Oct. 14, 1958 J. A. EINHIPLE 2,855,998

CONTINUOUS WEB PERFORATING MACHINE

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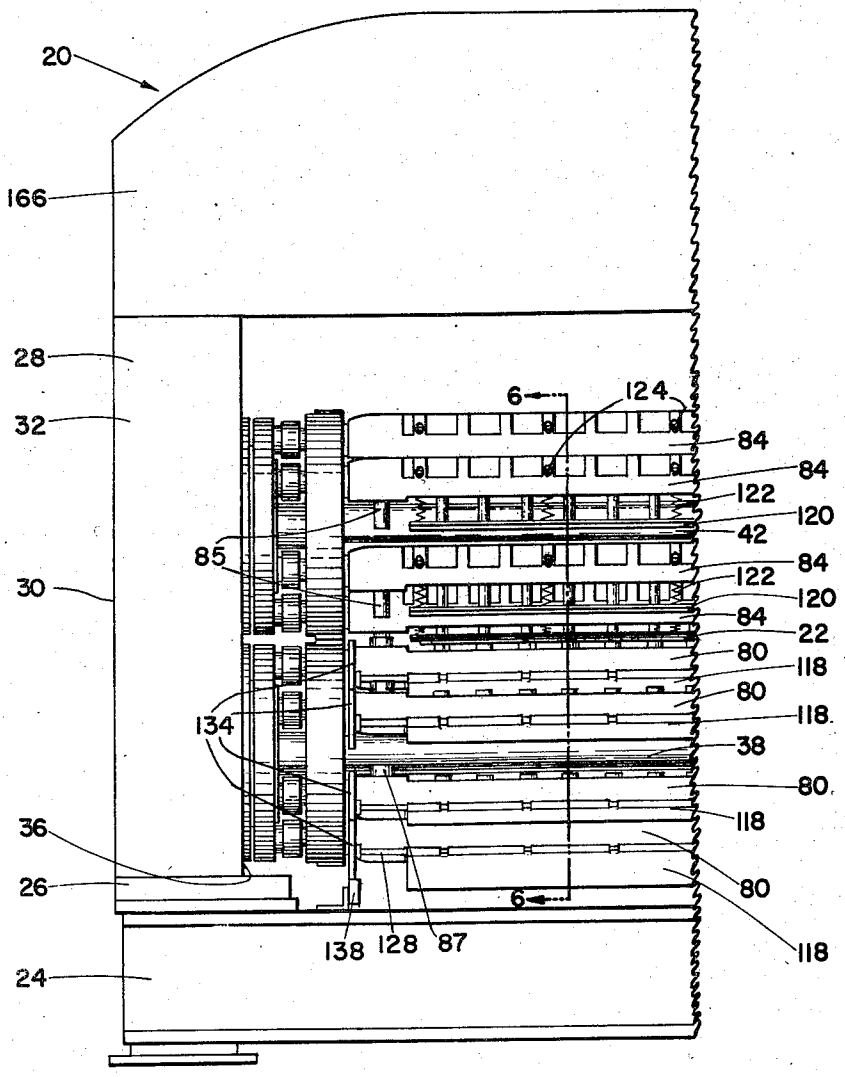


FIG. Ia

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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 2

