United States Patent [19]

Miller et al.

[11] **3,889,509**

[45] **June 17, 1975**

[54] **HORIZONTAL CAN IRONING PRESS**

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[73] Assignee: **Gulf & Western Manufacturing Company,** Southfield, Mich.

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[21] Appl. No.: **458,392**

[52] **U.S. Cl.** **72/349;** 72/361; 72/467

[51] **Int. Cl.** **B21d 22/30**

[58] **Field of Search** 72/343, 347, 348, 349, 72/467, 468, 455, 456, 361

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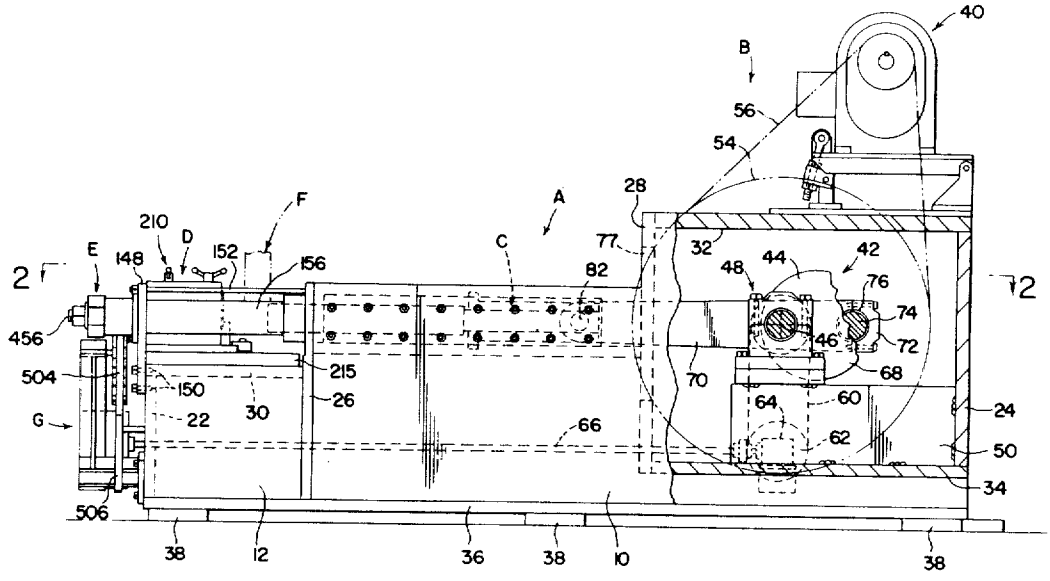
Primary Examiner—Richard J. Herbst

Attorney, Agent, or Firm—Meyer, Tilberry & Body

[57] **ABSTRACT**

An improved machine is provided for forming a can body having a closed end and a peripheral side wall extending therefrom. The machine includes a frame supporting a reciprocable slide on which a pair of ironing punches are removably mounted. The frame is provided with squared-off gibs receiving and slidably supporting squared-off follower rods on the slide. Each punch is threadedly engaged with the slide, and corresponding punch removal assemblies provide quick assembly and disassembly of the punch and slide components. Adjustable ironing rings are provided for each punch, and each ring support assembly is pivotal about a vertical axis to align the ring assembly and punch axis. The can end doming assemblies are mounted on a cross bar releaseable for pivotal movement about a vertical axis adjacent one side of the frame, and an indexing pocketed discharge star wheel between the ironing ring and doming assemblies receives and discharges formed can blanks following the doming operation.

