Jan. 13, 1970 O. W. STOECKLI 3,488,987

METHOD AND APPARATUS FOR PRODUCING SMOOTH-EDGE BLANKED SHEET METAL PARTS

Filed Dec. 7, 1967 3 Sheets-Sheet 1

FIG. 1

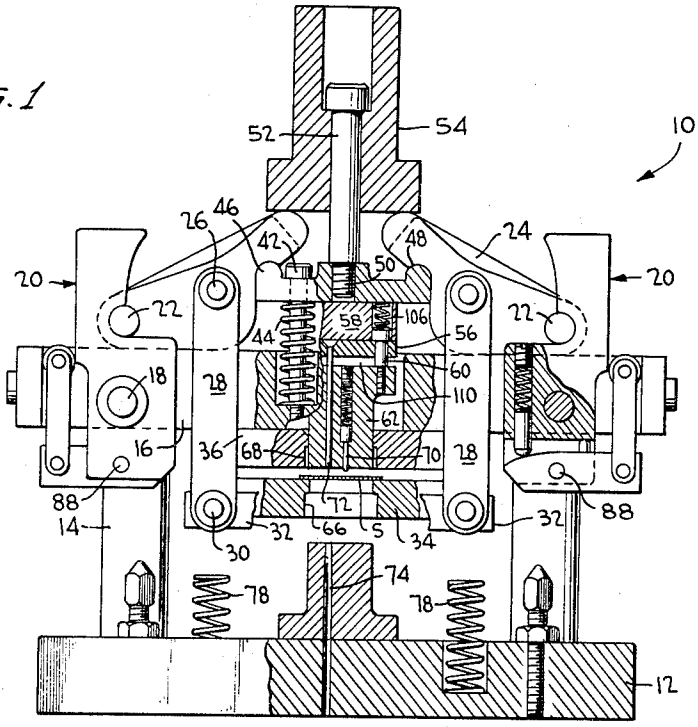

FIG. 2

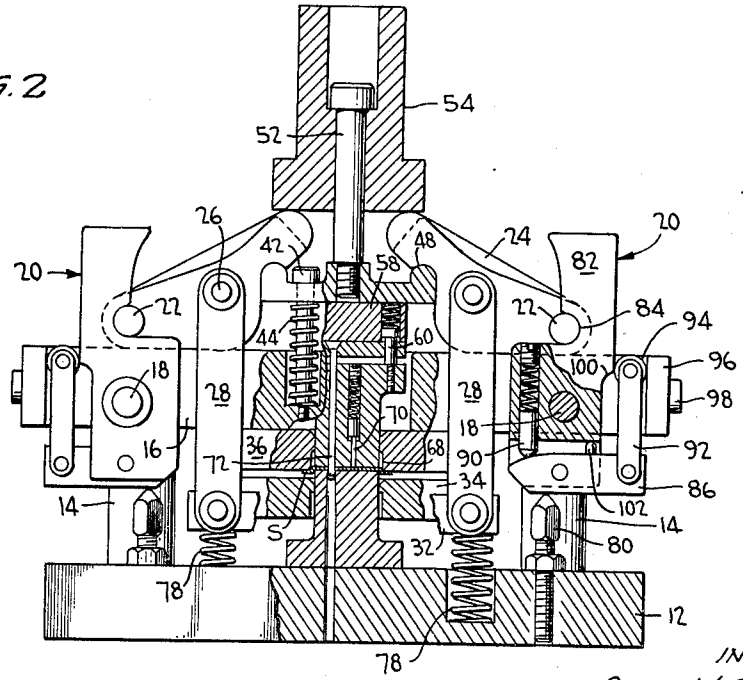

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FIG. 3