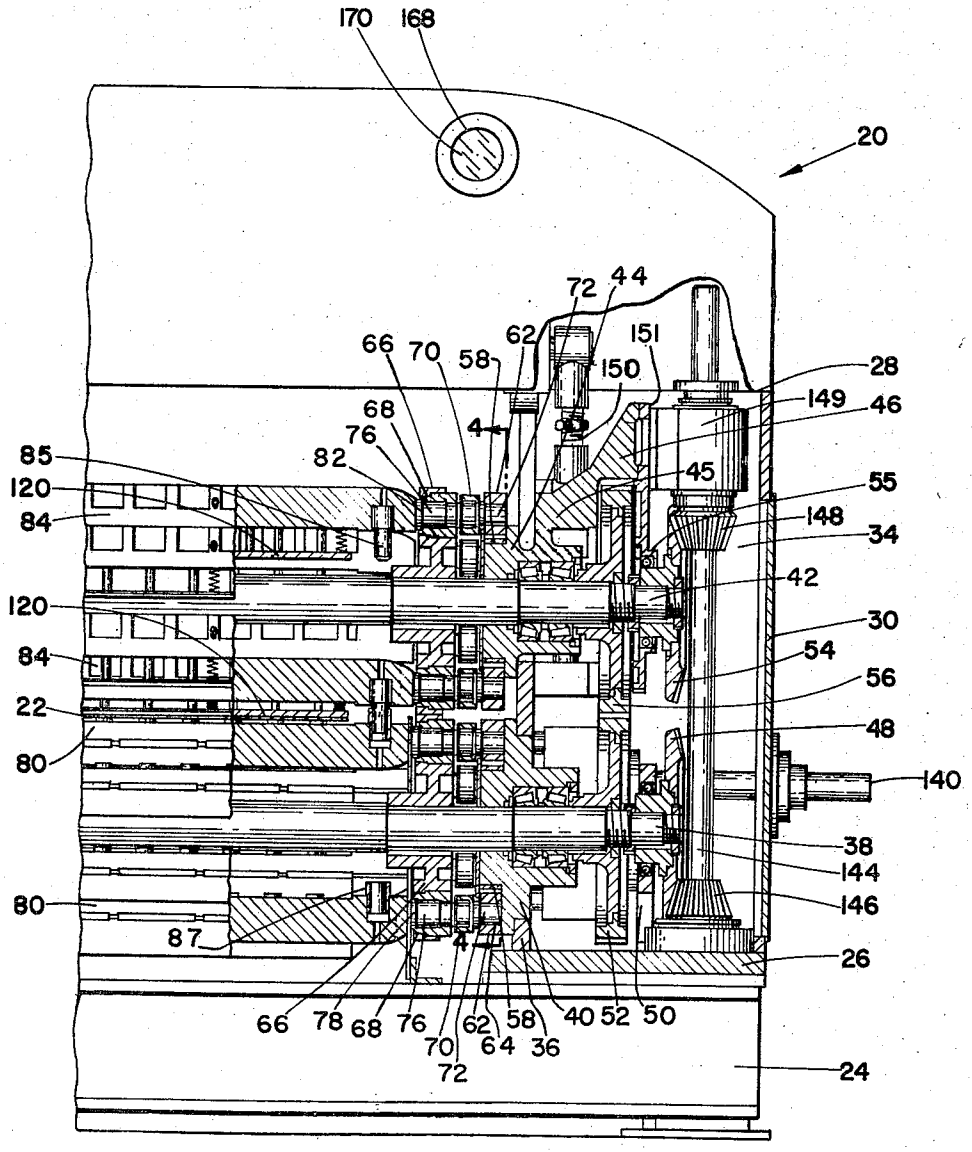


FIG. 1b

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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 3

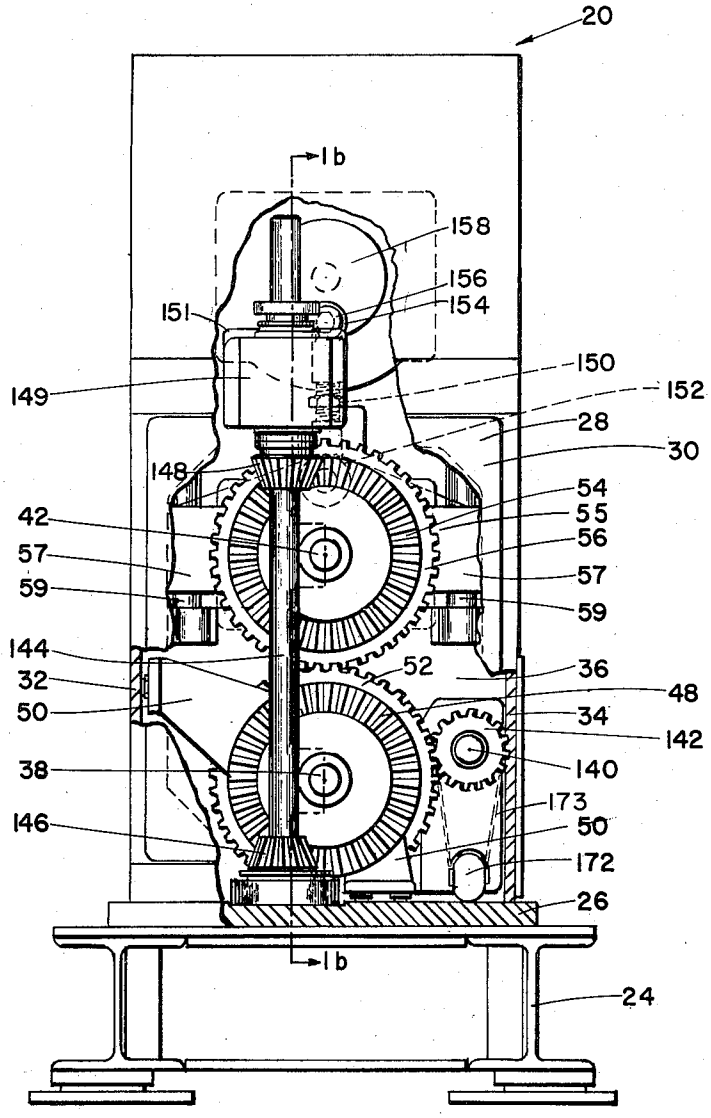


FIG. 2

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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 4