27 Claims, 17 Drawing Figures



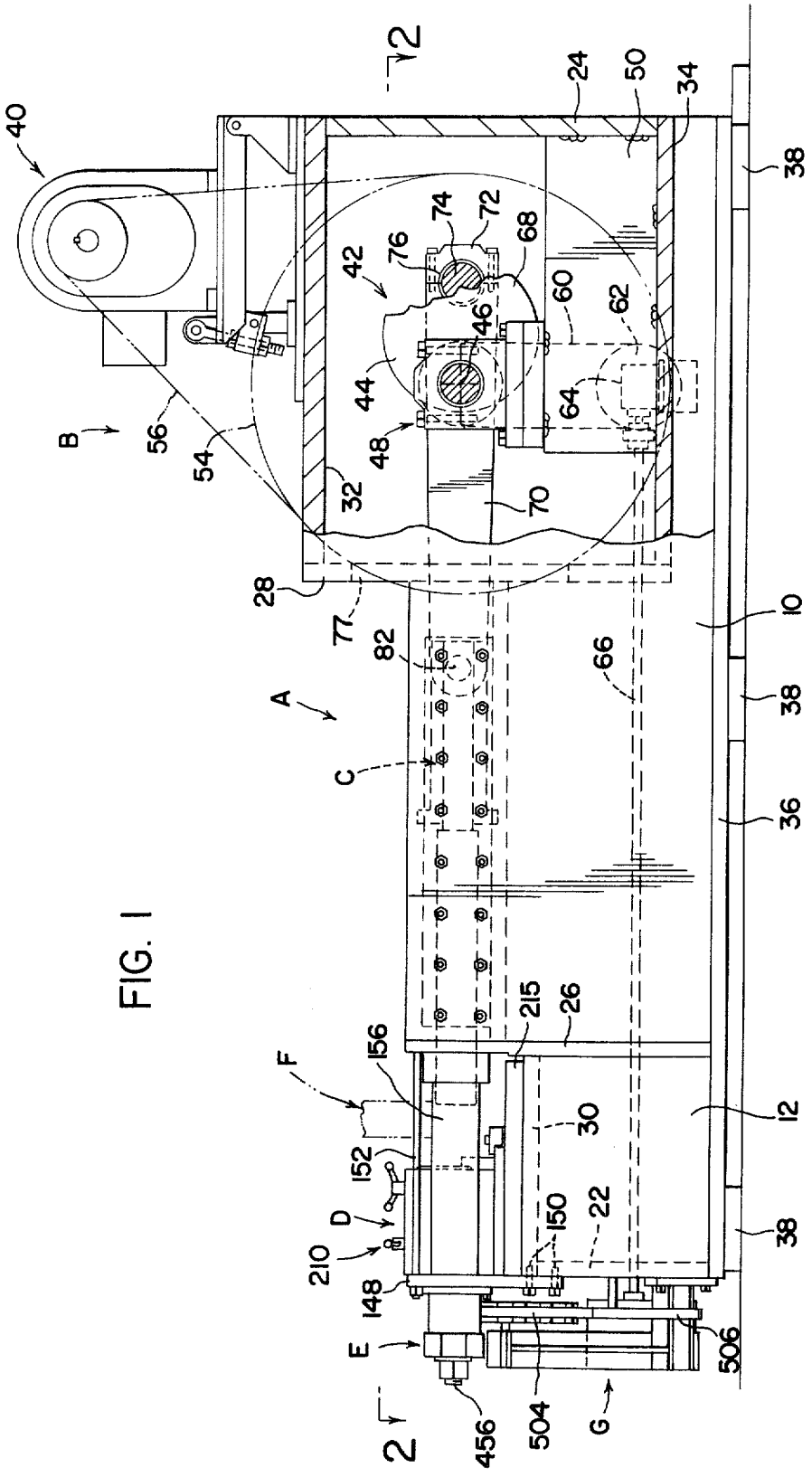

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FIG. 1

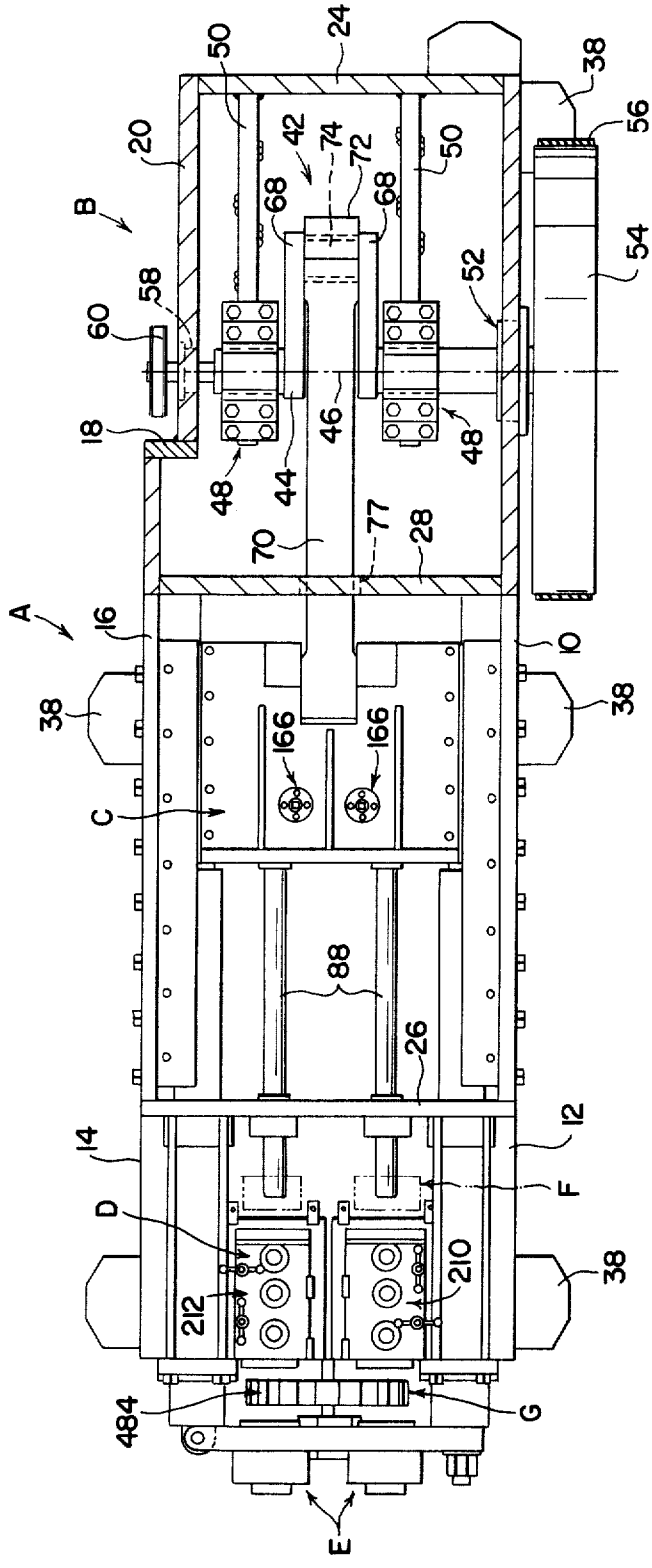
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FIG. 2

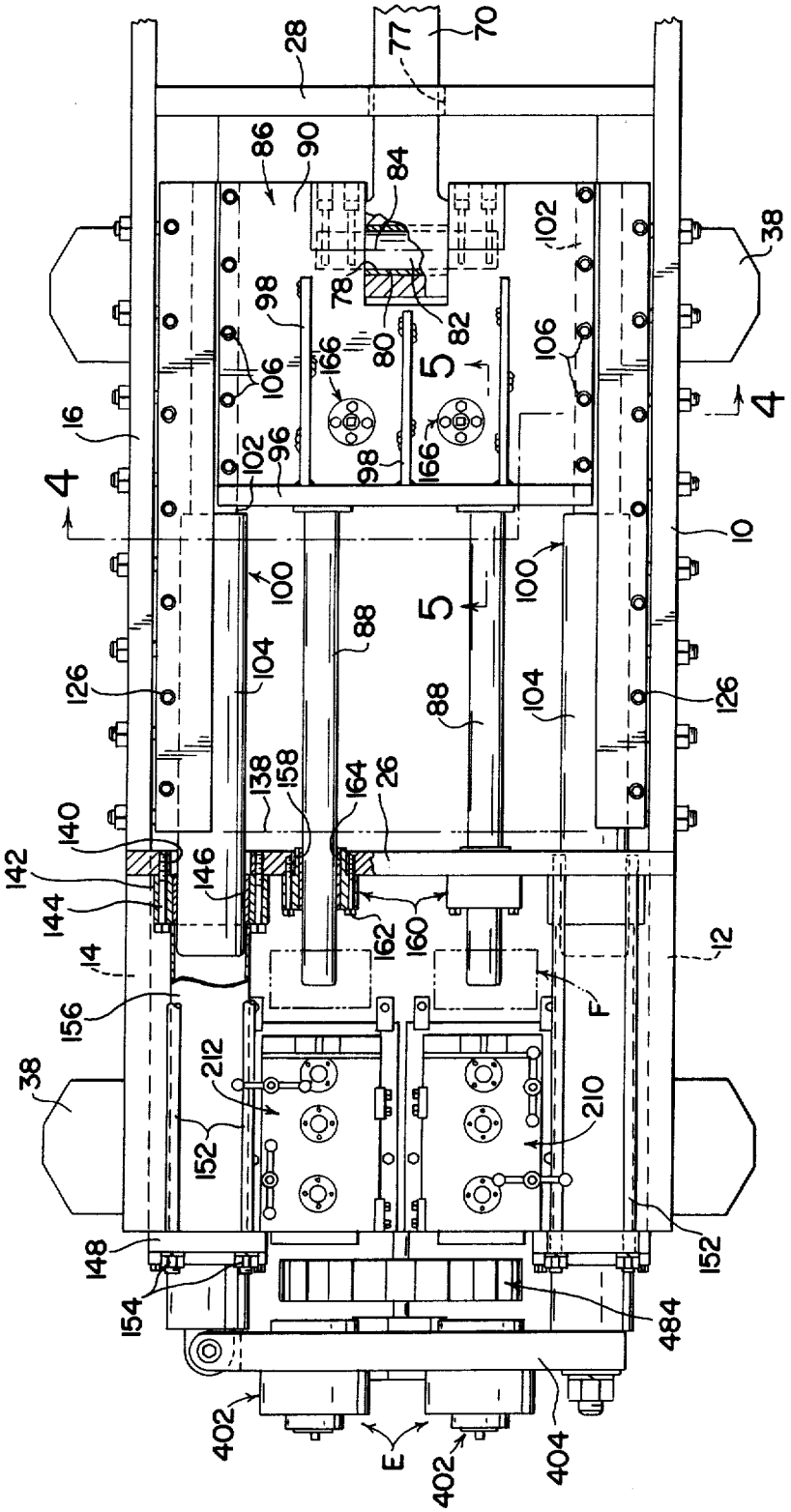
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FIG. 3

