April 13, 1954 M. H. NIELSEN 2,674,780

DIE MECHANISM

Filed Nov. 5, 1948 2 Sheets-Sheet 1

Fig. 1.

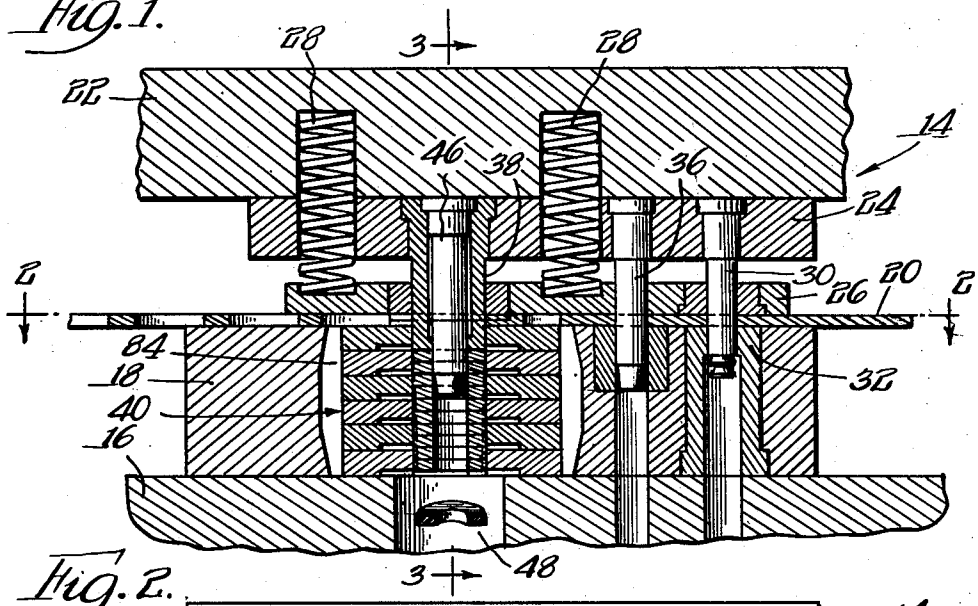


Fig. 2.

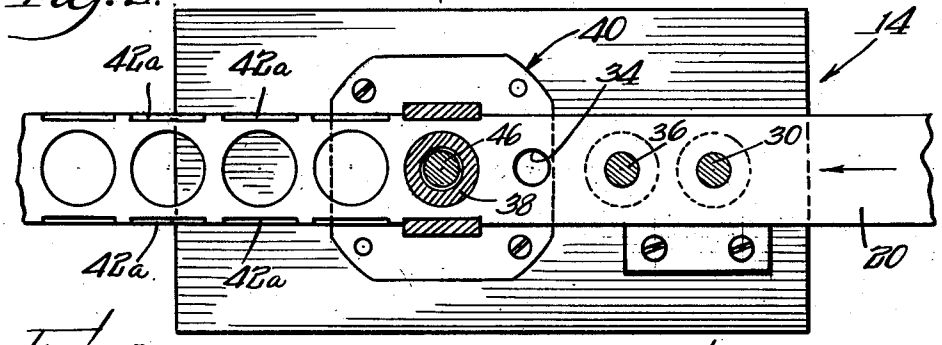


Fig. 3.

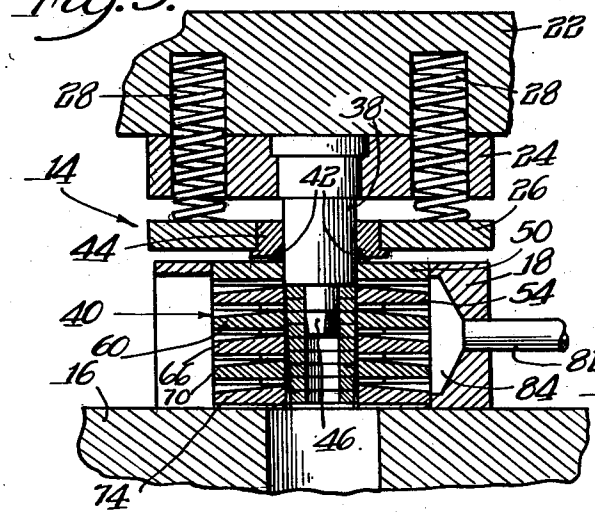


Fig. 4.

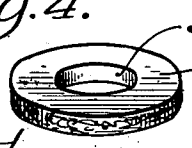
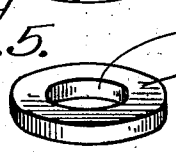


Fig. 5.



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Fig. 6.