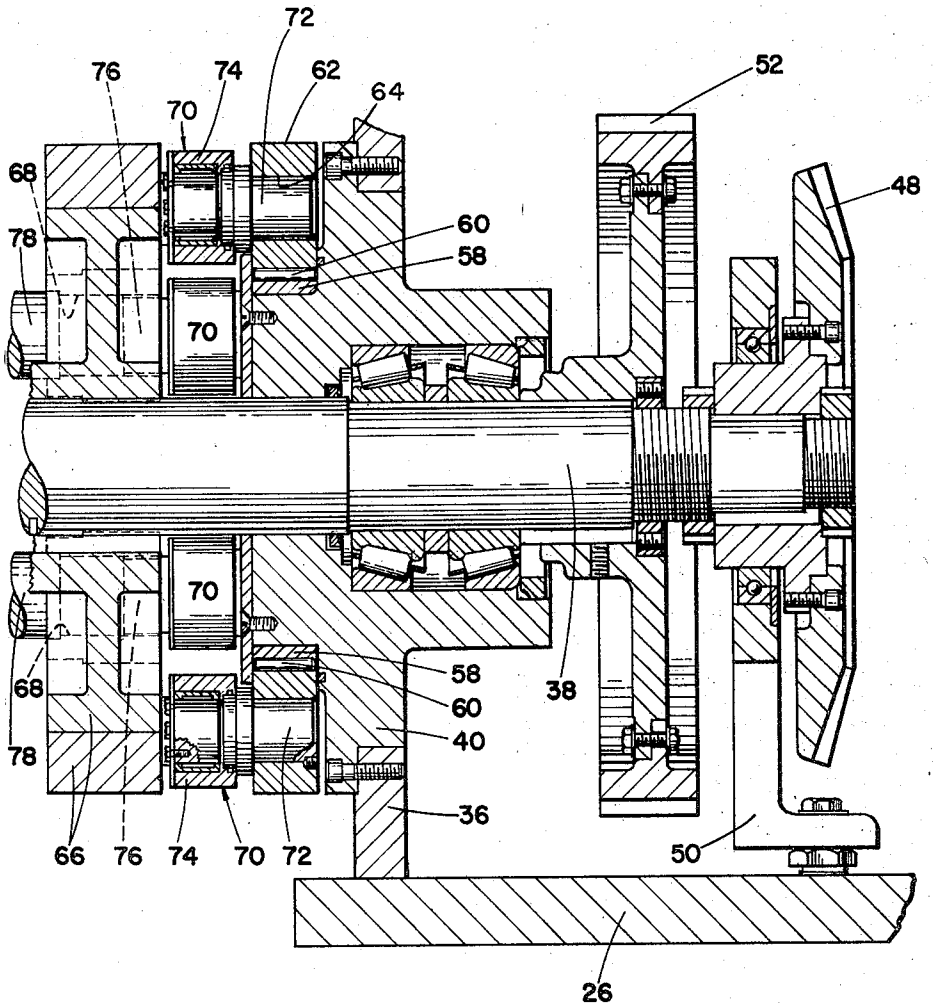


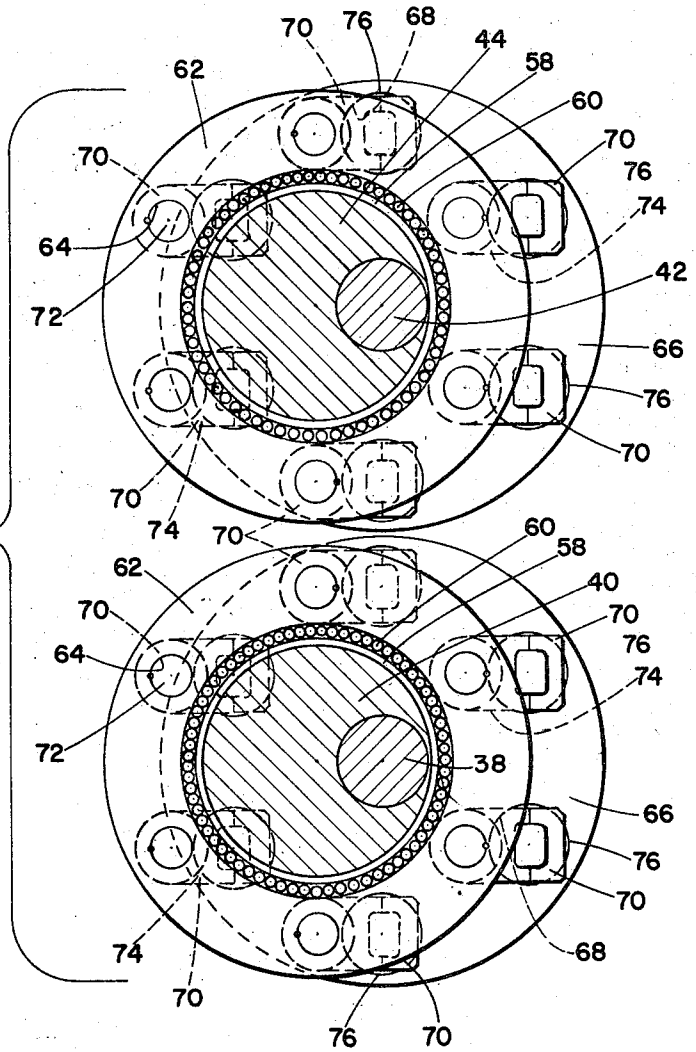
FIG. 3

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CONTINUOUS WEB PERFORATING MACHINE

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FIG. 4



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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 6

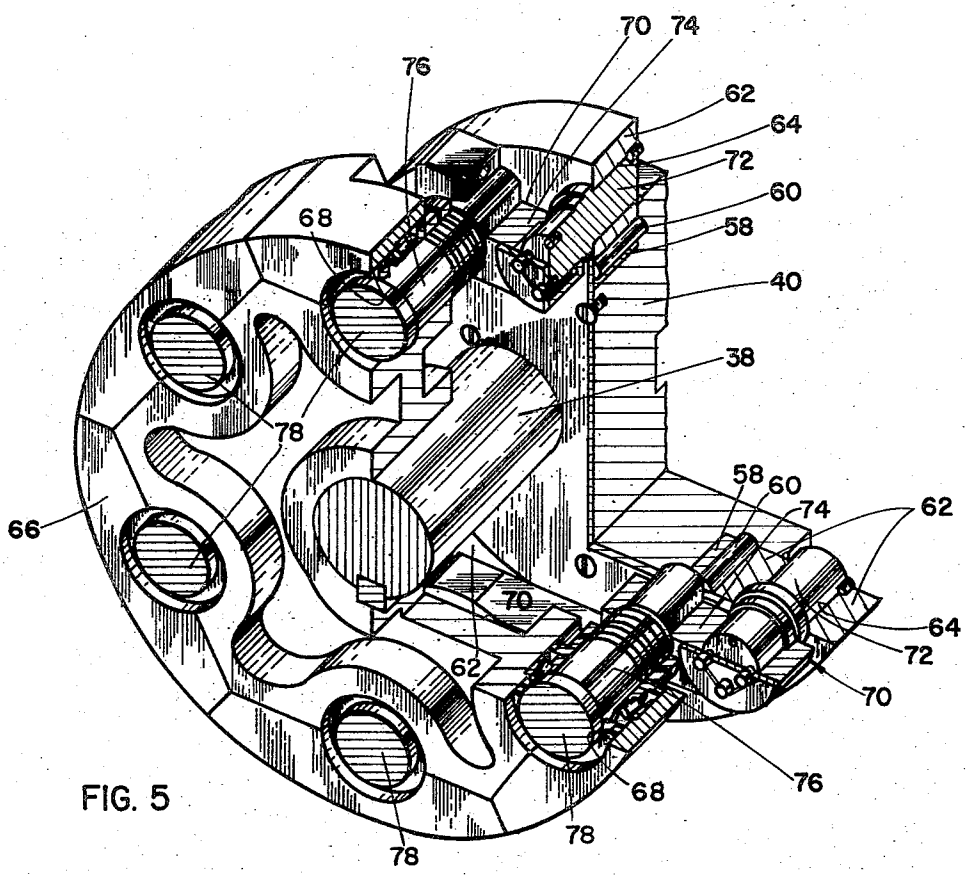


FIG. 5

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CONTINUOUS WEB PERFORATING MACHINE

