June 25, 1946. J. S. NIELSEN 2,402,836

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Filed Nov. 22, 1943 2 Sheets-Sheet 1

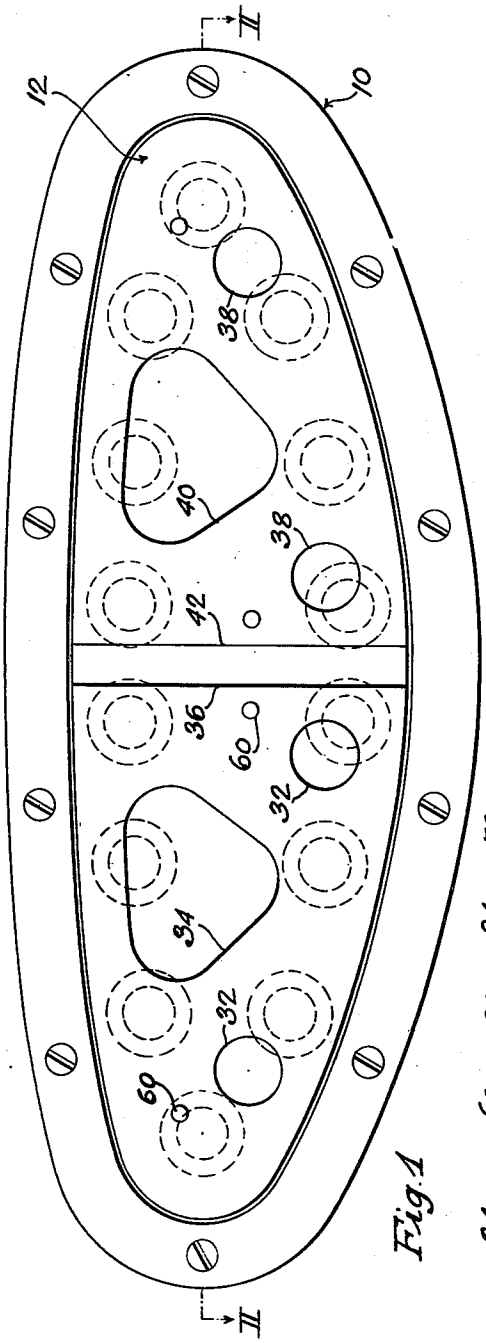


Fig. 1

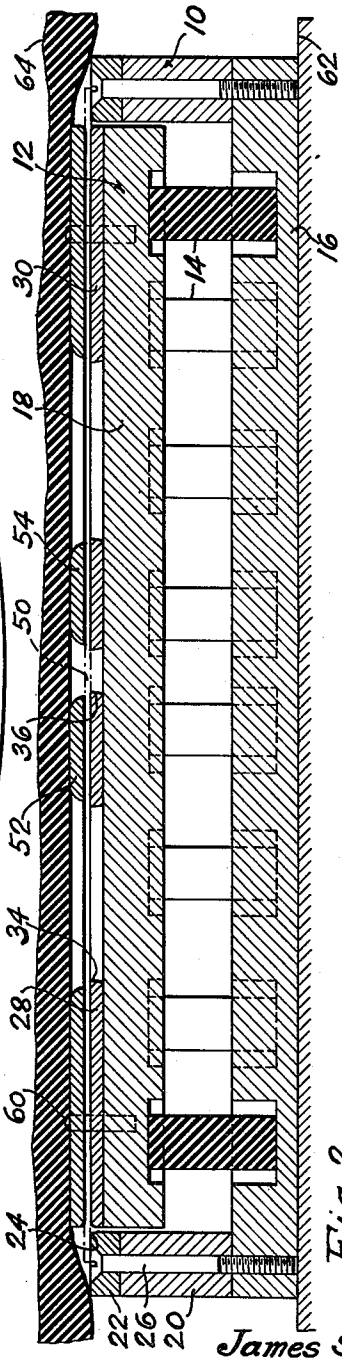


Fig. 2

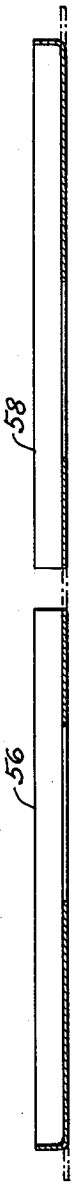


Fig. 3

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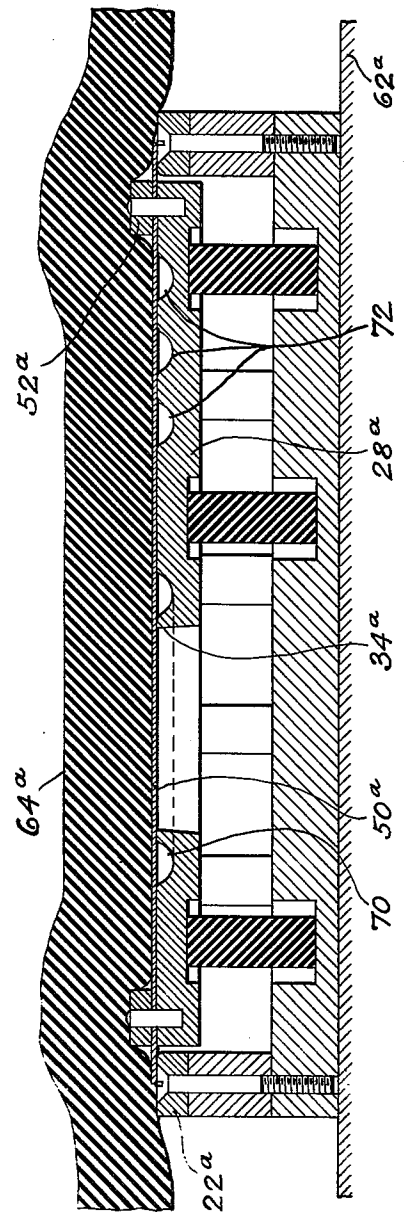


Fig. 4

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Patented June 25, 1946 2,402,836

UNITED STATES PATENT OFFICE

2,402,836

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Application November 22, 1943, Serial No. 511,269

5 Claims. (Cl. 113—42)

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This invention relates to dies for forming sheets, especially of metal, and, more particularly, is concerned with a die of this type which is operated in a power press in combination with a rubber platen to form sheet material, and, usually, cut the sheet material, also.

Prior to this invention a sheet, especially of metal, was formed and cut out in a power press over dies, either elevated or hollowed out, by direct contact of a rubber platen with the sheet. With this process it was possible to obtain smooth flanges only along straight or slightly curved lines, or when the material was stretched in flanging, but flange portions being compressed in flanging and having a smaller than a certain radius and being of a required width became wrinkled and had to be smoothed out by hand, involving time, labor, and expenses. In other cases, expensive fully complementary male and female draw dies were required to achieve the desired result.

The object of this invention is to overcome the foregoing and other difficulties by producing flanged articles of perfect workmanship without additional hand work.

Another object of this invention is the use of a draw die which is much simpler and less expensive than the conventional type of steel die and better suited for curved flanging than the ordinary die used in combination with a rubber platen.

Another object of this invention is to provide a long-wearing, low maintenance expense drawing and cutting die which can be quickly and readily made, and which is capable of turning out large numbers of substantially perfect articles.

For a better understanding of this invention, reference should be had to the accompanying drawings, in which Fig. 1 is a top plan view of a typical die of the invention; Fig. 2 is a cross-sectional view taken on line II—II of Fig. 1; Fig. 3 is a sectional view taken on the same line II—II but showing an article representing the nose portion of a sheet metal rib, right and left-handed, of an airplane wing into which also lightening holes are cut by the die; and Fig. 4 is a view similar to Fig. 2 but illustrating another embodiment of the invention.