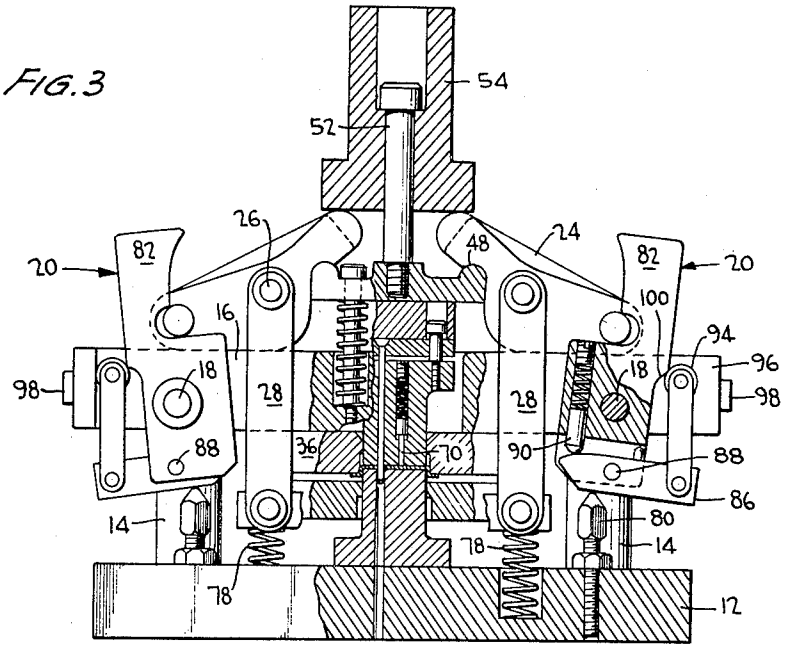
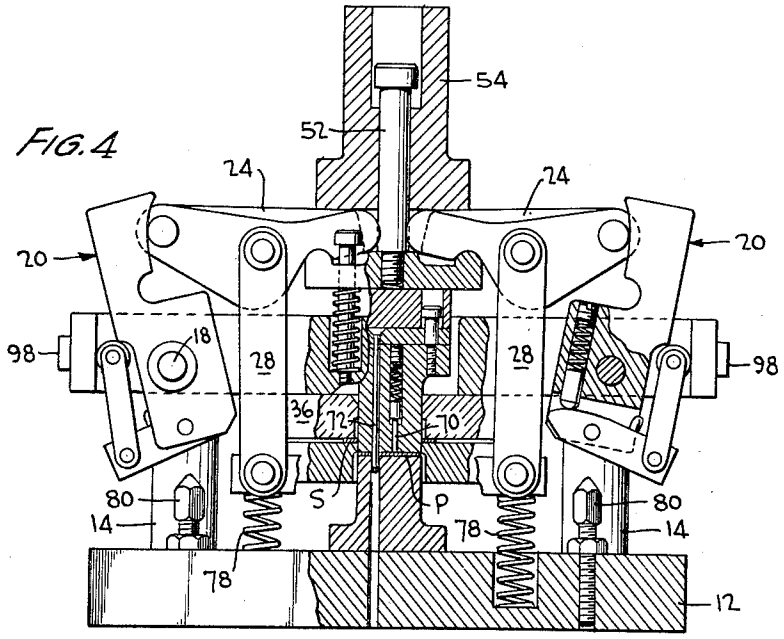


FIG. 4



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Filed Dec. 7, 1967 3 Sheets-Sheet 3

FIG. 5

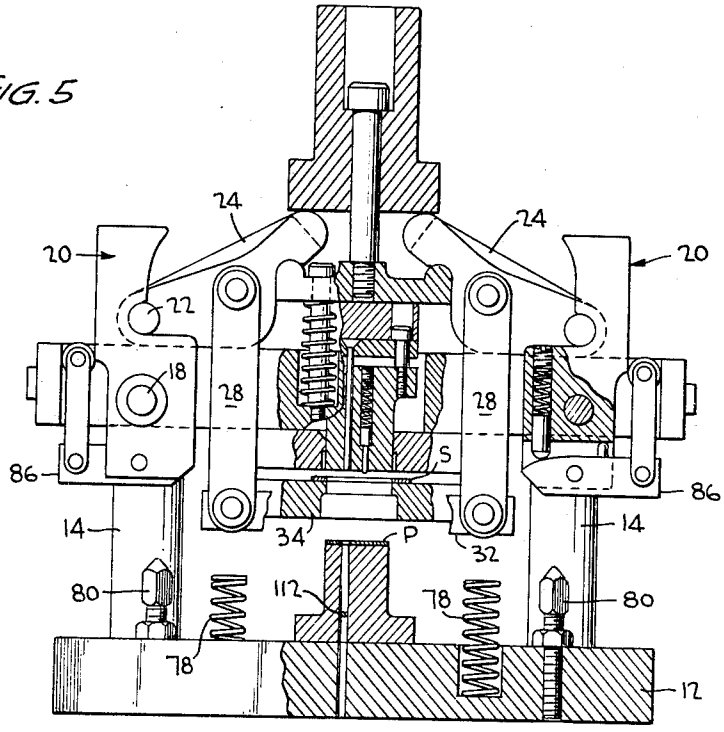
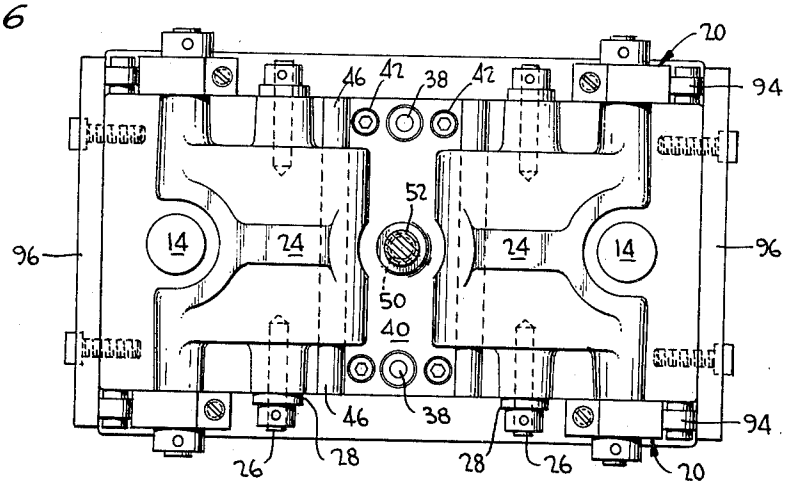