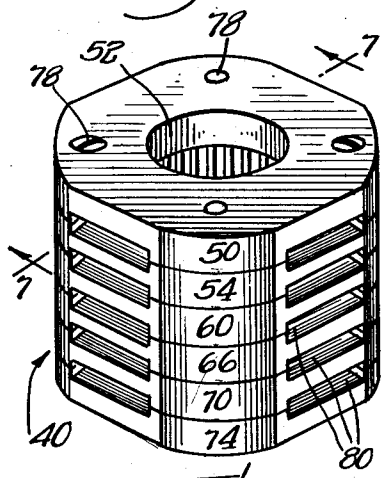


Fig. 7.

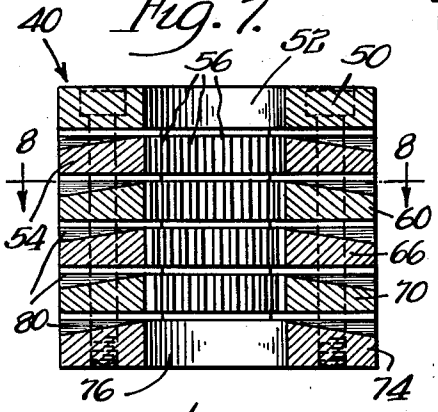


Fig. 8.

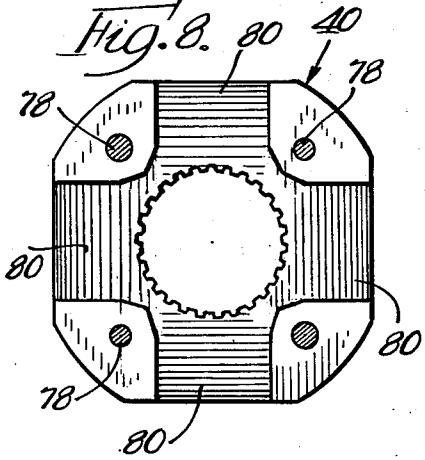


Fig. 9.

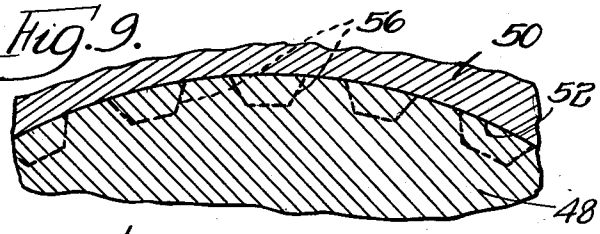


Fig. 10.

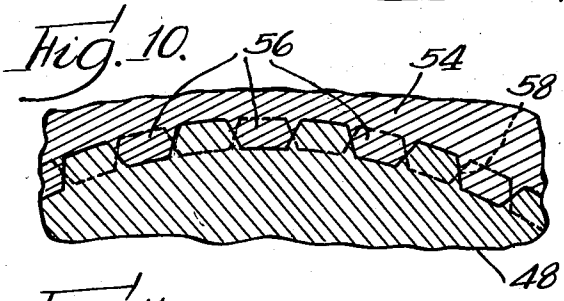


Fig. 11.

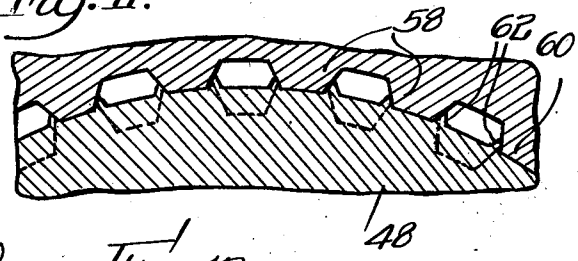


Fig. 12.

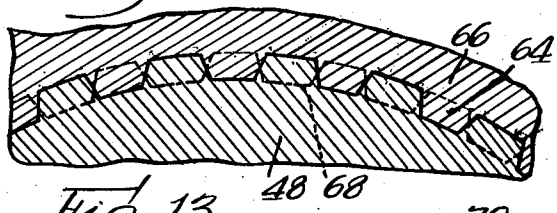
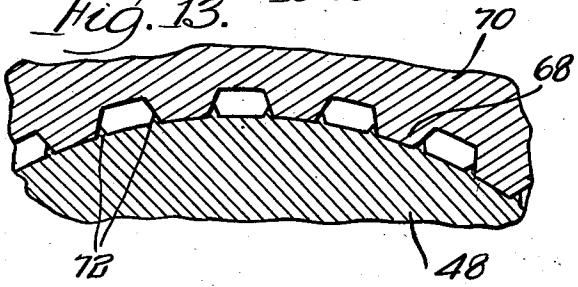


Fig. 13.