FIG. 4

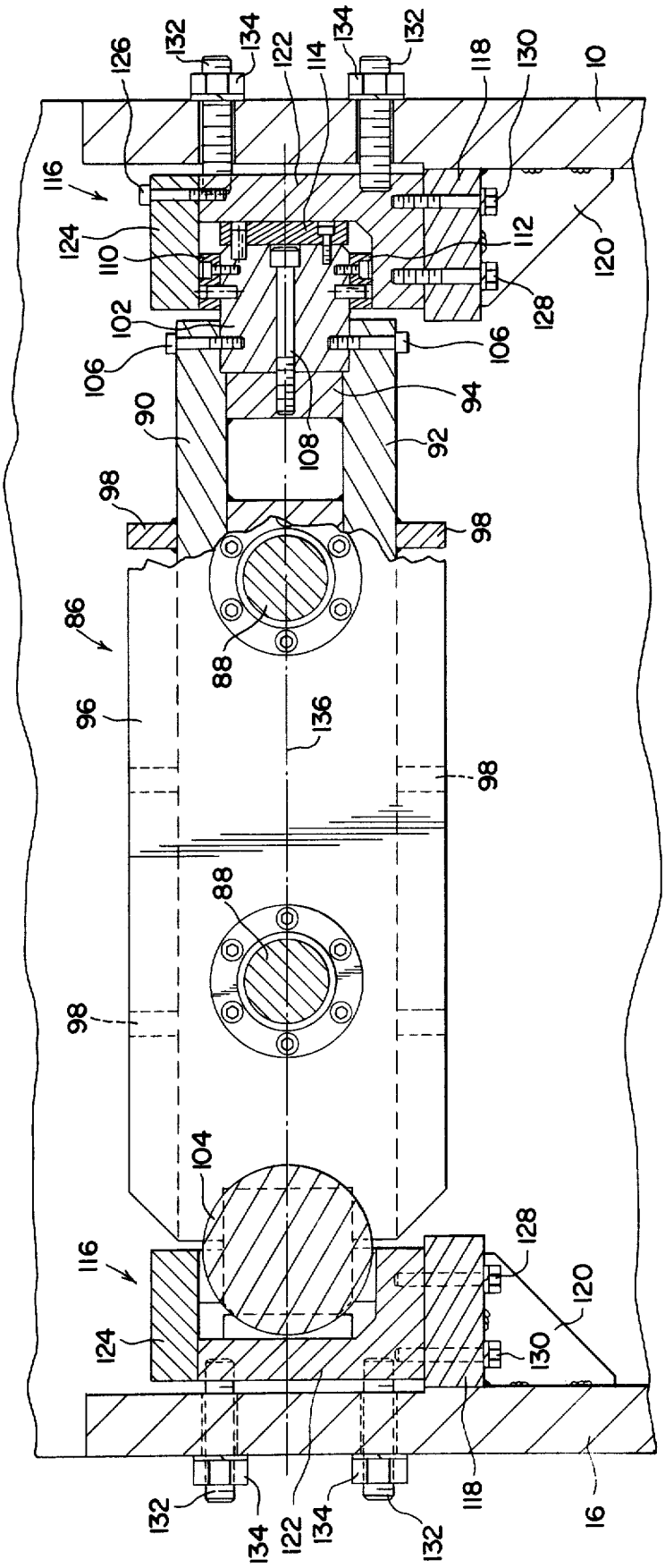
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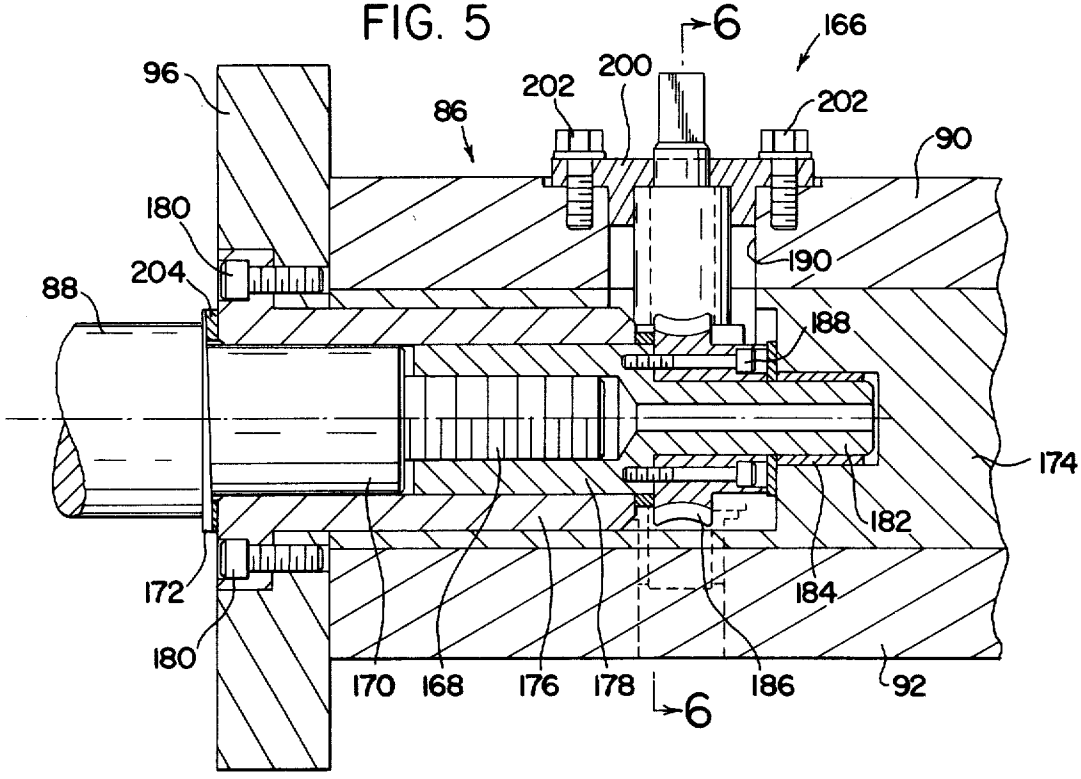
FIG. 5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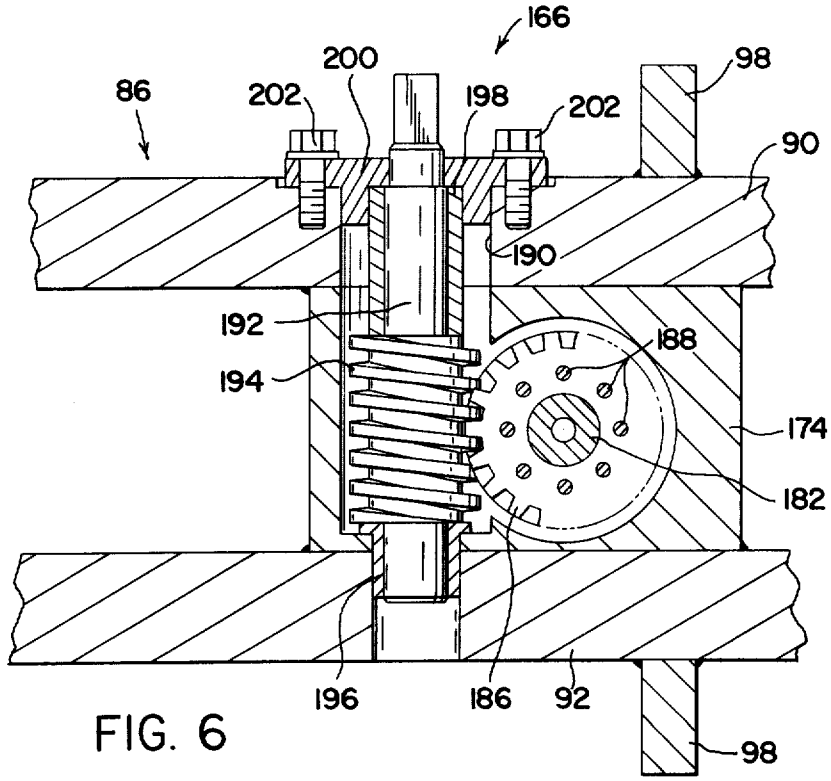
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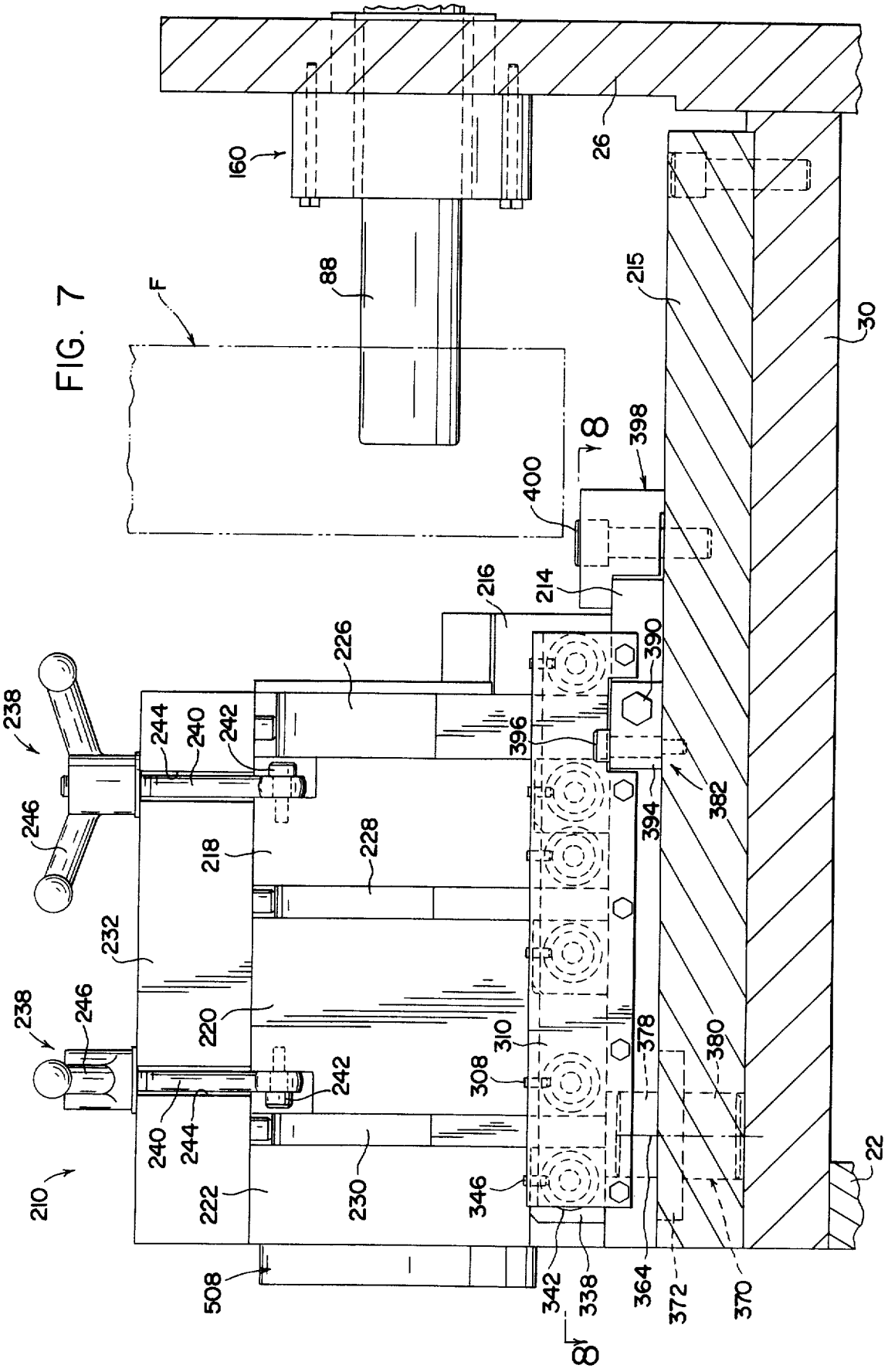
FIG. 6