FIG. 6



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METHOD AND APPARATUS FOR PRODUCING SMOOTH-EDGE BLANKED SHEET METAL PARTS

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ABSTRACT OF THE DISCLOSURE

A method and means for forming sheet metal parts by a machine which includes compound dies. As the machine operates, its stroke moves a punch and die relatively toward one another to blank the outside contour of the sheet metal parts. A further punch and die thereafter shaves the outer edges of the blanked part to provide a smooth edge surface. The blanking and shaving are performed during a single stroke of the machine, and, if it is desired to have internal holes in the part, a piercing operation can also be performed during such single stroke.

This invention relates to the fabrication of parts formed from sheet metal or the like and more particularly it relates to a method and apparatus wherein the parts are blanked to the desired configuration, and thereafter, the edges of the blanked parts are shaved to provide a smooth outer edge which is free from burrs.

There are many well known forms of blanking devices for producing sheet metal parts and one satisfactory form of such apparatus is shown in my prior U.S. Patent No. 3,216,299, issued Nov. 9, 1965. In general, all such prior devices, including the one shown in my aforementioned patent, utilize punch and die arrangements for forming a particularly shaped part out of a larger piece of metal. Basically, the sheet of metal to be blanked is interposed between a punch and a punching die and these members are moved relatively to each other to thus blank out a part of a particular configuration. The configuration is determined by the particular shape of the punch and the punching die. In many instances, it is often desired to provide one or more apertures or perforations within the part being blanked out from the sheet of metal, and accordingly, means are often provided to perform such a piercing operation simultaneously with the blanking operation.

Naturally, it will be understood that once a part or series of parts have been punched or blanked from a large sheet of metal, the outside edges of the individual parts often have burrs, tangs and other imperfections. It is thus desirable to shave or otherwise smooth these outer edge surfaces to provide a clean and even edge on the final part. Of course, it is possible to smooth the edges by a separate sanding or smoothing operation after the blanking has been completed, but such a procedure is more expensive since it involves a separate machining operation. Thus, it would naturally be desirable and beneficial to accomplish the smoothing or shaving operation in combination with the blanking or punching operation.

In my aforementioned patent, there was described an arrangement, which, in its most basic sense, accomplished the punching or blanking operation during a downstroke of the apparatus and accomplished the shaving operation during the upstroke of the apparatus. In contrast to the arrangement of my prior patent, however, the present invention accomplishes both the punching and shaving operations during a single unidirectional stroke of the apparatus.

The prime object of the present invention is to provide a method and apparatus which produces blanked and shaved metal parts and which accomplishes both the blanking and shaving operations during a single stroke of the apparatus, preferably, the downstroke.

Another object of the present invention is to provide an improved method and means for accomplishing a seriatim punching and shaving operation to provide smooth edged blanked metal parts.

Another object of the present invention is to provide a combination punching and shaving apparatus for producing sheet metal parts, such apparatus being operable in a simple yet efficient manner to assure that such parts are produced with smooth edges and with the minimum degree of movement of the apparatus itself.

