

Dec. 29, 1964

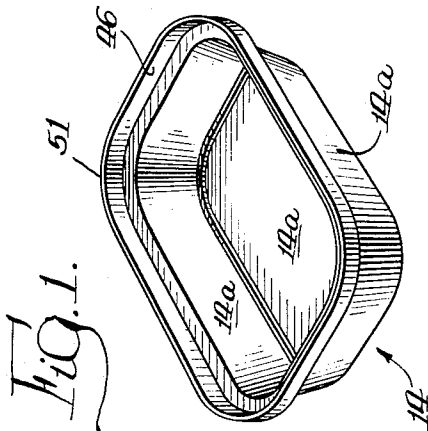
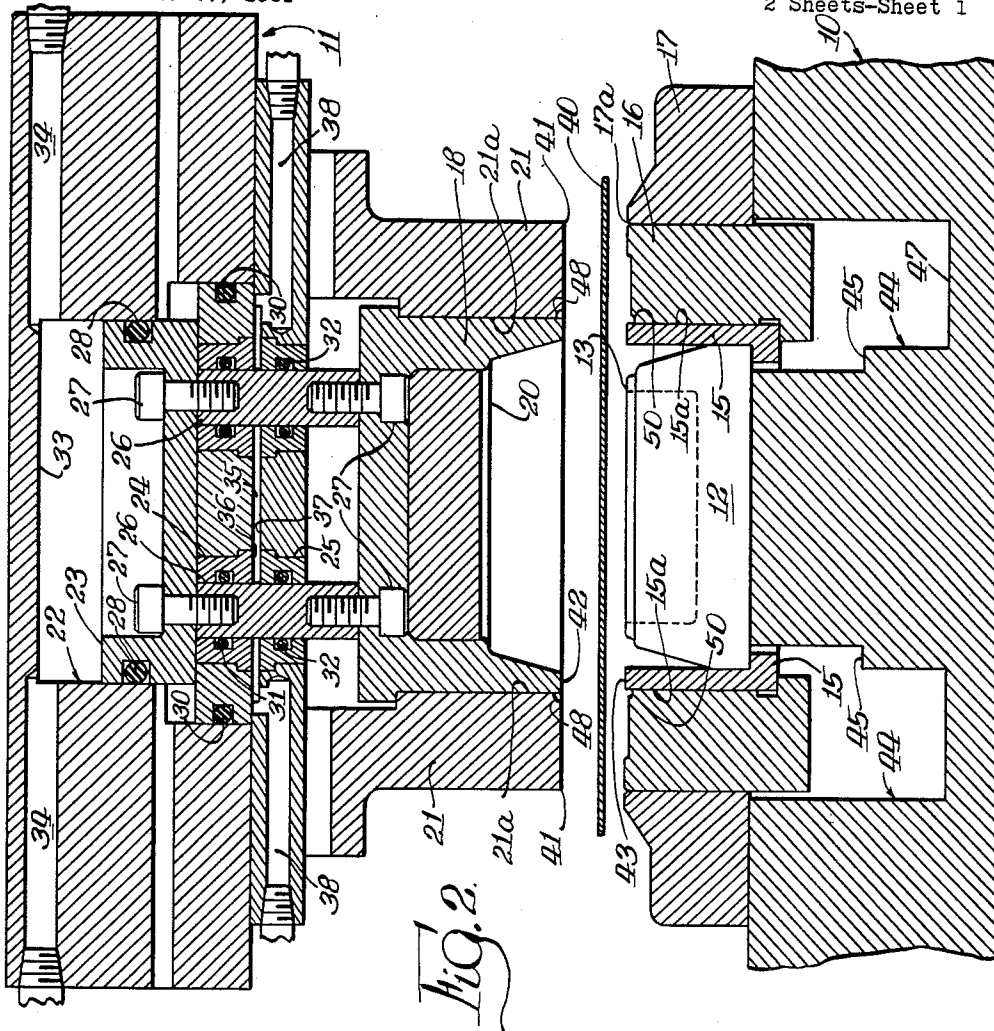
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3,163,142