FIG. 7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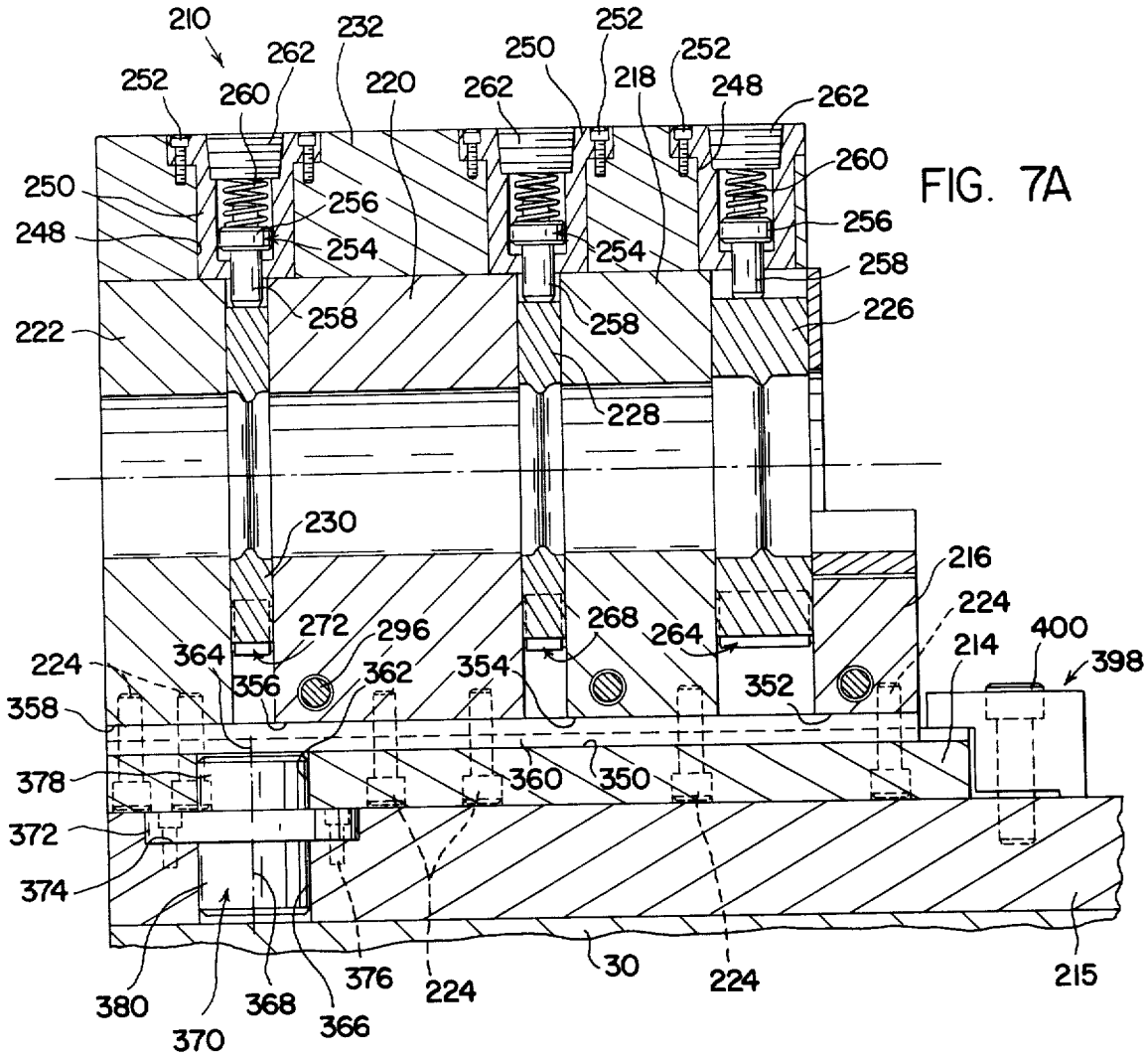
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FIG. 7A

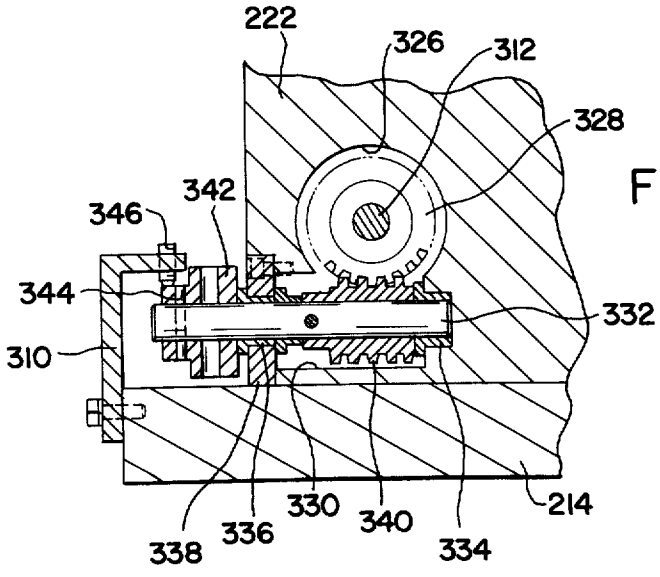
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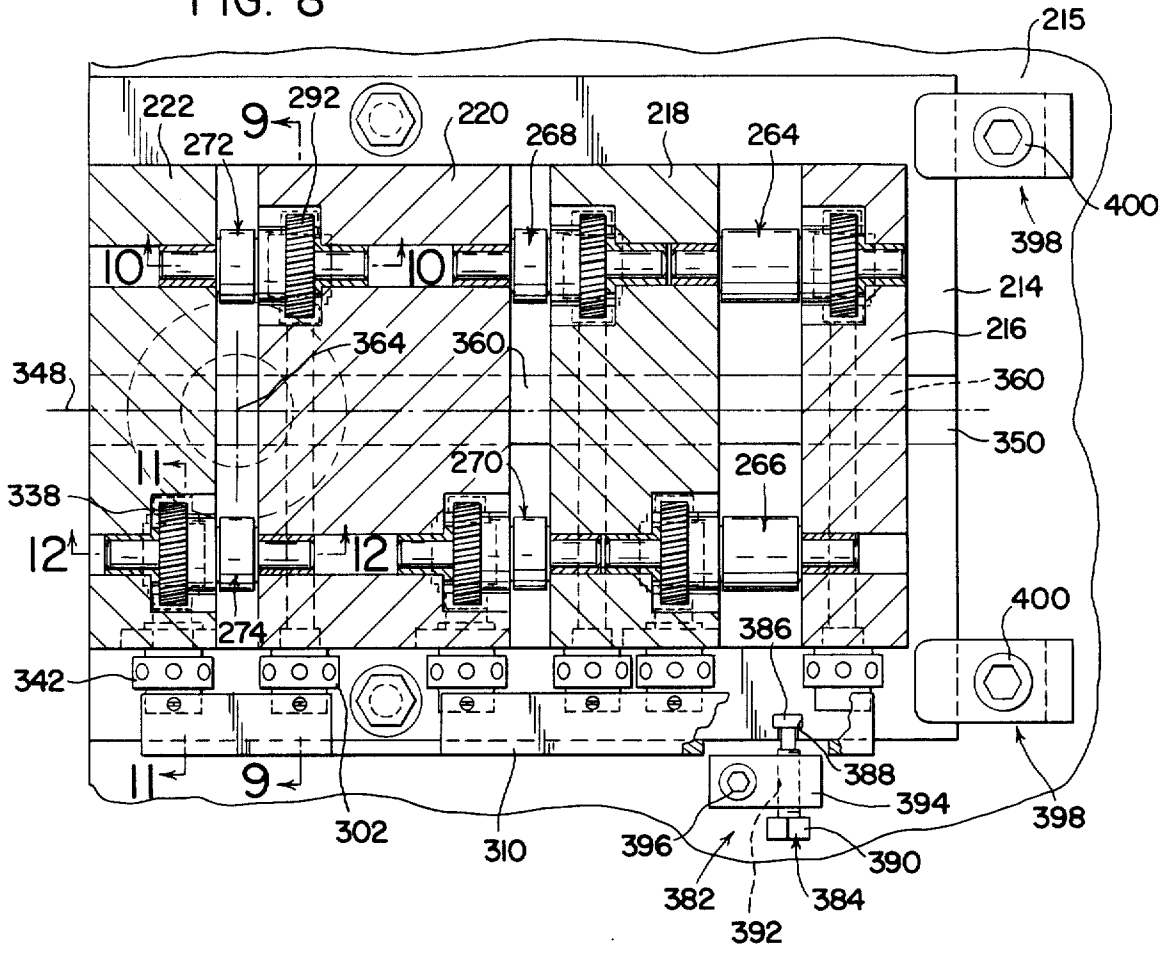
FIG. 11