Another object of the present invention is to provide a method and apparatus for punching and shaving sheet metal parts with a higher degree of speed and efficiency than was heretofore possible.

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description which, taken in conjunction with the annexed drawings, discloses a preferred embodiment thereof.

Referring to the drawings:

FIGURES 1–5 are diagrammatic side elevational views, partly in section, showing the progressive operation of apparatus in accordance with the present invention and caapble of performing the method aspects thereof; and,

FIGURE 6 is a top plan view of the apparatus of FIGURES 1–5.

With continued reference to the drawings, there is shown in FIGURE 1, apparatus in accordance with the principles of the present invention, and suitable for carrying out the method aspects thereof. Such apparatus is generally designated **10** and it includes a generally flat base plate **12** having a pair of spaced apart upstanding guide posts or columns **14**. A head plate **16** is mounted in spaced relationship above the base plate **12** and apertures are provided within the head plate so that the guide columns **14** can pass therethrough. As a result, the head plate **16** can be moved toward and away from the base plate **12**, with such movement being guided by the columns **14**. In considering the "stroke" of the apparatus **10**, if it is assumed that the base plate **12** is fixed, then movement of the head plate **16** toward the base plate can be regarded as the "downstroke" and movement of the head plate away from the base plate can be considered as the "upstroke."

The head plate **16** carries four spaced apart laterally extending pins **18** which serve as pivot pins for mounting four lock mechanisms generally designated **20**. The details of these lock mechanisms will be described shortly hereinafter. For the present, it is sufficient to state that the locking mechanisms **20** releasably engage laterally extending pins **22** which project from a pair of linkage members **24** disposed above the head plate **16**.

Each linkage member **24** carries the locking pins **22**, extending laterally from opposite sides thereof, and additionally, each member **24** carries a pair of laterally extending pivot pins **26** which serve to mount four depending connecting links links **28**. The links **28**, in turn, are pivotally mounted at **30** to a shaving die mounting plate **32** which carries therewithin, a shaving die **34**, which is thus more or less suspended by the connecting links **28**. Preferably, the shaving die **34** is removably attached to the shaving die mounting plate **32** to enable such die to be replaced, if desired.

A blanking die **36** is carried on the underside of the head plate **16** in spaced relation above the shaving die **34** and the strip of stock material, designated S, from which

the parts are to be formed is interposed in the spaced between these dies **34** and **36**.

The head plate **16** also carries a pair of centrally disposed and laterally spaced apart upstanding guide posts **38** whose purpose is to position a movable shaving punch guide plate **40**. A series of bolts **42** extends between the guide plate **40** and the head plate **16** and compression springs **44** are disposed in surrounding relationship to the bolts **42** to assure that the plate **16** and **40** are normally urged away from each other.

As can be noted, the shaving punch guide plate **40** is provided along its edges with a pair of raised ridges or beads **46** which nest cooperatively in grooves or channels **48** formed in the linkage members **24**. The guide plate **40** also has a threaded central aperture **50** which receives the end of an elongated bolt **52**. A top plate means **54** is provided above the linkage members **24** so that the lower edge of the top plate means **54** abuts against the upper edge of the linkage members **24**. The top plate **54** is maintained in position due to the fact that the elongated bolt **52** extends therethrough and threads into the aperture **50** of the shaving punch guide plate **40**.

The central axis of the apparatus **10** can be generally considered as the axis passing along the elongated bolt **52**. As such, the die openings and punches are positioned along this central axis. More specifically, there is provided a shaving punch mounting plate **56** attached beneath a spacer **58** carried on the underside of the shaving punch guide plate **40**. Bolts **60** connect from this mounting plate **56** into the enlarged shoulder portion of a shaving punch **62**. A blanking punch **64** is mounted upon the base plate **12** in coaxial alignment with the shaving punch **62**. The cross sectional configuration of the punches **62** and **64** is substantially the same, and, quite naturally, openings must be provided within the shaving and blanking dies **34** and **36** respectively to accommodate these punches. Thus a die opening **66** is provided in the shaving die **34** to act as a relief for the piece after it passes through shaving. A similar die opening **68**, provided in the blanking die **36**, is the die clearance necessary for blanking.