As illustrated in the drawings, the drawing and cutting die comprises a fixed part, indicated as a whole by the numeral 10, and a movable part, indicated as a whole by the number 12. The movable part 12 includes a plate 18 which rests on springs 14 supported by a base plate 16 of the fixed part 10. The springs may be made of steel, but preferably are made of oil-resistant rubber

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blocks, and fitting into aligned sockets in the base plate 16 and the movable plate 18.

Both plates 16 and 18 may be made of Masonite, a substantial plastic, or of some similar material. The side wall 20 of the fixed part 10 is provided with a top plate 22, made of steel and having rounded corners at 24, and the plate 22 is fastened to the base plate 16 by screws 26. The movable plate 18 is provided with punch or shear plates 28 and 30, when it is desired to cut lightening holes in the work. The plates 28 and 30 are made of plow steel, which have cutting edges 32, 34 and 36, and 38, 40 and 42, respectively, for the cutting out of lightening holes in the web portion of the articles, as well as for cutting the web in two, if made of one piece of sheet for both the right and left-handed articles. The top of the movable part is made substantially flush with the top of the fixed part, in order to have a level support for the blank 50 to be formed.

Draw plates 52 and 54, having perforations corresponding to those of the punch plates, and holding down the blank 50, which is to be transformed into articles 56 and 58, are secured in place by pins 60 and are of such contour dimensions that they, like their support, are just sufficiently spaced from the inside contour of the plate 22 to allow the blank 50 to be drawn with its edge portion around the corner 24 of the steel plate 22 and into that space when the movable part 12 is forced, by means of a rubber blanket or platen, down against the springs 14. The die is used in a power press having a solid rigid platen 62 and a platen or blanket 64 of rubber or similar material which operates against the form-giving side of the die. As soon as sufficient pressure has been built up between the rubber platen 64 and the web portion of the article, the lightening holes are punched or cut out against the cutting edges and the web is cut through in the center. The plate 18 may move down against the plate 16 before the shearing pressure builds up, as described. In the downward movement of the plate 18 the rubber blocks 14 flow into the recesses shown. It will be recognized that a separate blank may be inserted in the die for each work piece, if desired, thus eliminating the cuts in the center of the web.