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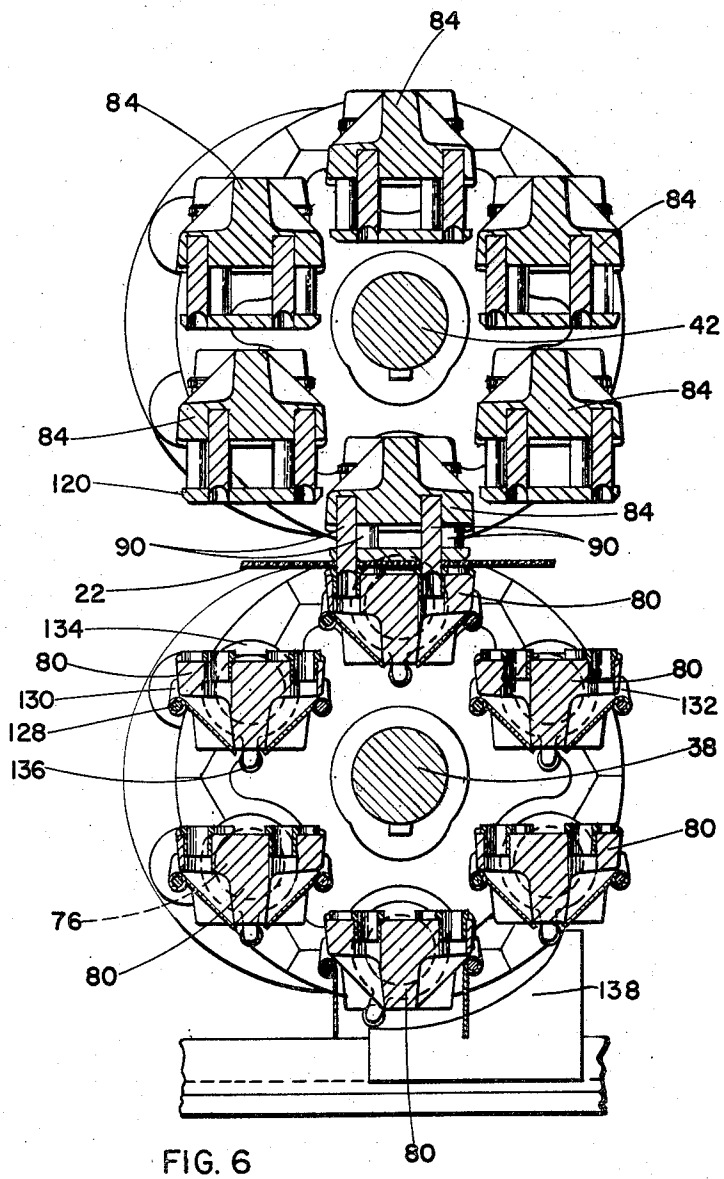


FIG. 6

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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 8