The shaving punch **62** carries a spring loaded pin **70** which functions to strip the blanked piece from the punch to prevent the piece from sticking to the punch after the machining operations have been completed. If it is desired to form the part with one or more holes or apertures therein, a piercing means must be provided to accomplish the piercing operation concurrently with the blanking operation. To this end, a piercing punch **72** can be provided. This piercing punch is mounted within the shaving punch mounting plate **56** and depends through a bore in the shaving punch **62**. An aligned bore **74** must be provided in the blanking punch **64** for receiving the end of the piercing punch **72** during the piercing operation, as will be described in greater detail hereinafter. The bore **74** can extend right through the base plate **12** so that the slugs or pierced pieces from the strip S can drop into a suitable scrap pile.

It will be noted that the base plate **12** includes a series of recesses **76**, each of which carries a compression spring **78** aligned generally beneath the connecting links **28**. Also, it will be noted that a series of upstanding release pins **80** are carried by the base plate **12**, such release pins being engageable with the lock mechanisms **20** for the purpose of operating the same in a manner to be described in greater detail hereinafter.

With the foregoing description in mind, it is believed that the operation of the apparatus **10** now can be described. In this connection, attention is directed generally to FIGURES 1 through 5. Let it be assumed that the apparatus is initially in the condition shown in FIGURE 1 and the strip stock S is inserted into the position shown in this figure. As the apparatus starts to operate and the movable assembly starts to descend toward the base plate **12**, which is normally fixed in position, the apparatus starts to move from the position of FIGURE 1 to that shown in FIGURE 2. Thus it will be noted from FIGURE 2 that the shaving die mounting pate **32** contacts the upstanding compression springs **78** extending above the base plate and starts to compress the same. Naturally, at the same time, the shaving die **34** is moved downwardly past the blanking punch **64** so that the upper surface of the blanking punch **64** passes through the die opening **66** in the shaving die **34** and contacts the underside of the strip stock S.

By the time that the apparatus **10** fully reaches the position shown in FIGURE 2, the blanking punch **64** will have moved to at least the underside of the blanking die **36**. Such movement will have forced the strip stock S up into the opening **68** in the blanking die thereby serving to blank the particular piece or part out of the remainder of the strip stock. Also, the piercing punch **72** will pass through the strip stock S and into the opening **74** in the blanking punch thereby forming a suitable hole or aperture in the part being blanked. The shaving punch **62** is elevated, by an amount equal to the thickness of the strip stock S and such elevation necessarily reduces the space or gap **110** between the top of the shaving punch **62** and the bottom of the shaving punch mounting plate **56**. Thus, by the time that the apparatus reaches the position shown in FIGURE 2, the blanking and piercing operations will have been completed and the piercing punch **72** itself is projected through the blanked out piece to thus generally maintain the piece in position and prevent it from shifting.

As the downstroke of the apparatus continues from the position shown in FIGURE 2 toward the position shown in FIGURE 3, the release pins **80** start to release or unlock the lock mechanisms **20**. At this point, it might be well to consider the specific details of the lock members **20**. As can be seen, each lock mechanism **20** includes a body member **82** pivotally mounted upon the pins **18**. The body member **82** includes a groove or channel **84** for receiving the locking pins **22** on the linkage members **24**. A release arm **86** is pivotally mounted by a pivot pin **88** at the bottom of the body member **82** and the pivot pin **88** is generally aligned beneath the pivot pin **18** which mounts the entire lock mechanism **20**. The body member **82** carries a spring biased plunger **90** which is urged against one end of the release arm **86** to normally maintain the same in the position shown in FIGURES 1 and 2. At the opposite end of the release arm **86**, an upstanding link plate **92** is provided. The link plate **92** is pivotally mounted at its lower end to the release arm **86**, and at its upper end, the link plate **92** carries a roller **94** which engages between the back of the body member **82** and a lock back-up plate **96** attached by bolts **98** to the edges of the head plate **16**. The back of the body member **82** is cut away at its lower portion, as indicated by the reference numeral **100**, and an adjustable stop member **102** is carried by the release arm **86** for purposes of limiting the pivotal motion thereof to a predetermined amount.

As can be noted from FIGURE 3, continuing downstroke of the mechanism causes the inner portion of the release arms **86**, on the lock mechanisms **20**, to come into engagement with the release pins **80** mounted on the base plate **12**. Thereafter, as the downstroke continues, the release pins **80** cause the release arms **86** to pivot against the action of the spring biased plungers **90** and as a result, the link plate **92** and the roller **94** are moved downwardly until the roller **94** enters the undercut portion **100** of the lock body. At this time, the lock body **82** is released so that the same can pivot about its pivot pin **18**.