FIG. 8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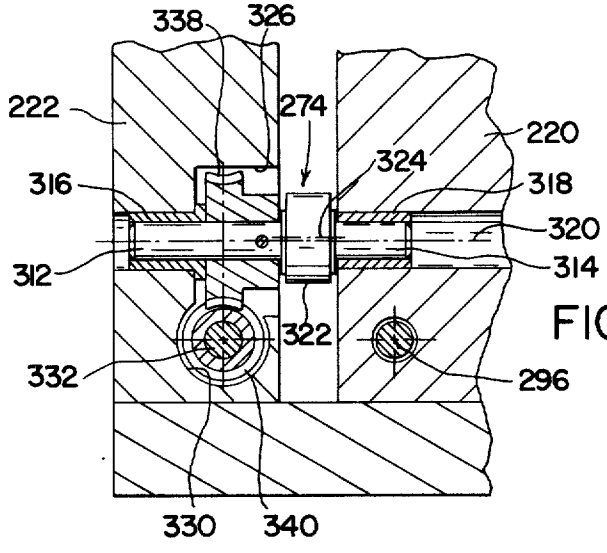
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FIG. 12

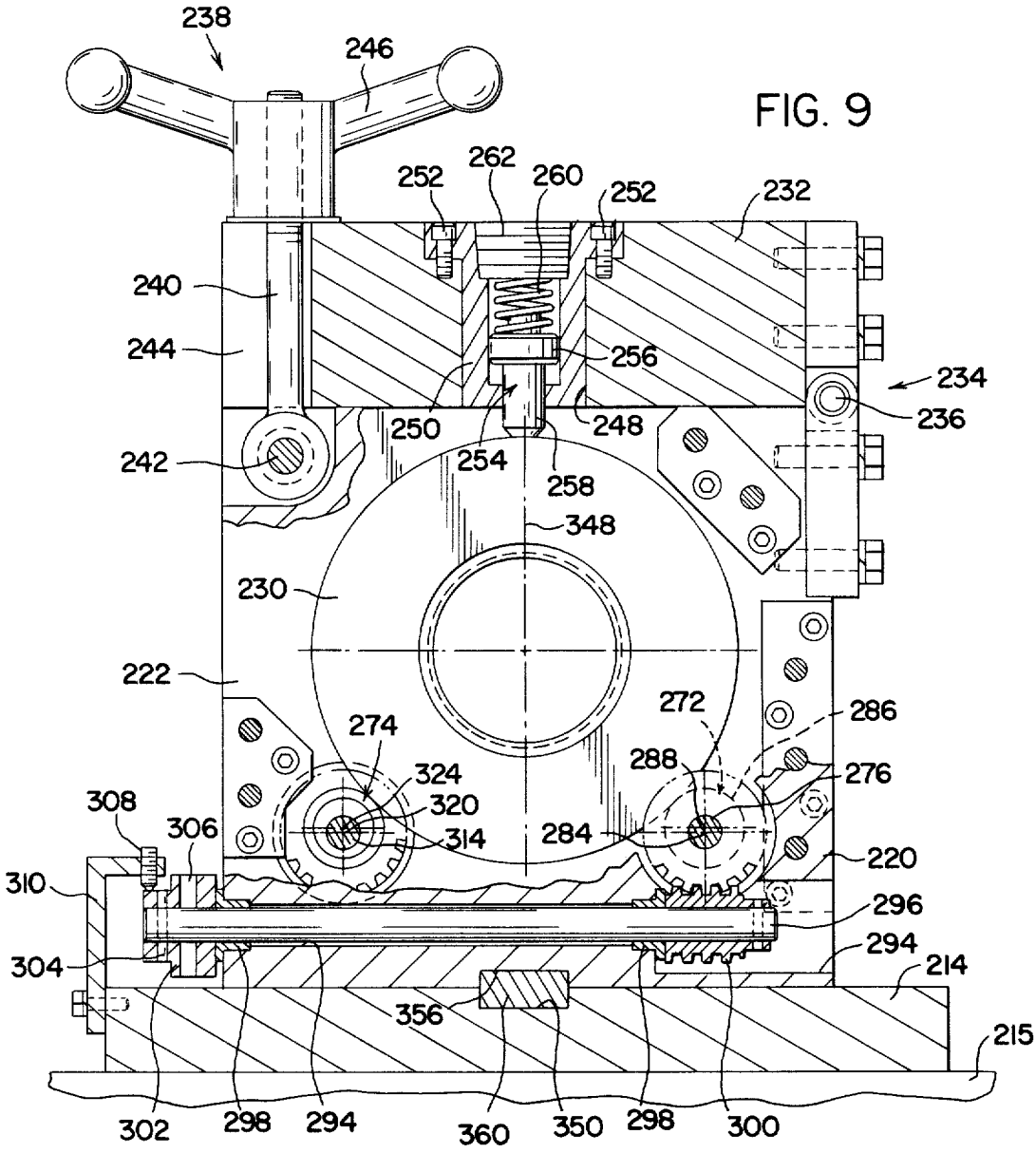
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FIG. 9

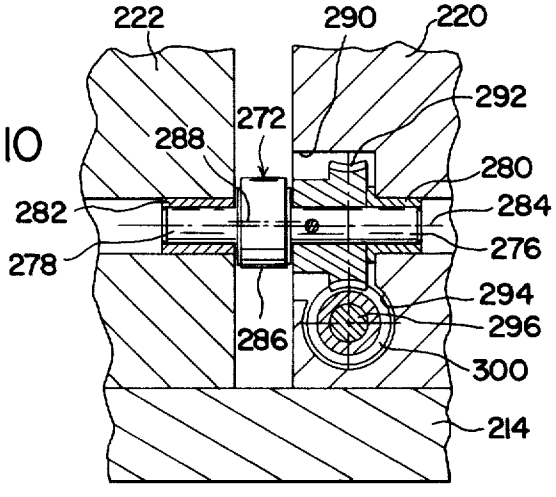
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FIG. 10