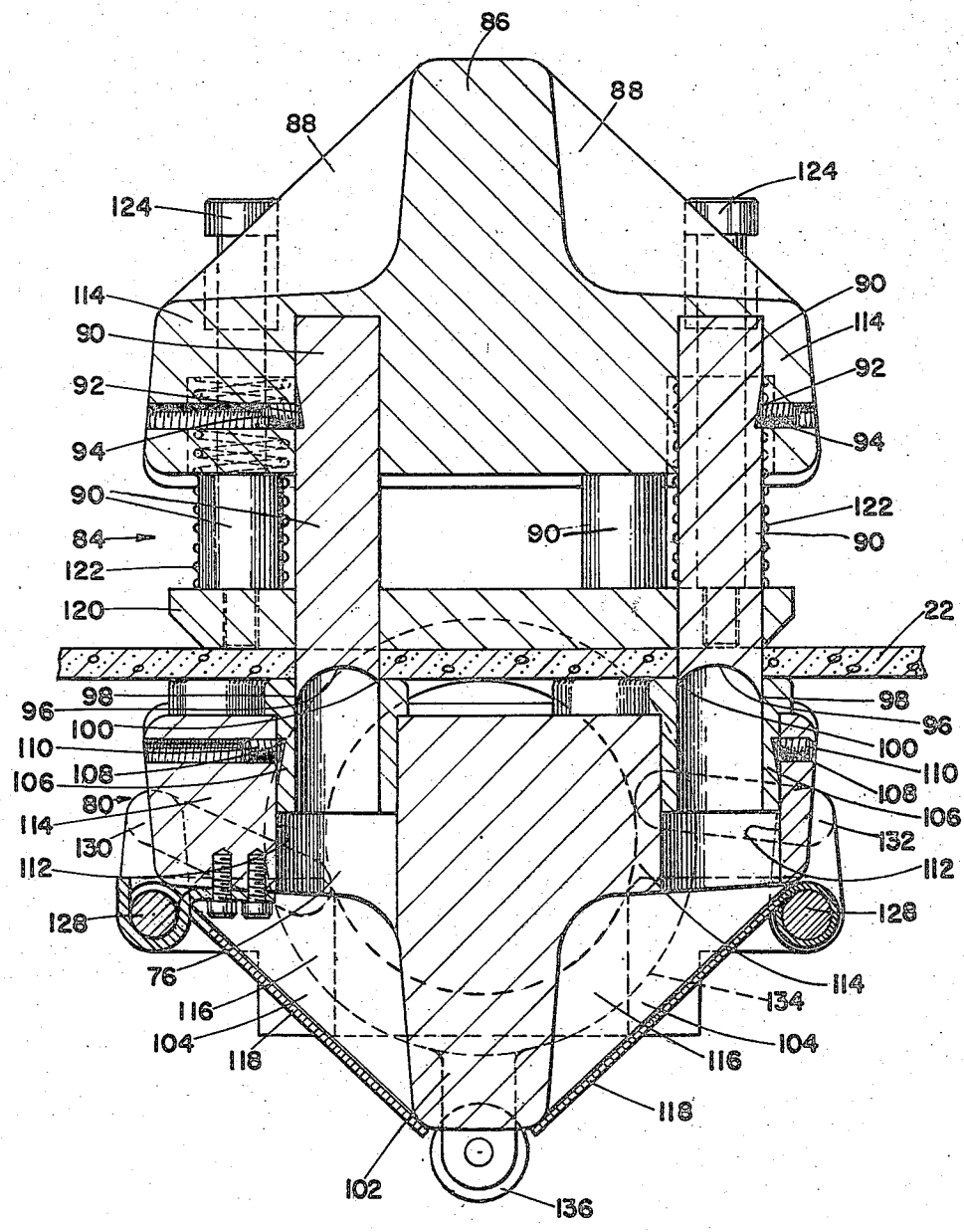


FIG. 7

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CONTINUOUS WEB PERFORATING MACHINE

Filed April 12, 1955 9 Sheets-Sheet 9

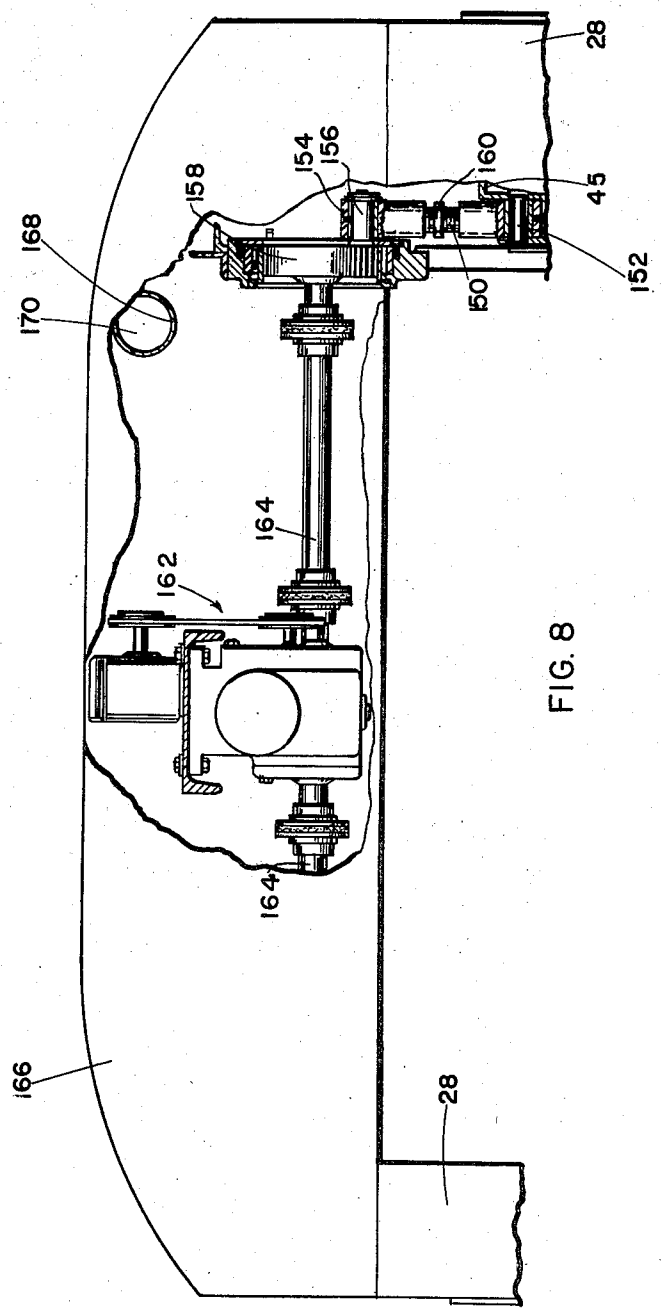


FIG. 8

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United States Patent Office 2,855,998 Patented Oct. 14, 1958

2,855,998

CONTINUOUS WEB PERFORATING MACHINE

John A. Einhiple, Kenmore, N. Y., assignor to National Gypsum Company, Buffalo, N. Y., a corporation of Delaware

Application April 12, 1955, Serial No. 500,751

2 Claims. (Cl. 164—90)

This invention relates to punching perforations in a continuously advancing web and is particularly directed to the perforating of gypsum board in the manufacture of perforated gypsum lath.

Flat, rectangular boards comprising a set gypsum core and reinforcing paper cover sheets, having a plurality of holes extending therethrough spaced evenly apart throughout the extent of the board, are a well known form of lath, for application to building framework as a base material for subsequent application of the plaster wall surface. The perforated form of board is well known as providing improved means for keying the surface plaster to the lath.

The perforations are generally made in the gypsum board while the board is still being advanced, as a continuous web, from the board forming machine along a conveyor system on which the gypsum core becomes partially set. The perforating operation is performed near the end of this conveyor, immediately prior to the cutting of the web into individual boards for subsequent transfer to a drying kiln. The uncut board, at the time of perforating, has set sufficiently and attained enough body to retain itself about a perforation without flowing, but is still considerably wet and weak, presenting difficulty in producing the desired quality in the punched hole. The need of a punch, or punch and die combination, capable of improving the quality of perforations is recognized.