Another way of describing the structure and operation of the improved die of the invention is that the invention employs complementary male and female dies only in the compression areas of the metal to be formed, and in all areas where the metal is left flat or is stretched or is sheared only one die is used in conjunction with the rubber

platen. It will be apparent that this greatly reduces die cost over fully complementary male and female dies without reducing die efficiency. Although the form of the invention shown in Figs. 1 to 3 operates as just described, Fig. 4 illustrates this somewhat more clearly. More particularly, in the compression areas of the blank 50ª, namely, the edges to be inwardly flanged, the plate 22ª acts as a female die and the plate or ring 52ª acts as a male die, with such dies cooperating to positively form the flange of the work piece in compression and without wrinkling or buckling. In the other areas the plate 28ª cooperates with the rubber pad or blanket 64ª to shear the blank 50ª against the cutting edge 34ª, to stretch the blank into a strengthening rib, as at 70, surrounding the lightening hole, to stretch the blank into strengthening ribs or other stretched shapes 72, and to hold the blank flat in other areas.

It might be noted that the action between the male die ring or part 52ª and the female die plate or ring 22ª is actually better and freer of wrinkles than the usual male and female die action because the rubber pad or blanket 64ª holds down the area of the blank to be formed into the flange until the area is progressively bent and drawn between the male ring 52ª and the female ring 22ª. Further, it will be recognized that this method and apparatus facilitates the forming of flanges Z-shaped in cross section merely by stopping the downward movement of the plate 28ª before the edge of the blank is drawn down between the male member 52ª and the female member 22ª.

It should be evident from the foregoing description that a tool according to this invention is a considerable improvement over the earlier expensive combination of male and female steel dies, as well as the more recent dies using either an elevated or hollowed-out form die in combination with a rubber platen and pressing the sheet blank to be formed either over or into the form die. The present invention, in fact, combines the advantages of the old steel dies with those of the newer dies using a rubber platen, whereby the forming and cutting elements made of steel can be very light and inexpensive without requiring highly skilled labor.

Although only several examples of the invention are illustrated in the drawings and described, it is to be understood that many variations therefrom may be made in construction and material within the spirit and scope of the appended claims.

I claim:

1. Apparatus for forming and compression-flanging sheet metal and the like, and including complementary male and female die means adapted to form those areas of the sheet metal to be compression-flanged, means rigidly supporting the female die means, means resiliently supporting the male die means for limited movement into the female die means, said male die means being adapted to shape all stretched areas of the sheet metal, and a rubber platen means for stretching the sheet metal to the desired shape on the male die means and for effecting movement of the male die means into the female die means to compression-form a flange, said rubber platen holding the edge of the sheet metal against the female die until the metal is pulled between the male and female die.

2. Apparatus for forming and cutting sheet metal, including a female die, a base rigidly supporting the female die, a metal stretching and cutting die resiliently supported on the base inside the female die for limited movement with respect to the female die, the top of the metal stretching and cutting die being normally substantially flush with the top of the female die, and adapted to receive a piece of sheet metal to be formed and hold the edge of the metal over the female die, an open center male die overlying the sheet metal and removably carried on top of the stretching and cutting die, and a rubber platen for forcing the male die into the female die to flange the edge of the sheet metal and to simultaneously stretch and cut the sheet metal on the stretching and cutting die.

3. Apparatus for forming sheet metal and the like, and including a male die, a complementary female die, means for effecting movement of the male die into the female die to compression-form the sheet metal with a drawing operation, said male die having a metal-forming surface other than that cooperating with the female die, and rubber platen means for working the sheet metal against the male die surface simultaneously with the movement of the male die into the female die, said rubber platen holding the edge of the sheet metal against the female die until the metal is pulled between the male and female die.

4. The combination in apparatus for flanging sheet metal and the like of a perforated male die and a complementary female die, said dies being adapted to engage with the sheet metal adjacent the flanges, means associated in fixed lateral relation with and movable with the male die for cutting the sheet metal, and rubber platen means for moving the male die into the female die to flange the sheet metal and for pressing through the perforations in the male die to cut the sheet metal on the cutting means.

5. Apparatus for forming sheet metal and the like, comprising a female die, a base rigidly supporting the female die, a metal stretching die resiliently supported on the base inside the female die, and with the top of the stretching die substantially flush with the top of the female die so that a piece of sheet metal to be worked can be placed over the tops of the two dies, an open center male die adapted to be secured over the sheet metal to the stretching die, and a rubber platen for simultaneously stretching the sheet metal into the stretching die and for moving the male die into the female die to effect a flanging operation on the sheet metal, said platen engaging with a wiping action on the edge of the sheet metal as it is drawn between the male and female die.

JAMES S. NIELSEN.