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DIE MECHANISM

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Application November 5, 1948, Serial No. 58,415

4 Claims. (Cl. 29—95.1)

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This invention relates generally to means for and methods of producing blanks from flat stock, and more particularly to blanking dies and to methods of producing blanks having smooth accurately formed peripheral surfaces.

It is well known to those skilled in the art of employing die mechanisms that difficulties have been experienced from the presence of fins or rough margins formed during the blanking operation. In conventional stamping or blanking operations there is ever present the tendency for the material adjacent the blank periphery to be drawn axially, so as to present the above mentioned uneven edge or fin. This is particularly true in drawing sheet metal. In drawing sheet metal there is ever present the tendency to form a chamfered or beveled edge along the advancing margin of the blank opposite from the above mentioned fin. Also, considerable difficulty has been experienced in forming blanks from non-metallic sheets such as molded fibrous materials, due to the tendency for such material to tear along the blank periphery during the punching operation. Because of the aforesaid difficulties such blanks are not suitable to be used where accurate peripheral dimensions and surface smoothness are essential. It is important, for example, if accurate gear teeth are to be formed in the periphery of a blank that the marginal dimensions of the blank be held within close tolerances and that the peripheral surface contour be free from any irregularities. It is therefore an important object of the present invention to provide means in the form of a die mechanism which will overcome the above mentioned and other disadvantages heretofore experienced. To this end, the invention contemplates a simple and extremely practical device whereby blanks conforming with predetermined dimensional and surface contour standards may be produced successively from a strip of sheet material.

More specifically, the invention contemplates apparatus and methods whereby disks may be blanked successively from sheet material at a given station, each blank as it is severed from the sheet stock serving to advance previously formed blanks into operative association with a series of peripheral cutting teeth.

It is a further object of the present invention to avoid subjection of the above mentioned flat stock to any tearing or crushing during the blanking operation, and to this end it contemplates successive removal of limited peripheral areas of the blank stock resulting in the ultimate presentation of a blank having the required peripheral characteristics.

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With the view of producing blanks having the desired marginal or peripheral characteristics referred to above, the present invention contemplates subjection of a disk stamped from flat stock to successive removal of limited circumferential areas of peripheral stock, such circumferential areas being also very limited in depth so as to avoid any tendency for the stock to be "pulled" axially, torn, or crushed.

It is another object of the present invention to provide apparatus and methods for producing blanks of the type referred to above, whereby chip removal is greatly facilitated, and to this end it is contemplated to employ relatively large openings positioned externally of and adjacent to the cutting zone, which openings readily will permit ejection of chips and thereby positively preclude jamming or clogging.

The foregoing and other objects or advantages will be apparent from the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a central vertical sectional view of a die mechanism which is representative of one embodiment of the invention.

Fig. 2 is a plan sectional view of the device shown in Fig. 1, said view being taken along the line 2—2 of Fig. 1 which is coincident with the plane of the upper surface of the flat stock.

Fig. 3 is a transverse sectional view taken substantially along the line 3—3 of Fig. 1.

Fig. 4 is a perspective view illustrating a blank having a roughened peripheral surface.

Fig. 5 discloses the blank after it has been trimmed so as to present an accurate smooth peripheral surface.

Fig. 6 is a perspective view of a die used in the mechanism shown in Figs. 1 to 3 inclusive, said die being made up of a plurality of superimposed die sections.

Fig. 7 is a central vertical sectional view of the die illustrated in Fig. 6.

Fig. 8 is a horizontal sectional view of the die taken along the line 8—8 of Fig. 7; and

Figs. 9 to 13 inclusive are fragmentary sectional views taken along various locations in the die to illustrate successive steps of rough trimming, finish trimming and final finishing operation in the production of a blank having a very accurate and smooth periphery.

Referring now to the drawing more in detail wherein like numerals have been employed to designate similar parts throughout the various figures, it will be seen that the present invention contemplates a die mechanism designated generally by the numeral 14 in Figs. 1 to 3 inclusive.

This die mechanism includes the usual base or bed 16 which supports a die block or plate 18. A strip of sheet stock 20 may be fed across the top surface of the plate 18 as illustrated in Figs. 1 to 3 inclusive. Above the work strip 20 is a punch block 22 which on its under side carries a punch holding plate 24. Below the plate 24 is a combined stripper and cutting plate 26 which is normally urged downwardly from the block 22 by suitable heavy duty coil springs 28.