The present most common method of forming these perforations is by a machine wherein a plurality of upper bolsters, each including a plurality of punches, cooperate with a plurality of lower bolsters, each including a plurality of dies, the two sets of bolsters being mounted on oppositely rotating spiders, the relation of all bolster faces to the horizontal being controlled by associated cams riding in a camway. The design of this prior machine recognizes the desirability of maintaining the punches and dies in a generally vertical disposition throughout an operative period of the cycle wherein the punches and dies are acting upon the moving web of board material, and it is for this general purpose that the cam and camway are incorporated into the prior design. The bolsters make a complete rotation in each cycle, incorporating a whip-type action during the non-operative portion of the cycle, necessitated by the vertically maintained condition during the operative portion.

It has now been found, however, that this use of cams and camways in maintaining verticularity during punching is highly subject to wear and loss of alignment, that close tolerances between punch and die cannot be maintained without excessive parts replacement, and that a new and improved punch structure, constructed in accordance with the present invention, cannot properly function in the absence of the close tolerances, within which the prior machines cannot be maintained for any reasonable period of operation. The prior design, further, includes an excessive number of power transmitting

elements between upper and lower spiders, each additional power transfer permitting additional sources of lost motion or misalignment due to inaccuracies or wear.

An object of the present invention is to provide, in a machine for perforating gypsum lath or like material, an improved punch for cooperation with a standard die, and further to provide such a combination of punch and die capable of improved performance with substantially decreased tolerances. Further objects are to provide a machine adapted through several means to maintain the close tolerances needed with the incorporation of the new punch; a new and improved motion for rotary punching; a novel means for providing the new motion; waste disposal means essential in the proper operation with the new motion; and a new combination with the punch and die elements of an improved power transmission means for the maintenance, to a very substantial degree, of the necessary close tolerances between punch and die.

These and numerous other objects and advantages will appear more fully when considered in connection with the following detailed description of a preferred embodiment of the invention and the accompanying drawings in which:

Fig. 1*a* is a front view of the left half of a rotary punching machine built in accordance with and embodying the invention.

Fig. 1*b* is a front view of the right half of the machine of Fig. 1*a*, parts having been broken away and parts shown in section as taken generally along line 1*b*—1*b* of Fig. 2.

Fig. 2 is a right end view of the machine of Fig. 1, cover plates having been broken away.

Fig. 3 is an enlarged view of the bolster support and drive elements of Fig. 1*b*, as taken along line 1*b*—1*b* of Fig. 2.

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1*b*.

Fig. 5 is an isometric view with parts broken away, of the structural details of the bolster support and drive elements.

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 1*a*.

Fig. 7 is an enlarged sectional view of one pair of bolsters as shown in Fig. 6 showing the novel punches and cooperative dies.

Fig. 8 is a front view, with cover plates broken away, to show the mechanism for raising and lowering the upper rotating elements of the machine of Figs. 1*a* and 1*b*.

General description

Figs. 1*a* and *b* and Fig. 2 show the front and right end views respectively of the lath perforating machine 20, through which a continuous web of partially set, paper covered, gypsum board 22 continuously passes. Although the machine 20 is capable of operating on board passing from front to rear or reversely, it will be apparent that when it is once installed for operation, usage will normally be in one direction only.

Machine 20 is supported by a frame-base 24 having fixed thereon a bed-plate 26 at each end thereof. Over each bed-plate 26 is an enclosed gear-box 28, made of a relatively light, removable, end cover-plate 30; fixed, heavier-gauge, upper-shaft supporting, front-plate 32 and rear-plate 34; and a lower-shaft supporting main-plate 36.

Machine 20 includes a lower-shaft 38, rotatably supported in opposed lower-hubs 40 which are fixedly mounted in main-plates 36 at each end of machine 20. An upper-shaft 42 is rotatably supported in opposed upper-hubs 44, which are the axially inner extent of hub supporting portions 45 of vertically-adjustably mounted upper-frames 46, which entire unit is slidably mounted

for vertical movement of upper-shaft 42 and its associated elements. By way of explanation, the punching operation of machine 20 is started and stopped by the lowering and raising of the upper-shaft 42 and its associated elements, while the shafts 38 and 42, and their associated elements, are rotating synchronously and the board 22 is passing therebetween. The complete mechanism associated with this feature is discussed completely further below.

Fixed on the right end of lower-shaft 38, is a bevel-gear 48. Upper-shaft 42 has a similarly disposed bevel-gear 54, fixed at the right end thereof. With the exception of bevel gears 48 and 54 and the associated conical gears and shaft disposed at the machine right end and a power input source at the right end, all discussed fully further below, the right and left ends of machine 20 are inverse counterparts and, for this reason, disclosure will be directed, generally, to the right end, as shown in Fig. 1*b*.

Inwardly of each end of lower-shaft 38, the shaft 38 is further supported, rotatably, in diagonal-braces 50, fixed to the bed-plates 26 and front plates 32. Inwardly from diagonal-braces 50, spur-gears 52 are keyed to lower-shaft 38.

Upper-frames 46 include axially outer cross members which are disposed axially inwardly of each end of upper-shaft 42. Cross members 55 extend horizontally outward in each direction from shaft 42, as seen in Fig. 2, forming guide shaft bearing portions 57 which are slidably mounted on fixed vertically extending guide shafts 59. Cross members 55, by the fixed vertical relation with guide shafts 59, maintain upper frames 46 in true vertical positions.

Inward of cross-members 55 are spur-gears 56, disposed for meshing with spur-gears 52 when upper-shaft 42 is adjusted to its normal operating, lowest vertical position. The lower and upper hubs 40 and 44 are disposed axially inward of the spur-gears 52 and 56, all of which hubs are fixed against rotation relative to the machine frame.