Simultaneously, it will be noted that the space or gap **110** between the top of the shaving punch **62** and the bottom of the shaving punch mounting plate **56** gradually diminishes from the size shown in FIGURE 2, when blanking has been completed, to zero as shown in FIGURE 4 when the locks are completely open. This gap **110** is provided for the purpose of assuring a time lapse between completion of the blanking operation and commencement of the shaving operation.

As will be understood by a comparison of the apparatus in FIGURE 3 with that of FIGURE 4, as soon as the lock bodies **82** have been pivoted far enough to release the lock engaging pins **22** from the lock grooves or channels **84**, the full force of the compression springs **78** is directed through the connecting links **28** to the linkage members **24**. This causes the linkage members **24** to move from the position shown in FIGURE 3 to that shown in FIGURE 4. Additionally, the shaving die **34** and blanking die **36** are forced toward one another to thereby clamp the blanked out strip stock S therebetween to prevent it from moving and inadvertently fouling the apparatus.

If attention will now be directed to FIGURE 4, the shaving operation performed by the present invention can now be described. It will be noted from FIGURE 4 that as the downstroke of the apparatus continues, the top plate **54** presses against the inner ends of the disengaged linkage members **24**. It will be noted that the blanked out piece P is now solidly held between the shaving punch **62** and the blanking punch **64** and that there is no further gap between the shaving die **34** and the blanking die **36**. Instead, it will be seen that between the base plate **12** and the shaving punch guide plate **40**, there is a solid column of material formed by the spacer **58**, the shaving punch mounting plate **56**, the shaving punch **62**, the blanked out piece of material P and the blanking punch **64**. This solid column forms a support which applies maximum pressure to the blanked out piece during the shaving operation and prevents any flexing or twisting thereof. The side ridges or beads **46** on the shaving punch guide plate **40** act as pivot hinges for the linkage members **24**.

Thus, as the downstroke of the apparatus continues and enters its final stage, the continued force which the top plate **54** applies to the inner end of the linkage members **24**, causes the linkage members **24** to pivot and thereby raise or lift the connecting links **28** in a direction opposite to the downstroke. As the connecting links **28** thus move upwardly, the shaving die mounting plate **32** and the shaving die **34** supported thereby are also moved upwardly. This draws the shaving die opening **66** across the outer surface of the blanked out piece P and such movement continues until, as shown in FIGURE 4, the combined downstroke of the apparatus and upward stroke of the shaving die **34** causes the outer edge of the blanked out piece P to be completely shaved and causes the remainder of the metal strip or stock S to be positively retained between the shaving die **34** and the blanking die **36**.

Once the entire downstroke has been completed, the piece P will not only be blanked out from the strip stock S, but the outer edges of the piece will be shaved and any internal openings will have been pierced. As the return or upstroke of the apparatus begins, the springs **44** cause the shaving punch guide plate **40** to be pushed upwardly, thereby pivoting the linkage members **24** outwardly and hence lowering the connecting links **28**, the shaving die mounting plate **32** and the shaving die **34** carried thereby. Likewise, the springs **106** react against the bolts **60** which carry the shaving punch **62** and this causes the gap **110** to open again. Thus, the piercing punch **72** is drawn into the shaving punch **62** and this relative movement causes the blanked out piece P to be stripped off of the piercing punch or punches **72**. Since the speed of reaction of the springs **44** and **106** is somewhat faster than the return or upstroke of the press, the springs **78** serve as a resisting force which tends to hold the upper part of the apparatus in the position of FIGURE 4.

After the entire return stroke or upstroke has been completed, the linkage members **24** again are re-locked by having the locking pins **22** engage with the grooves or channels **84** in the lock members **20**. Thus, as can be seen from FIGURE 5, when the cycle is completed, the final or finished blanked out piece P is resting freely on the top of the blanking punch **64**. This piece P, of course, has been blanked, shaved and pierced, and the same can then be removed by an air blast or by some mechanical means, or less advantageously, even removed manually. The slug **112** from the piercing operation drops through the bore **74** in the blanking die **64** and base plate **12**, while the remaining scrap rests upon the top of the shaving die **34**. Since this scrap is usually integrally connected with the remaining part of the strip stock S, the scrap itself can be removed from the apparatus merely by suitably advancing the strip stock until an imperforate part is disposed over the shaving die **34**. Then, the foregoing operation can be repeated and a new piece will be blanked, shaved and pierced. Of course, if desired, the operation of the apparatus, and hence the performance of the method, can be made sequential or automatic by any well known type of control device.