DIE ASSEMBLY

Filed June 30, 1961

2 Sheets-Sheet 1



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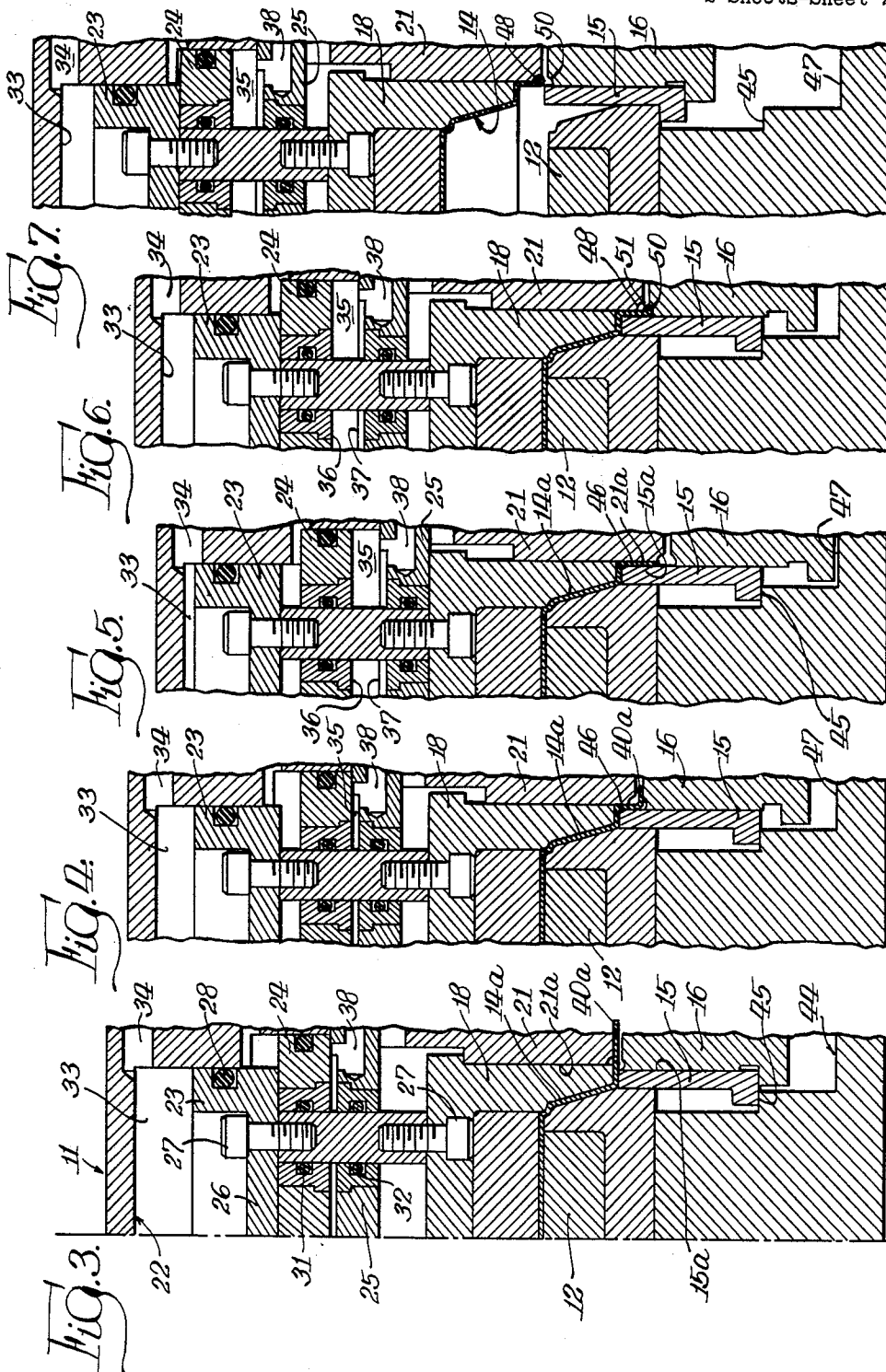
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Filed June 30, 1961