FIG. 13

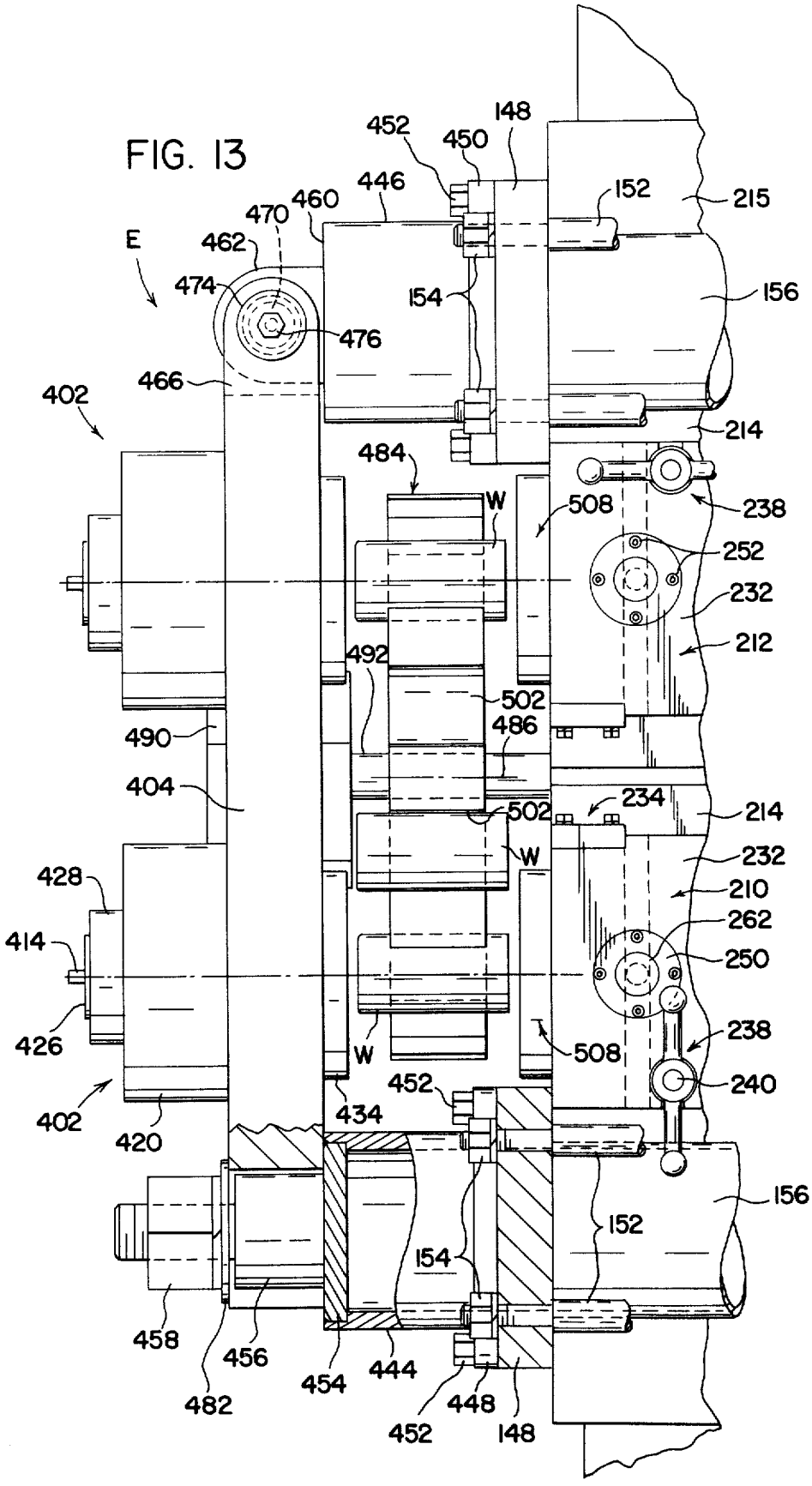
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FIG. 14

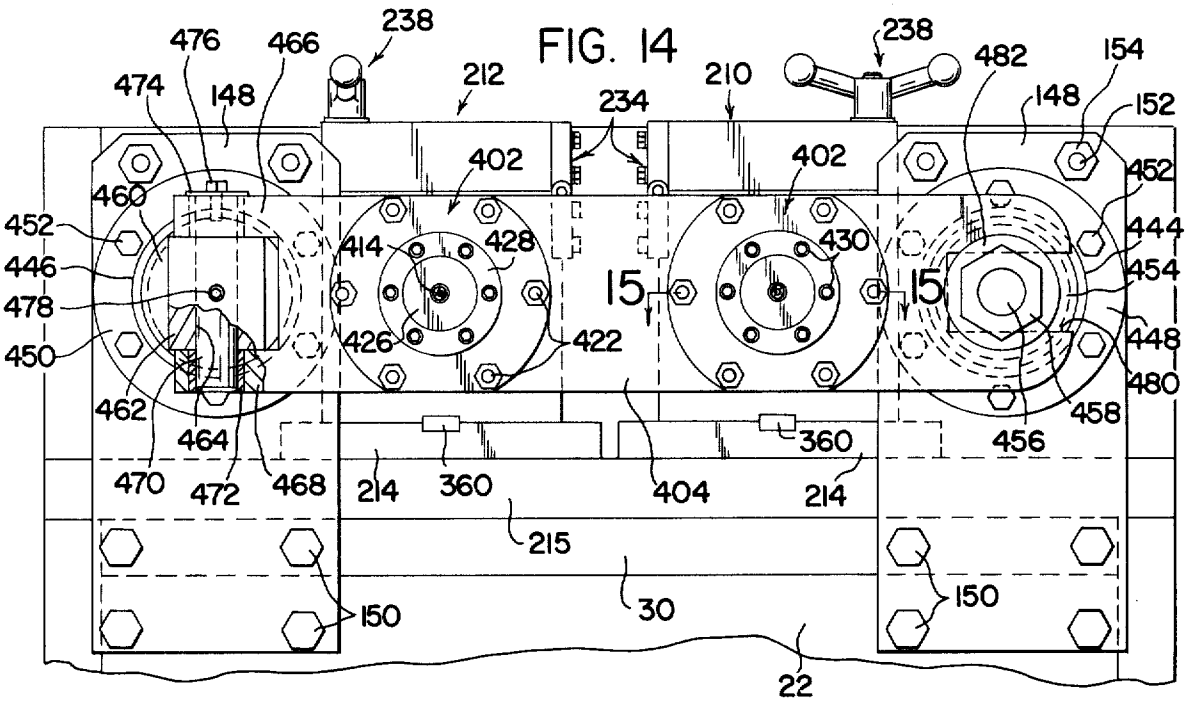
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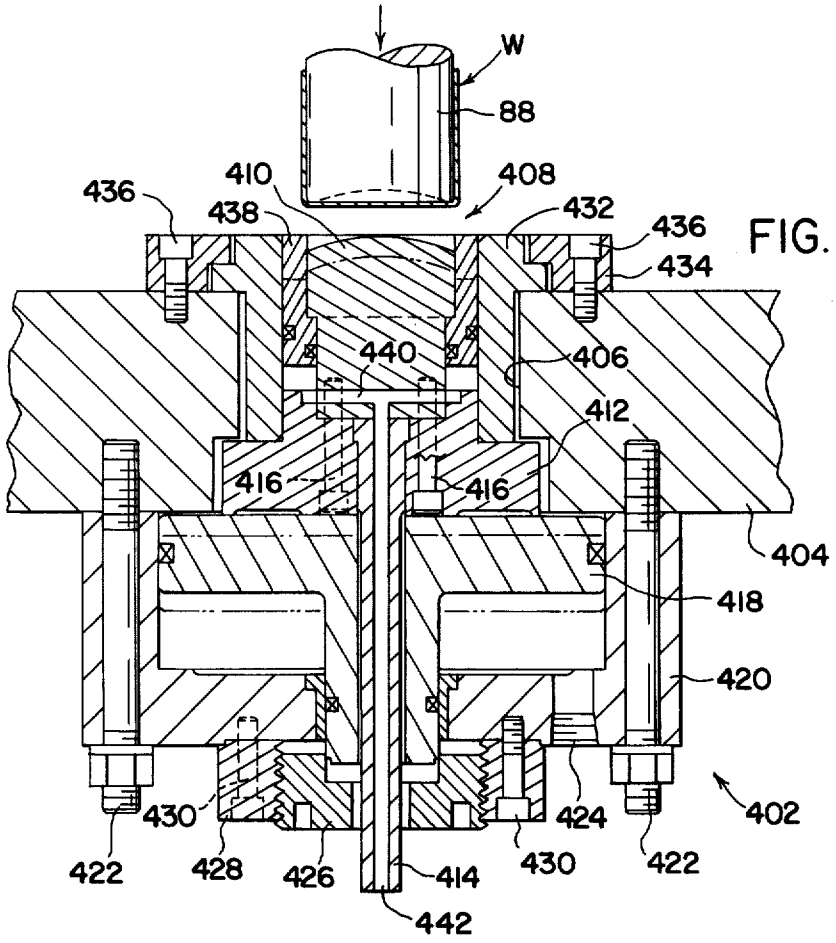
FIG. 15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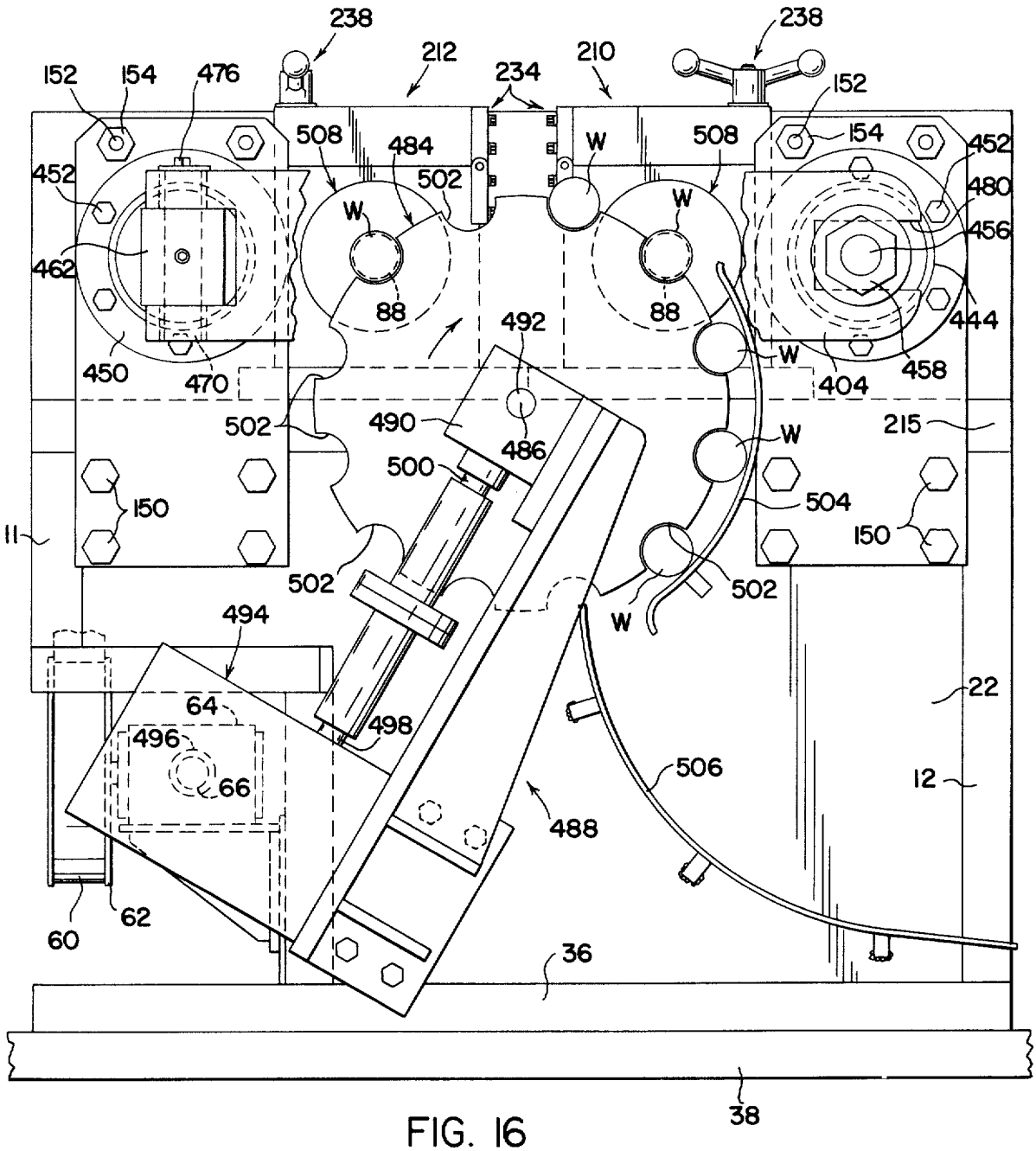
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FIG. 16