After reading the foregoing detailed description, it should be apparent that the objects set forth at the outset of the specification have been successfully achieved by the present invention.

What is claimed is:

1. In the method of producing formed parts from sheet stock by moving first and second means relatively toward one another as the strip stock is interposed therebetween, the improvement which comprises:

providing a blanking punch assembly on one of said means;

providing a blanking die assembly on the other of said means;

moving one of said means in a given direction toward the other of said means until said blanking punch assembly contacts said sheet stock and forces at least a portion thereof partially into said blanking die assembly to thereby blank a part out of said sheet stock;

providing a shaving assembly for smoothing the edges of said blanked out part;

moving at least a part of said shaving assembly in a direction opposite to said given direction while continuing to move said one of said means in said given direction to thereby shave said blanked out part; and

moving said one of said means in a direction opposite to said given direction after said shaving assembly ceases moving, thereby separating said means and providing a formed part having shaved edges.

2. The improvement defined in claim **1** further including the step of piercing said part as said part is being blanked out of said sheet stock.

3. Apparatus for producing formed parts from sheet material, comprising:

a first plate member including a blanking punch;

a second plate member including an opening aligned with said blanking punch;

guide means between said first and second plate members to permit one to be moved relatively to the other while maintaining said opening in alignment with said blanking punch;

blanking die means interposed between said first and second plate members;

shaving die means interposed between said blanking die means and said first plate member;

said blanking die means and shaving die means each including a die opening aligned with said blanking punch;

a shaving punch extended through said second plate member opening and at least partially through said blanking die opening;

mounting means coupling said blanking die means and said shaving die means to said second plate member in a manner which permits relative movement between said blanking die means and said shaving die means; and

operating means coupled with said mounting means for moving said blanking die means and shaving die means relative to each other;

said sheet material being insertable between said blank-

ing and shaving die means in alignment with their respective die openings;

said apparatus being operable by moving said first and second plate members relative to one another to cause said blanking punch to pass through said shaving die opening into contact with said sheet material to force said sheet material at least partially into said blanking die opening, thereby blanking a part from said sheet material;

said operating means being operable after said part has been blanked from said sheet material to move said shaving die means toward said blanking die means thereby moving said shaving punch at least partially into said shaving die opening to smooth the edges on the blanked part while it remains retained in position between said shaving and blanking punches.

4. Apparatus as defined in claim **3** further including a piercing punch movably mounted within said shaving punch and projectable beyond the end of said shaving punch and a bore means formed within said blanking punch in alignment with said piercing punch, whereby, as said piercing punch is projected, it passes through the part retained between said blanking and shaving punches and at least partially into said bore means, thereby piercing an aperture in said part.

5. Apparatus as defined in claim **3** wherein said operating means includes movable linkage means and wherein said mounting means includes connecting link means operatively connected between said linkage means and said shaving die means.

6. Apparatus as defined in claim **5** further including a shaving punch mounting plate which has at least one portion which engages said linkage means and acts as a fulcrum therefor.

7. Apparatus as defined in claim **6** wherein said operating means further includes an additional plate member juxtaposed to said shaving punch mounting plate and engaged with said linkage means, said additional plate member being movable relative to said shaving punch mounting plate to pivot said linkage means about said fulcrum to thereby move said connecting link means and thus move said shaving die means toward said blanking die means for smoothing the edges of said part.

8. Apparatus as defined in claim **7** further including lock means mounted on said second plate member, said lock means including an engaging portion which operatively abuts against said linkage means to prevent said pivotal movement thereof, said lock means further including a lock release means which releases said engaging portion from operative abutting against said linkage means so that said linkage means can pivot.

9. Apparatus as defined in claim **8** further including means carried by said first plate member which actuates said lock release means when said first and second plate members have been moved relatively to one another for a preselected amount.

10. Apparatus as defined in claim **3** further including compression spring means carried by said first plate member in alignment with said mounting means for exerting a biasing effect on said mounting means when said first and second plate members have been moved relatively to one another for a preselected amount.

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U.S. Cl. X.R.

72—327, 328; 83—55, 519