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3,163,142

DIE ASSEMBLY

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Filed June 30, 1961, Ser. No. 121,003

5 Claims. (Cl. 113-45)

This invention relates to a die assembly and more particularly to an improved double action die.

In forming articles having a deep draw many limitations are imposed on the manufacturer. Particularly, in the formation of deep drawn objects from relatively thin material such as aluminum foil the manufacturer is hampered by the specifications of the material used. Thus, for deep drawing it is necessary to use heavier gauge stock to avoid tearing. This material promotes excessive wrinkling. The present invention provides for drawing deeper pans with the use of lighter gauge alloys, without substantially stretching, tearing, or wrinkling of the material.

It is therefore an object of this invention to provide a new and improved blanking and drawing die capable of eliminating the above problems.

Another object of this invention is to provide a new and improved double acting die assembly for making deep draws.

Still another object of this invention is to provide a new and improved die assembly for deep drawing relatively thin metallic stock.

A further object of this invention is to provide a new and improved die assembly for cutting and deep drawing aluminum foil pans with full vertical flange curls.

Yet another object of this invention is to provide an apparatus for forming sheet material for use with a press having a ram and bed including means mounted on said ram and bed for forming the material therebetween, means for gripping said material before and during the initial forming operation as the ram moves toward the bed, and means for maintaining the gripping of the material during the final forming operation as the ram is withdrawn to prevent tearing and excessive wrinkling of the material.

Other objects and advantages of the invention will be apparent from the following description of an embodiment thereof as shown in the accompanying drawings, in which:

FIG. 1 is a perspective view of a pan made in accordance with the present invention;

FIG. 2 is a partial vertical sectional view showing a die assembly embodying the invention;

FIG. 3 is a fragmented vertical sectional view similar to FIG. 2 and showing the second stage of a cycle of operation of the present invention;

FIG. 4 is a view similar to FIG. 3 showing the third stage of a cycle operation;

FIG. 5 is a view similar to FIG. 4 showing the fourth stage of a cycle of operation;

FIG. 6 is a view similar to FIG. 5 showing the fifth stage of a cycle operation, and

FIG. 7 is a view similar to FIG. 5 showing the sixth stage of a cycle operation.

For purposes of clarity the constituent parts of the present invention and the operation thereof shall be described separately.

The Parts

Referring more particularly to the drawings, FIG. 2 illustrates an embodiment of the present invention mounted in a suitable press tool (not shown) wherein the die base 10 is mounted on the bed of the press tool. Conventional bolster and air cushion devices (not shown)

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may be employed to facilitate the mounting. The upper punch shoe, indicated generally at 11, is secured to the ram (not shown) of the press which is adapted by conventional means for movement toward and away from the press bed. Fixedly secured to die base 10 is the lower form punch 12 whose periphery 13 is shaped to conform to the shape of the article to be manufactured. An inner draw ring 15 circumscribes lower form punch 12 and is adapted for movement vertically with respect thereto. An outer draw and curl ring 16 circumscribes the inner draw ring 15 and is also adapted for vertical movement relative to the lower form punch 12. Mounted on die base 10 is the lower die shoe 17 which carries the lower cutting edge 17a to aid in cutting a blank from the material.

Punch shoe 11 carries upper form punch 18 having a cavity 20 which is shaped to engage its periphery 13 to the lower form punch 12. The clearance between the cavity 20 and form punch 12 when engaged is designed to conform to the required thickness of the object to be formed. A blanking punch and upper curl ring 21 is circumjacent the upper form punch 18 and is adapted for relative vertical movement thereto during the cycle of operation.