The work strip 20 is fed step by step from the right side of the die mechanism 14 as viewed in Fig. 1. As the advancing end of the strip 20 is first moved into position, the punch block and parts carried thereby occupies its uppermost position so as to permit clearance between the lower extremity of a blanking punch 30 and a complementary die bushing 32 mounted within the die plate 18. Movement of the strip at this point is arrested, and subsequent downward movement of the punch causes an aperture 34 to be formed. After the subsequent upward movement of the punch 30 the work is advanced to its next position with the previously formed aperture 34 coming to rest immediately beneath and in registration with a locating pin 36. Subsequent downward movement of the punch moves the locating pin 36 into the previously formed aperture 34 and the punch 30 again blanks an aperture in the work. After the above mentioned final operation has again been repeated, the work is advanced into position beneath a blanking punch 38 and above a die structure designated generally by the numeral 40. This die structure and the operations performed by it are best illustrated in Figs. 6 to 13 inclusive.

As the work strip 20 reaches its position beneath the punch 38 and above the die structure 40, the punch block 22 descends, first bringing into contact with the work strip opposed shoulders 42 of a punch bushing 44 best illustrated in Fig. 3. The contact of the punch bushing 44 with the work occurs before contact of the punch 38 with the work but after a locating pin 46 within the punch 38 moves into registration with the previously formed aperture 34. Continued downward movement of the punch block 22 and plate 24 after the punch bushing 44 has been moved into engagement with the upper surface of the work strip 20 causes increased compression of the coil springs 28. The pressure exerted during this period of the cycle is sufficient to cause the shoulders 42 to become embedded within opposite margins of the stock. The stock is not completely sheared but is gripped on opposite sides by these shoulders. Note the recesses 42*a* on the opposite sides of the work piece in Fig. 2 which are formed by the shoulders 42.

The purpose of initially engaging opposite margins of the work strip 20 by the shoulders 42 is to hold the material of the work stock firmly in position while the punch 38 acts upon the sheet stock. That is to say, the shoulders 42 support opposite sides of the work and thus counteract any tendency for the work to bulge or tear during the blanking operation of the punch 38. This enables very narrow stock to be employed, thus reducing resulting scrap to a minimum.

After the shoulders 42 of the punch bushing 44 have firmly gripped the opposite margins of the work strip 20 so as to form the recesses 42*a*, continued downward movement of the punch block 22 brings the punch 38 into operative association with the work strip. This causes an annulus 48 to be rough blanked from the strip stock 20. This annulus or blank member 48 is illustrated in Fig. 4. In performing this rough blanking operation the punch 38 coacts with a die plate 50 forming the uppermost element of the die structure 40. This die plate 50 is provided with a central aperture 52 which cooperates with the punch 38. An initial stamping or blanking operation, such as that performed by the coaction of the punch 38 and the die plate 50 results in a rather rough peripheral surface and diameter dimensions not conforming with required standards of accuracy. Hence the blank must be subjected to further peripheral treatment.

As the work strip is again indexed or shifted a second blank is punched from the stock by the punch 38 and complementary die plate 50, and this blank serves to force the previously formed blank through the next adjacent die plate 54. This die plate 54 is provided with circumferentially spaced internal teeth 56 designed to perform a roughing trimming operation upon the blank periphery.

In Fig. 9 a fragmentary horizontal sectional view is taken transversely of the die plate 50 looking downwardly. Thus the blank 48 is within the opening 52 of the die plate 50 and immediately beneath the blank will be seen the peripheral teeth 56 of the next adjacent die plate 54. In Fig. 10, which constitutes a similar sectional view taken transversely of the plate 54 it will be seen that the teeth 56 of the die plate 54 have removed limited circumferentially spaced areas of relatively small depth from the periphery of the blank 48. Immediately beneath the blank will be seen in dotted lines the teeth 58 of the next adjacent die plate 60. Fig. 11 constitutes a section taken transversely of the die plate 62. It will be seen that the die plate 60 again trims the peripheral stock, leaving only small projecting portions 62. In Fig. 11 die teeth 64 of the next adjacent die plate 66 will be seen in dotted position immediately beneath the blank. Fig. 12 is a section taken transversely of the die plate 66 showing the teeth 64 thereof removing limited circumferentially spaced areas of peripheral stock. The periphery of the blank has now been reduced in diameter and presents a plurality of peripheral projections 68. In Fig. 12 the teeth 68 of the next adjacent die plate 70 are shown in dotted lines. As the blank is forced through the die plate 70 as shown in Fig. 13 the teeth 68 remove all but small peripheral projections 72. As the die is finally forced through the last die member 74 at the bottom of the structure 40, the small peripheral projections 72 are sheared off as the blank is forced through the die opening 76.

