19 and 22 to cavities 12 and 14, respectively.

On the end of the crankshaft 28 of the press, which through shaft 6 operates the upper member 7 of the assembly, there is mounted a cam 29 which, upon rotation of the shaft, operates a microswitch 30. This microswitch activates a 4-way solenoid

valve 31 to allow approximately 100 lbs. shop compressor air from pipe 32 to flow into pipe 33, which communicates with an air hydraulic booster cylinder 34 behind the piston 35 in the latter. Connected to the piston 35 is a rod 36 which extends through the opposite end of the cylinder 34 and extends into an oil filled, hydraulic cylinder 37, the latter being connected to the lower end of vertical pipe 25 which, as before stated, communicates with pipes 19 and 22 leading to the cavities of the die press. A pipe 38 leads from cylinder 34 back to the 4-way valve 31, which is also provided with exhaust pipe 39.

The driving piston 35 in cylinder 34 forces rod 36 into the hydraulic cylinder 37. The ratio of the area of piston 35 to the area of the end of rod 36 provides an amplification of pressure in cylinder 37 from 100 lbs. per square inch of the air introduced in the cylinder 34 to approximately 3,500 lbs. per square inch in the oil contained in the cylinder 37. The check valve 27, previously referred to, closes upon this increase of pressure to shut off the pressure system from the reservoir 24. The oil in the cylinder 37 is normally maintained under 5—30 lbs. per square inch from the low oil pressure in reservoir 24, but when the hydraulic pressure rises, the check valve 27 closes, and the oil in the pipes 19 and 22 leading to the cavities in the die builds up sufficiently to push the stampings back against the retreating punches and pushes them out of cavities 12 and 14 as the press opens.

When the crankshaft 28 reaches a certain point in its revolution, the cam 29 actuates the 4-way solenoid valve 31 which then applies air pressure on the opposite side of piston 35 through pipe 38 to return the air cylinder to its original position. At this point, oil is again being flushed through the system by the lower pressure supply from reservoir 24. Valve 26 is a manual valve which may be turned off to conserve the oil supply.

An open metal pan 40 is arranged beneath the press to catch escaping oil which is returned from the tank 40 through pipe 41 and pump 42 to the reservoir 24. The reservoir is maintained at 5—30 lbs. per square inch pressure by a compressed air supply through pipe 43.

It may be pointed out that while the invention has been illustrated and described as applying pressure to the cavities of both the upper and lower members of the assembly, in some instances it may be desirable to apply pressure to only one of the members. Such an adaptation is considered within the scope of the present invention.

In the stamping of some parts which are particularly hard to eject because of their configuration or because of nicks or scratches in the die, it has been found that a piece of flexible material such as neoprene blanked at the same time as the part and preceding the part into the cavity facilitates the maintenance of an hydraulic seal in the cavities. This is useful if the die has a small nick allowing the pressure to escape. Also, if a coating of this material is applied to the stock, it may facilitate the operation in difficult situations. Normally, the blanks themselves and the close tolerances maintain a sufficient hydraulic seal in the cavities.

It is believed that the operation of the invention will be clearly understood from the foregoing. However, it may be briefly stated as follows:

The blank A from which stampings are to be made is passed between the upper and lower members 7 and 9 of the press in the direction of the arrows shown in FIG. 1. In this FIG., the assembly is shown closed at the bottom or dead center of the press stroke and has severed both the supplemental blank B and the final blank C from the main blank A. During this operation, low pressure from the oil in reservoir 24 has maintained the blanks in flat condition against the bottoms of the male members of the assembly, and when the press has reached this closed position, the cam 29 has actuated the 4-way valve 31 and the pressure cylinder 37 to greatly increase the pressure applied to the cavities. When the press opens for enough, the blanks B and C are forced out of their respective cavities and can be pushed away by any of the current methods of the trade. The stock or blank A is then advanced for another stroke of the press.

From the foregoing, it is believed that the invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. A punch and die assembly comprising complementary male and female elements for receiving therebetween a blank to be stamped, at least one of said elements being provided on its operating face with a cavity contoured to define the part to be stamped, the face of the opposite element being contoured to complement and fit closely into said cavity when the two elements are in closed position with said blank therebetween, means for forcing said elements together, means connected to said cavity, operable upon completion of the closing stroke of said elements for admitting fluid under pressure behind the stamped part in said cavity to eject the same, and means for applying a constant pressure to said cavity during the punching operation behind the blank being punched to thereby maintain the latter in flat condition against the face of said complementary element and remove air from the cavity.

2. A punch and die assembly as claimed in claim 1, wherein the operating faces of said elements are provided with compound punch and die cavities for simultaneously stamping from said main blank a supplemental blank and, from the latter, a final blank.

3. A punch and die assembly as claimed in claim 2, including means for admitting fluid under pressure in the cavities of both elements behind the parts being stamped.

4. A punch and die assembly comprising a fixed stamping element and a reciprocable stamping element for receiving therebetween a blank to be stamped, said fixed stamping element being contoured to fit within a complementary cavity in the reciprocable stamping element to stamp one part from said blank, said cavity of said reciprocable stamping element being provided with a depending male configuration within its radial boundaries adapted to fit within a complementary recess in the opposed face of said fixed stamping element and contoured to define the final part to be stamped, means for forcing said elements together with said main blank therebetween, and means operable at the conclusion of the closing stroke of said elements for admitting fluid under pressure to the respective cavities behind the stamped part therein for ejecting said stamped parts.

5. A punch and die assembly as claimed in claim 4, including means for supplying a constant, relatively low pressure to said cavities during the punching operation behind the blank being punched to thereby maintain the latter in flat condition against the faces of the complementary elements and remove air from said cavities, and means operable upon the completion of the closing stroke of said elements for automatically increasing the pressure of the fluid admitted to said cavities for ejecting the stamped parts therefrom.

6. In a method of stamping parts from a main blank of sheet material with a punch and die assembly, the step of constantly applying fluid under pressure to the cavity in the die element of said assembly, behind the part being stamped to force the latter against the operating face of the punch element of said assembly to thereby remove air from the cavity and maintain said part in flat condition.

7. In a method as claimed in claim 6, the additional step of increasing the pressure applied to said cavity at the conclusion of the stamping operation to eject said stamped part from said cavity.

8. In a method as claimed in claim 6, the step of applying a coating of flexible plastic material to said main blank on the surface thereof preceding said punch element into said die element, to facilitate the maintenance of an hydraulic seal in said cavity around the part being stamped.