A stepped opening indicated generally at 22 is provided in the shoe 11 to slidably receive an upper cylinder or slide 23, an intermediate cylinder or slide 24 and a lower cylinder or slide 25. A pair of suitable bushings 26 and securing means, such as bolts 27, are provided to guide the cylinders 23, 24 and 25 in their respective vertical movements. Preferably, sealing means such as O-rings 28 and 30 may be provided in the upper and intermediate cylinders, respectively, for the sealing engagement thereof with stepped opening 22. Further, similar, suitably sized O-rings 31 and 32 in intermediate cylinder 24 and lower cylinder 25, respectively, may be provided for sealing engagement of the cylinders 24 and 25 with bushings 26. Thus sealed off, upper section or chamber 33 of opening 22 communicates through air passageways 34 with a suitable source (not shown) of regulatable but constant pneumatic pressure. A similar air space 35 is defined by the lower face 36 of intermediate cylinder 24 and the upper face 37 of lower cylinder 25. This latter air space communicates through air ports 38 with a second suitable source (not shown) of selectively regulatable pneumatic pressure.

At the initial stage of the cycle of operation, as will be more fully described, outer edge 41 of upper curl ring 21 cuts a blank 40a out of the sheet of material 40 from which the pan 14 (FIG. 1) is formed. Further, the blank 40a is gripped between the annular pressure surfaces 42 and 43 of upper form punch 18 and draw ring 15. Preferably, pressure surfaces 42 and 43 are disposed normal to the direction of travel of punch shoe 11 during the cycle of operation. This gripping of the material is effected just as the blank 40a is cut but substantially immediately before the initial draw is made and is continuous throughout the greater part of the drawing and forming operation. However, a positive grip or support is always maintained on the disc 40a or a critical portion thereof in a manner which shall be hereinafter described.

A recess 44 is provided in the die base 10 to take up the vertical movement of draw ring 15 and curl ring 16 under the urging of the ram as it makes a stroke. A ledge 45 in the recess 44 defines the limit of the downward vertical movement of draw ring 15 but curl ring 16 continues downwardly under the urging of the ram until it stops closely adjacent lower ledge 47.

Finally, curl grooves 48 and 50 in upper curl ring 21 and curl ring 16, respectively, are provided to form a curl 51 on the edge of the vertical flange 46 of the pan 14.

A curl is desirable to add strength against peripheral tearing and for a more pleasing appearance. The present invention permits the facilitated formation of a full vertical curl due to the positive gripping of the material as described herein.

The Operation

Reference is made to FIG. 2 which illustrates the first or blank stage of a cycle of operation. A sheet of material 40 is shown interposed between the die base 10 and punch shoe 11. A predetermined magnitude of air pressure is present in upper section 33 and is maintained substantially constant during the entire cycle of operation. Preferably, air space 35 is vented to atmosphere at this point. Thus, the ram moves the upper punch shoe 11 downwardly without any relative movement between its parts as the cycle begins. The outer edge 41 cuts the blank 40a from the sheet material 40 as the pressure surfaces 42 and 43 are urged into positive gripping relation therewith. Upper form punch 18 continuing downwardly (under the influence of the ram) into engagement with lower punch 12 draws the body 14a of the pan 14 and completes the first draw or second stage (FIG. 3) of the cycle of operation. At this point, under the urging of punch 18, draw ring 15 has moved downwardly and is abutting ledge 45 thereby limiting further downward movement thereof.

The blank 40a is still positively gripped between the pressure surfaces 42 and 43 of the upper punch 18 and draw ring 15. The amount of force with which the grip is maintained is regulatable and determined by the conventional air cushion in the recess 44 in the die base 10.