It will be apparent from the foregoing description of the die structure 40 that the die plates thereof function to first rough blank an annulus from the strip stock within the die plate 50 and then rough trim the periphery of this blank between the die plates 54 and 60. This rough trimming consists in the successive removal of limited circumferential areas of stock. This initial rough trimming cuts away the surface roughness resulting from the initial blanking operation but further trimming is necessary in order ultimately to produce a blank having the required degree of surface smoothness and accuracy. Hence the two subsequent die plates 66 and 70 perform the final trimming by again removing circumferentially spaced limited areas of peripheral stock. The last die plate 74 which is provided with an aperture 76 defined by a smooth accurately dimensioned wall performs

the finishing operation which consists in removing the small peripheral projections left from the previous trimming operation, and at the same time lapping or burnishing the surface of the blank so as to produce the desired peripheral surface characteristics.

It will be noted that the die plates of the die structure **40** are stacked one upon the other and held together by suitable dowels **78**. It will also be seen that the adjoining surfaces of adjacent dies are provided with radial recesses or openings **80** which in plan partake the shape of a cross (see Fig. 8). These recesses or passageways **80** become larger toward their outer extremity as clearly illustrated in Figs. 3 and 7. The purpose of the recesses or passageways **80** is to facilitate the disposition of chips formed during the trimming operations. These passageways are sufficiently large to accommodate all of the chips as they are formed during each downward stroke of the punch block **22**, and their disposition is such as to enable displacement of accumulated chips by directing a blast of air through the passageways from any suitable source as, for example, from the conduit **82** shown in Fig. 3. The introduction of kerosene vapor through the air conducting passageways also serves a very useful function. The vapor provides sufficient lubrication to facilitate the punching operation and the compressed air blows away the chips that are directed to the passageways **80**. It will be seen from Fig. 3 that a chamber **84** is provided within the die block **18** to receive the blast of compressed air, preferably mixed with kerosene vapor from the conduit **82**. The chips are blown across the die structure **40** and emerge at the open side of the chamber **84** to the left of Fig. 3.

It will be apparent from the foregoing description that the present invention contemplates improved apparatus and methods whereby accurately dimensioned blanks may be produced. By first rough trimming and thereafter finish trimming the blank periphery, it is in condition to be lapped or burnished by the final die section or plate. Also, by having the shaper teeth of certain of the die sections arranged in staggered relation with respect to the teeth in the next adjacent section, peripheral areas of limited cross-section at space intervals may be removed without subjecting the material of the blank to deleterious strains and stresses. The functioning of the shaper teeth of each die section or plate is such that the blank periphery is properly trimmed before being subjected to the final burnishing operation. By having the radially disposed arrangement of chip accommodating passageways, the removal of chips from the area adjacent the shaper teeth is greatly facilitated. As previously pointed out, the introduction of compressed air further enhances the ease with which chip disposal may be accomplished. The use of a lubricating vapor, such as kerosene vapor introduced through the air conducting passageways, provides sufficient lubrication to facilitate the punching and trimming operations. It will also be apparent that the die mechanism contemplated by the present invention is easily assembled and disassembled and constitutes a minimum number of constituent parts. Hence the present invention provides very economical apparatus and methods for producing blanks having accurate and perfectly formed peripheral contours.

While for purposes of illustration certain structural details have been disclosed herein, it will be obvious that other modifications and changes may be made without departing from the spirit and scope of the appended claims.

The invention is hereby claimed as follows:

1. Die mechanism for producing accurately dimensioned blanks including a series of stationary plate-like female die sections arranged in superposed stack formation for trimming peripheral sections from a previously formed blank, at least two adjacent plate-like die sections having internal and circumferentially spaced shaper teeth disposed entirely around the inner periphery thereof and of limited and the same radial extent, each tooth extending the axial length of its associated die section, the teeth of one said die section being peripherally staggered with respect to the teeth on the adjacent die section for successively removing from the blank single peripherally spaced sections of the same depth by each tooth with the sections removed by the teeth of one die section constituting substantially the entire remainder of material left between previously removed sections, and a finishing die section having a smooth internal periphery for removing any residual minute projections from the blank and burnishing the same.

2. Die mechanism as claimed in claim 1, wherein the die sections immediately adjacent the finishing die section have the teeth thereof projecting inwardly to a slightly greater extent than the teeth of the more remote die sections.

3. Die mechanism as claimed in claim 1, wherein chip removal passages are provided between each of the die sections.

4. Die mechanism as claimed in claim 1, wherein the die sections are provided with offset corner sections serving to space apart adjacent die sections to provide chip removal passages communicating with the shaper teeth.

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