Fig. 5 is an isometric cutaway view of the lower right hub 40 and its cooperative adjacent elements, the opposite lower hub portions and the upper hub portions being constructed similarly and shown with like numerals designating similar parts.

Referring now to Figs. 4 and 5, the horizontally eccentric relation of shafts 38 and 42 relative to the axis of hubs 40 and 44 is seen. Lower- hubs 40 and upper-hubs 44 each include an axially inwardly projecting, cylindrical inner-race 58, disposed about each of which is a roller-bearing 60. The races 58 and roller-bearing 60, will be seen in Figs. 4 and 5 to be eccentrically disposed relative to the respective roller-shafts 38 and 42, which extend therethrough. Large inside-diameter, hub-supported, cooperative spiders 62 are rotatably mounted on roller-bearings 60 and include six evenly circumferentially spaced end-sockets 64, all equally radially spaced from race 58.

Axially inward of lower-hubs 40 and upper-hubs 44, and fixedly, coaxially mounted on the shafts 38 and 42, are small inside-diameter, shaft-mounted, supporting spiders 66, including six evenly circumferentially spaced bearing-sockets 68. Six crank-arms 70 are rotatably mounted between each pair of spiders 62 and 66, each crank-arm comprising an end-journal 72, rotatably disposed in an end-socket 64, a crank-portion 74, and an inner bolster-journal 76, rotatably disposed in a bearing socket 68.

It will thus be seen that, with supporting-spiders 66, fixed to shafts 38 and 42, rotation of these members will cause the crank-arms 70 and the cooperative-spiders 62 to rotate evenly therewith and, due to the horizontal eccentricity between the spiders 62 and 66, the crank-arms 70 will be held horizontal throughout this rotation.

Referring now to the lower-shaft assembly, the inner bolster-journals 76 of crank-arms 70, rotatably disposed in the axially inward supporting-spiders 66, are rigidly affixed at their axially inner end 78 to the ends of six lower die-supporting bolsters 80. Thus, since die-bolsters 80 are fixed relative to crank-arms 70, it will be apparent that with rotation of spider 66 the die-bolsters 80 will be moved annularly about and completely around lower-shaft 38 maintaining a fixed vertical position throughout this rotation.

Similarly on the upper-shaft assembly, the inner bolster-journals 76 of crank-arms 70 are rigidly affixed at the axially inner ends 82 to the ends of six upper punch-supporting bolsters 84. Punch-bolsters 84 rotate about upper-shaft 42, in fixed vertical position, oppositely and synchronously to the rotation of the die-bolsters 80.

It should be definitely noted that in Fig. 1*b* the two spiders 62 and 66, which are eccentric one to the other, are both cross sectioned through their respective centers, which are not in the same plane, in order to more clearly disclose the relation between the elements and the transmission of motion throughout the elements of machine 20. For the clearest understanding of the relation of the bolster support and drive elements, attention is directed to Figs. 4 and 5, Fig. 3 being taken along a broken plane, see line 1*b*—1*b* of Fig. 2.

Referring back to Figs. 1*a* and 1*b*, guide pins 85 are shown extending downwardly from each end of punch bolsters 84 and complimentary guide holes 87 are disposed in each end of die bolsters 80 for reception of guide pins 85 to further maintain the close tolerance cooperation between opposed bolsters.

Referring now to Fig. 7, a cooperative pair of bolsters are shown in operating position, including a die bolster 80, at its uppermost position in its cycle of rotation, and a punch bolster 84, at its lowermost position in its cycle of rotation. Punch bolster 84 includes an inverted T-shaped body portion 86, which is reinforced at spaced positions along its extent with webs 88. Two rows of cylindrical perforating punches 90 are mounted to extend downwardly from the bottom faces of punch bolsters 84, the punches 90 being alternately staggered in pairs, to provide improved spacing of perforations in the finished perforated board.

The punches 90 are solid cylindrical bodies having a depression 92 for lockingly engaging the punch 90 with a set screw 94. The cutting end faces 96 are concavely formed, substantially as though severed semi-cylindrically, that is by a plane which is arcuate in one direction. The faces 96 have a leading cutting edge 98 projecting axially further than an opposite, trailing cutting edge 100. The difference in projecting distance is the result of spacing the axis of the abovesaid arcuate plane from the punch axis, avoiding an intersecting of axes, It will be seen that the difference in projecting difference will be dependent upon the spacing of axes and the arcual radius. The preferred axial difference in length of the edge 98 and edge 100 is substantially equal to the thickness of board 22. The punches are disposed in bolsters 84 with leading edges 98 disposed away from the adjacent punch in the opposite row, so that equal and opposite thrust are created by adjacent punches.

Die-bolster 80 includes an upright T-shaped body portion 102, which also is reinforced at spaced positions along its extent with webs 104. Two rows of hollow cylindrical dies 106 are mounted on the top face of die-bolster 80, alternately staggered in pairs for reception of the punches 90. The dies 106 are formed with a depression 108 for engagement of set screws 110 for locking the dies relative to bolster 80. Dies 106 are disposed in holes 112 which extend entirely through the bolster flange portions 114, the arrangement being that board material, in the form of slugs, which is removed by the punches and dies, will pass entirely through the flange portion 114. These slugs are caught in retaining chambers 116, which are formed beneath each row of

dies on each side of the bolster by elongate doors 118, each door extending throughout the undersurface of one side of each bolster 80. Doors 118 are so mounted, as will be described herebelow, that they are caused to open when the die bolsters 80 are located at the lowest point in the cycle preventing slugs of waste material from falling from a bolster in operating position at the top of the cycle onto the top face of a bolster located therebelow.