HORIZONTAL CAN IRONING PRESS

This invention relates to the art of can making and, more particularly, to an improved forming press for making seamless can bodies.

The present invention is particularly suited for making seamless can bodies from metal, such as aluminum or steel, and, accordingly, will be described with particular reference thereto. It will be appreciated, however, that the invention is capable of broader application and could be used for making seamless can bodies or similar articles from a variety of materials.

As is well known, seamless metal can bodies are often produced by deep drawing a circular metal blank into a cupshaped member which is subsequently redrawn or ironed to elongate and thin the side wall of the blank to desired dimensions. Generally, the bottom wall of the blank is then domed axially inwardly of the side wall and the side wall is trimmed to the desired height to produce a can body having the required final size and configuration.

A variety of machines have been designed for achieving the ironing and doming operations in the production of a seamless can in the foregoing manner. Generally, such machines include a frame supporting at least one ram or punch for horizontal movement along a linear path between first and second positions. One or more ironing rings are supported by the frame in the path of movement of the punch and between the first and second positions thereof, whereby a can blank introduced onto the end of the punch moves through the ironing ring or rings during movement of the punch from the first to the second position to achieve ironing of the side wall of the blank. Such machines further generally include a doming assembly which is aligned with the punch and supported by the frame for engagement by the punch and a can blank thereon when the punch reaches its second position. The doming assembly and punch cooperate to achieve doming of the end wall of the can blank. Following such doming, the punch is returned to its first position, the can blank is stripped from the punch during initial return movement thereof, and the formed can is removed from the machine.

The present invention is directed to a machine of the foregoing character and in which certain of the operating components of the machine provide for improved performance, ease of assembly and adjustment, increased useful life and increased operating efficiency.

More particularly in accordance with one aspect of the present invention, a can blank ironing press is provided which includes a slide supported by the press frame for reciprocating movement to simultaneously displace a punch or punches between first and second positions relative to the frame. The frame is provided with squared-off gibbing on laterally opposite sides thereof to receive squared-off guide bars mounted on the sides of the slide. Preferably, circular slide guide rods extend from the ends of each of the guide bars and are supported for reciprocation by apertured bearings mounted on the frame. The squared-off gibbing and support bar structure provides a simplified support bearing arrangement for the slide, and the slide guide rods add desirable stability and support for the slide during reciprocating movement thereof and especially during movement of the punch and a can blank thereon through the ironing rings.

In accordance with another aspect of the invention, the punch or punches of an ironing press are removably mounted on a reciprocable press slide in a manner which facilitates quick assembly and disassembly therebetween. In this respect, the slide is provided with a rotatable punch coupling member, and the coupling member and corresponding end of the punch are provided with cooperably interengaging threads. The coupling member on the slide is adapted to be rotated relative to the punch to achieve threaded engagement or disengagement therebetween. In the preferred embodiment, rotation of the coupling member is achieved by a drive gear arrangement including a drivable shaft exposed relative to the slide and rotatable relative thereto by a crank or the like, whereby the punch can be quickly assembled or disassembled from the slide to facilitate maintenance or replacement operations.

In accordance with yet another aspect of the present invention, a unique ironing ring assembly including one or more ironing rings is provided for the punch of an ironing press. The axis of each ironing ring is adjustable laterally and vertically relative to the corresponding punch axis, and the ironing ring support is adjustable relative to the press frame about a vertical pivot axis at one end of the ring support. Adjustment of the ironing ring axis relative to the ironing ring support and punch axis is achieved by a rotatable cam arrangement. The cam arrangement includes a pair of cams underlying the ring and rotatable about axes parallel to the ring axis, and the cams are independently rotatable relative to the ring support member. The vertical axis about which the ring support member is pivotal intersects the horizontal punch axis. The pivot axis is disposed adjacent one end of the ring support member and thus provides for laterally aligning the ironing ring axis with the punch axis.

In accordance with still another aspect of the present invention, a doming assembly is provided for each punch member of an ironing press and is supported at a location for engagement by the punch member and a can blank thereon following the ironing operation. The doming assembly is mounted on a horizontal support member extending transversely of the punch axis, and one end of the support member is interconnected with the frame for pivotal movement about a vertical axis. The other end of the support member is releaseably secured to the frame to support the doming assembly in the operative position thereof with respect to the punch. By releasing the secured end of the support member, the latter can be swung horizontally to one side of the frame, whereby the doming assembly is readily accessible for maintenance purposes or the like.