As the ram continues its stroke, under the urging of the upper curl ring 21, curl ring 16 moves downwardly relative to the draw ring 15 initiating the formation of the vertical flange 46 of the pan 14. FIG. 4 illustrates this third or vertical flange stage of the operating cycle. At this point the downward movement of the ram has caused a reduction of the upper chamber 33 causing greater force to bear against the completed body 14a of a pan 14. Air pressure is now introduced into the space 35 through port 38. The introduction of pressure may be regulated by any suitable means, such as cam action, which may be operatively linked to the ram of the press.

As the air is being introduced into the space 35, the ram continues downwardly to its lowermost position this causing the further downward movement of the curl ring 16 to its limit of movement closely adjacent ledge 47 under the urging of the upper ring 21. In this manner, the formation of the vertical flange 46 of the pan 14 is completed between the forming surfaces 15a and 21a of the inner draw ring 15 and the upper curl ring 21, respectively. This stage is referred to as the fourth or wipe down stage and is illustrated in FIG. 5. At this stage greater air pressure has been introduced into space 35 and is calculated to have a force greater than that exerted by the air in chamber 33 thereby causing the movement of the intermediate cylinder 24 upwards within the opening 22 in the direction of the upper cylinder 23. It should be noted, however, that a very slight upward movement of upper punch 18 is occasioned by this introduced air pressure. Therefore, little, if any, pressure is maintained by the surfaces 42 and 43 on the almost completed disc 40a (pan 14). However, at this point the flange 46 is suitably and laterally supported between the forming surfaces 15a and 21a of the curl rings 15 and 21, respectively.

FIG. 6 illustrates the fifth or curling stage of the operating cycle and shows the beginning of the final or upward movement of the ram's stroke in the embodiment illustrated. This movement causes the upward vertical travel of the curl rings 16 and 21 resulting in the initiation of the formation of the curl 51 in flange 46 by the curling grooves 48 and 50. By virtue of the continued support of the flange 46 between the forming surfaces 15a and

21a during the entire curling operation, the present invention permits the formation of a full vertical flange curl along with the use of lighter gauge material, the usual problems of wrinkling and tearing being substantially obviated.

As the ram starts moving upwardly the upper cylinder 23 tends to drop and which would transmit greater force to the pan body 14a through the upper punch 18. This force is excessive and damaging to the formed article necessitating the use of material having greater thickness and strength. Use of such material, however, results in excessive and undesirable wrinkle formation in the completed article. The present invention meets the problem by providing for the upward movement of the intermediate cylinder 24 (FIG. 5). Therefore, the cylinder 24 is in position to support the descending upper cylinder 23 (FIG. 6) and prevent the transmission of the resulting excessive force to the article. Thus protected, the article is not excessively wrinkled or damaged and, additionally, may be formed of a lighter alloy without the attendant danger of tearing.

As the ram continues its upward stroke the draw ring 15 and the curl ring 16 are allowed to return to their respective normal positions (FIGS. 2 and 7) by the withdrawal of the punch 18 and the draw ring 21. At this point, the pan 14 is completely formed.

Further, since the pan 14 is not substantially gripped between the pressure surfaces 42 and 43 during the upward stroke of the ram, the above described following movement of the rings 15 and 16, strips the pan 14 from the lower punch 12 causing it to rise with the upper punch 18. FIG. 7 shows the completed pan 14 and illustrates the sixth stage in the operating cycle. At this point, when the ram has almost completed the full operating cycle and is nearing its starting position (FIG. 2), the air pressure in space 35 is reduced more or less sharply whereby the upper cylinder 23 is urged downwardly by the greater, substantially constant pressure in the chamber 33 causing the ejection of the pan 14. The cycle of operation is now complete and the ram may start downwardly to repeat the cycle and form another pan.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations are to be understood therefrom, as some modifications will be obvious to those skilled in the art.