Each punch bolster 84 further includes a spring loaded stripper plate 120, which is disposed below and extends throughout the extent of the bottom face of the punch bolsters. Springs 122 continuously urge the stripper plate 120 downward, and spring core bolts 124, disposed through the center of spring 122, slidably mounted, in a fixed vertical position, in the flange portions 114 of bolsters 84, preferably at a web 88, and fixed at the end thereof in stripper plate 120, maintain the alignment of stripper plate 120. It will be apparent that as the upper bolster in Fig. 7 moves upward, stripper 120 prevents web 22 from moving upward therewith, see Fig. 6, as might otherwise occur due to friction on punches 90.

By referring to Figs. 1*a*, 6 and 7, the operation of the slug catching doors 118, will be more clearly apparent. Doors 118 are pivotally mounted on rotatably mounted, pivot-shafts 128, extending throughout the length of the respective doors. Pivot-shafts 128, at each end of doors 118, are connected through linkages 130 and 132, which are further connected to annular rings 134. Rings 134 are rotatably mounted at each end of die-bolster 80, and have extending therefrom camway follower rollers 136, rotatably disposed therebelow. A camway 138, mounted on frame 24, is located along the lower periphery of the path of rollers 136 during rotation of bolsters 80. Camway 138 causes rollers 136 to move sidewards relative to the bolsters 80, rotating the annular rings 134, which, through linkages 130 and 132, operate pivot-shafts 128, opening doors 118. Further progression of roller 136 along camway 138 allows roller 136, due to the shape of camway 138, to return to its normal central position, reclosing, by means of the same mechanisms, the doors 118.

Referring now to Fig. 1*b* and Fig. 2, a power source (not shown), in any usual form, drives by means of a drive shaft 140, a gear 142 which is constantly in mesh with lower spur gear 52.

When the upper shaft 42 and its associated punch bolsters 84 are adjusted to their normal operating, lowest vertical position, a direct drive from lower to upper shaft is maintained at each end of the machine through the cooperative spur gears 52 and 56. During a change from an operating to a non-operating condition, which is accomplished by raising the upper shaft 42 and punch bolsters 84, a continuous condition of synchronism must be maintained between the punches 90 and dies 106. This synchronism is provided by means of a vertical shaft 144 at the right end of machine 20, and is included in Fig. 1*b* for clear disclosure although it is disposed in front of the sectioning plane 1*b*—1*b* as will be seen in Fig. 2. Shaft 144 has a lower conical gear 146 fixed thereon to cooperate with lower bevel gear 48. Conical gear 146 is driven by bevel gear 48 and drives vertical shaft 144, on which is axially-slidably keyed an upper conical gear 148 for intermeshing with and driving upper bevel gear 54. Vertical shaft 144 is rotatably and slidably supported at its upper portion by a hollow cylindrical mounting 149 affixed to an upper outer face plate portion 151 of upper frame 46.

The raising and lowering of the upper shaft 42, and punch-bolsters 84, is accomplished by means of a raising and lowering mechanism, acting through each end of machine 20, the right end of which is shown generally in Fig. 8. The raising and lowering mechanism acts through and supports the upper shaft assembly by crank-arms 150, pivotally connected to upper-frames 46 as at hanger-shafts 152. Crank-arms 150 are pivotally connected at upper ends 154 to crank pins 156 extending axially outward from the radially outer portion of crank wheels 158. Rotation of crank wheels 158, through a 180° arc in either direction, will be seen to raise the upper shaft assembly a distance twice the distance between the crank wheel axis and the crank pin axis. Crank arms 150 are further adapted for adjustment of length by turn buckles 160 provided at the central portion thereof. It will be seen that the preferred arrangement is such that when crank wheels 158 are so disposed that crank pins 156 are at the lowest position, turn buckles 160 are adjusted and locked to provide proper disposition of punch-bolsters 84 and punches 90, relative to the die-bolsters 80 and dies 106. Power and control means for rotating crank wheels 158 are shown generally at 162, with shafts 164 extending from each side thereof to drive the pair of crank wheels 158.

As will be readily seen from Fig. 8, the raising and lowering mechanisms are contained and supported in an enclosed overhead housing 166, extending between and supported on the two gear boxes 28. A lubricant reservoir 168 with sight glasses 170 at each end thereof is also disposed in housing 166. An oil pump 172, seen in Fig. 2, is driven by drive shaft 140, through chain 173, the balance of the lubricating system not being shown.

Having completed a detailed disclosure of a preferred embodiment of my invention so that those skilled in the art may practice the same, I contemplate that variations may be made without departing from the essence of the invention or the scope of the appended claims.

1. In a machine for perforating a continuously advancing web of gypsum board material, punch and die bolsters mounted for equal and opposite, opposed rotation, means for maintaining said bolsters in constant parallelism throughout said rotation permitting relatively close tolerances to be maintained durnig operation, said punch bolsters comprising a plurality of punches mounted therein extending therefrom toward said die bolsters, said die bolsters comprising an equal plurality of hollow tubular dies axially extending in line with said punches, said punches comprising a solid cylindrical body, the working end of said body presenting an uninterrupted concave surface, said surface being one which is formed by a plane arcuately curved in one direction and perpendicularly intersecting said body in the opposite direction, the arcual axis of said surface being spaced from the central axis of said cylindrical body.

2. In a machine for perforating a continuously advancing web of gypsum board material, punch and die bolsters mounted for equal and opposite, opposed rotation, means for maintaining said bolsters in constant parallelism throughout said rotation permitting relatively close tolerances to be maintained during operation, said punch bolsters comprising a plurality of punches mounted therein extending therefrom toward said die bolsters, said die bolsters comprising an equal plurality of hollow tubular dies axially extending in line with said punches, said punches having a working end comprising an uninterrupted face lying in a plane which is arcuate in one diametric direction, a protruding cutting edge at each opposed edge formed by said arcuate face, the arcual axis being spaced from the central axis of said punch, providing one leading cutting edge protruding further than an opposite trailing cutting edge, said difference in length of protrusion being substantially equal to the thickness of sheet to be perforated thereby.

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