I claim:

1. An apparatus of the character described for forming sheet material for use with a press having a ram and bed including, a punch shoe secured to the ram for movement therewith toward and away from said bed, an upper punch engaged with and capable of movement relative to said shoe, said upper punch having a pressure surface for gripping the material, an upper curl ring mounted on said punch shoe and circumscribing said punch, said curl ring having a pressure surface for gripping the material, a die base mounted on said bed and having a lower punch adapted for cooperating with said upper punch to form the material therebetween, an inner draw ring circumscribing the lower punch and adapted for limited vertical movement relative thereto, said draw ring having a first pressure surface adapted to cooperate with the pressure surface on said upper punch for gripping the material therebetween before, and during the forming operation and having a second pressure surface adapted to cooperate with the pressure surface on said upper curl ring for gripping the material therebetween after the forming operation, a first slide associated with said upper punch and capable of limited movement relative to said ram, said first slide adapted to selectively transmit downward force to said upper punch, a chamber communicating with said first slide, means for delivering substantially constant air pressure into said chamber whereby a force is transmitted to the upper punch through said first slide effectively parallel to the direction of movement thereof as the ram moves toward the bed, said movement effecting the

initial forming of the material between the upper and lower punches, said pressure surfaces on said draw ring and upper punch positively gripping the material before and during the initial forming thereof as the draw ring is urged by the upper punch to move relative to the lower punch, and means for maintaining the positive gripping of the material between the second pressure surface on said draw ring and the pressure surface on said upper curl ring during the final forming stage, said means including a second slide adapted for limited movement relative to the first slide and capable of selectively supporting same, an air space communicating with said second slide, means for introducing increasing air pressure into said space to exert force on the second slide as the ram nears the bottom of its stroke, whereby the magnitude of the force on said second slide is greater than and opposed to the force on said upper punch thereby separating said upper punch and said lower punch while maintaining the positive gripping of the material between said pressure surfaces during the final forming thereof as the ram withdraws, whereby the material is protected from damage or wrinkling due to excessive force.

2. In a die assembly for forming sheet material for use with a press and a bed including a ram mounted for movement toward and away from the bed during each cycle of forming operation, a punch member, means movably mounting said punch member on said ram for movement relative to said ram toward and away from said bed, a die base mounted on said bed and having a second punch for conformingly engaging said first punch as the ram moves toward said bed with the sheet material between said ram and bed, and resilient means for moving said first punch relative to said ram and toward said second punch as said ram moves toward the bed, in combination therewith means overcoming said resilient means and blocking and moving said first punch away from said sheet material during the final forming operation prior to movement of said ram away from the bed.

3. In a die assembly for forming sheet material for use with a press and a bed including a ram mounted for movement toward and away from the bed during each cycle of forming operation with the sheet material held between the ram and bed, a punch member, means movably mounting said punch member on said ram for move-

ment relative to said ram toward and away from said bed, a die base mounted on said bed and having a second punch for conformingly engaging said first punch as the ram moves toward said bed, and resilient means for moving said first punch relative to said ram and toward said second punch as said ram moves toward the bed, in combination therewith means overcoming said resilient means and blocking movement of said first punch toward said second punch during the final forming operation.

4. The device of claim 3 wherein said overcoming and blocking means comprises pressure means for applying sufficient pressure against said first punch to overcome said resilient means, said pressure means including: a piston member slidably mounted in said ram for movement relative to the ram and the bed between said first and second punch members between a blocking position toward said first punch member and an unblocking position away from said first punch member, said piston member being in engagement with and blocking movement of said first punch when in blocking position, and means for applying fluid pressure to said piston member in an amount and a direction forcing said piston member against said first punch member for moving said piston member to blocking position and overcoming said resilient means.

5. The device of claim 3 including means for urging the resulting product formed from said sheet material against said first punch means responsive to initiation of movement of the ram away from the bed for removal of the product from the second punch along with the first punch, said first punch moving toward said bed relative to said ram at the end of the withdrawal stroke responsive to deactivation of said overcoming and blocking means for ejecting the formed product from said first punch.

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