A further feature of the present invention resides in the provision of a two punch ironing press with a pocketed discharge wheel supported by the frame for rotation about a horizontal axis. The wheel is positioned axially beyond the ironing ring of the press and is provided with pockets adapted to receive formed can blanks upon return movement of the two punches from the extended toward the retracted positions thereof. In this respect, prior to the ironing operation the discharge wheel is positioned for empty pockets thereof to be aligned with the punch members. Upon completion of the ironing operation the punch members are returned to the retracted positions thereof and during the initial return movement the formed can blanks are stripped from the plungers and are deposited in the dis-

charge wheel pockets. The discharge wheel is then indexed to displace the formed can blanks along a discharge path and to position another pair of pockets in the wheel relative to the punch members. The discharge wheel is driven through the main drive assembly for the machine for the indexing of the wheel to be coordinated with punch reciprocation. The indexing discharge wheel provides structural simplicity and efficiency in operation to achieve a desired control of the discharge of formed can blanks from a machine.

Accordingly, an outstanding object of the present invention is the provision of a can blank forming press having improved operating characteristics.

Another object is the provision of a can blank forming press arrangement which facilitates assembly, disassembly, adjustment and maintenance procedures and minimizes the time required for such procedures.

Yet another object is the provision of a can blank ironing press having an improved slide and slide support structure by which the slide and a punch assembly mounted thereon are supported for reciprocation relative to the press frame.

A further object is the provision of a press of the foregoing character having an improved arrangement for removably mounting a punch component on the slide.

Another object is the provision of a can blank ironing press having an improved ironing ring support assembly which facilitates vertical and horizontal adjustment of an ironing ring axis relative to the corresponding punch axis.

Still a further object is the provision of a can blank ironing press having an improved ironing ring support assembly which facilitates adjustment of the axis of an ironing ring relative to a support member therefor, and adjustment of the support member relative to the corresponding punch axis, which adjustments are independent of one another.

Still a further object is the provision of an ironing and doming press having an improved support structure for the doming assembly and by which the doming assembly is releaseably supported for pivotal movement relative to the frame from an operable to an inoperable position with respect to the corresponding punch.

Yet another object is the provision of a can blank ironing press having an improved arrangement for discharging formed can blanks from the machine.

Still another object is the provision of an improved ironing and doming press which is of simple construction, is efficient and durable in operation and is capable of producing can bodies at a high rate.

The foregoing objects, and others, will in part be obvious and in part pointed out more fully hereinafter in conjunction with the written description of a preferred embodiment of apparatus appearing in the accompanying drawings in which:

FIG. **1** is a side elevation view, partially in section, of an ironing and doming press constructed in accordance with the present invention;

FIG. **2** is a plan view of the press taken along line **2—2** in FIG. **1**;

FIG. **3** is a plan view, partially in section, of the slide assembly and the corresponding portion of the press frame of the ironing and doming press shown in FIG. **1**;

FIG. **4** is a sectional elevation view of the slide and frame assembly taken along line **4—4** in FIG. **3**;

FIG. **5** is a sectional elevation view of the punch removal assembly taken along line **5—5** in FIG. **3**;

FIG. **6** is a sectional elevation view of the punch removal assembly taken along line **6—6** in FIG. **5**;

FIG. **7** is a side elevation view of an ironing ring tool assembly of the press;

FIG. **7A** is a sectional side elevation view of the tool assembly shown in FIG. **7**;

FIG. **8** is a plan view in section of the tool assembly the view being taken along line **8—8** in FIG. **7**;

FIG. **9** is a sectional elevation view of the tool assembly taken along line **9—9** in FIG. **8**;

FIG. **10** is a sectional elevation view of the tool assembly taken along line **10—10** in FIG. **8**;

FIG. **11** is a sectional elevation view of the tool assembly taken along line **11—11** in FIG. **8**;

FIG. **12** is a sectional elevation view of the tool assembly taken along line **12—12** in FIG. **8**;

FIG. **13** is an enlarged plan view of the doming assembly of the press illustrated in FIG. **1**;

FIG. **14** is an end elevation view of the doming assembly;

FIG. **15** is a plan view in section of a doming unit taken along line **15—15** in FIG. **14**; and,

FIG. **16** is an end elevation view of the discharge star wheel assembly for the press.

Referring now in greater detail to the drawings wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only and not for the purpose of limiting the invention, FIGS. **1** and **2** show the overall arrangement of the ironing and doming press which includes a horizontally extending main frame A which supports a main drive assembly B for reciprocating a punch and slide assembly C in working relationship with ironing ring assemblies D and doming assemblies E. Cup-shaped metal can blanks are sequentially fed to the punch members of punch and slide assembly C by a feed assembly F located between the punch and slide assembly and the ironing ring assembly D. The blanks are fed in timed relationship with reciprocation of the punch and slide assembly, and the ironing ring assembly D and doming assembly E function respectively to elongate the side walls of the can blanks and dome-in the bottom walls thereof to form a can having the desired final configuration. The formed can bodies are discharged from the machine by an indexing discharge assembly G positioned beneath the path of movement of the punch members and between ironing ring assembly D and doming assembly E.

FRAME A

The specific construction and arrangement of frame A is not of particular importance to the invention; however, as shown in FIGS. **1** and **2** the frame is comprised of upright wall members **10** and **12** defining one side, and upright wall members **14, 16, 18** and **20** defining the other side. The frame further includes a cross plate **22** at one end thereof, a cross plate **24** at the other end thereof, and cross plates **26** and **28** intermediate the opposite ends of the frame. A horizontal frame plate **30** extends across and is disposed atop side plates **12** and **14**, and horizontal frame plates **32** and **34** extend respectively between the upper and lower edges of cross plates **24** and **28**. The several wall members are welded or otherwise interconnected to provide a rigid frame unit and are likewise welded or otherwise suitably interconnected with a base plate **36** having mounting

strips 38 extending therebeneath and across the frame.

DRIVE ASSEMBLY B

The drive assembly includes a fixed speed, geared motor 40 and a crank assembly 42 including a crank member 44 supported for rotation about a crank axis 46 by a pair of bearing block assemblies 48 mounted within the frame on support plates 50. One end of the crankshaft extends through wall member 10 and a bearing assembly 52 supported by the wall member and is provided outside the frame with a flywheel 54 which is interconnected with drive motor 40 by a suitable endless belt 56. Accordingly, rotation of the output shaft of motor 40 rotates flywheel 52 to rotate crank member 44. The other end of the crankshaft extends through wall member 20 and a suitable bearing assembly 58 supported thereby and is connected through an endless belt 60 with a pulley 62 fixed on the input shaft of a gear box 64 having an output shaft 66 which drives the formed can discharge assembly G as described more fully hereinafter. It will be appreciated that other power take-offs may be employed in conjunction with crankshaft rotation to achieve desired functions such as, for example, operation of the feed mechanism for introducing can blanks into the press.

Crank member 44 includes a pair of crank arms 68 pivotally interconnected at their outer ends with one end of a connecting rod 70. Any suitable interconnection between the crank arms and rod 70 can be provided and in the embodiment illustrated the end of the connecting rod is recessed and provided with a recessed connection cap 72 which together with the end of the rod cooperatively receive crank pin 74. A suitable bushing 76 is interposed between crank pin 74 and the connecting rod. The other end of connecting rod 70 is pivotally interconnected with the slide component of punch and slide assembly C. In this respect, as best seen in FIG. 3, the latter end of connecting rod 70 is provided with an aperture 78 lined with a suitable bushing 80 to receive a wrist pin 82 having its opposite ends suitably interconnected with the slide member.

Accordingly, it will be appreciated that rotation of crank member 44 about axis 46 imparts reciprocating movement to the punch and slide assembly C relative to the frame and between first and second positions corresponding to the opposite ends of the throw of the crank member. Cross plate 28 is of course provided with a suitable window 77 through which connecting rod 70 extends. Pin 82 has a horizontal axis 84 about which the corresponding end of connecting rod 70 pivots during reciprocating movement of the punch and slide assembly, and pin axis 84 and crank axis 46 lie in a common horizontal plane.

SLIDE AND PUNCH ASSEMBLY C

The slide and punch assembly C and the component parts thereof are illustrated in FIGS. 3-6 of the drawing. With regard first to FIGS. 3 and 4, it will be seen that assembly C includes a slide designated generally by the numeral 86 and a pair of punches 88 which are removably mounted on the slide as set forth more fully hereinafter. Slide 86 includes a top plate 90 and a bottom plate 92 which are spaced apart and interconnected in parallel relationship by longitudinally extending ribs 94. Ribs 94 are spaced laterally inwardly of the corresponding side edges of plates 90 and 92 and are interconnected with the slide plates such as by welding. Slide 86 further includes a vertical front plate 96 extending across the front edges of plates 90 and 92 and interconnected therewith such as by welding. The slide structure thus defined is further reinforced by upper and lower gusset plates 98 welded to front plate 96 and the corresponding one of the upper and lower plates 90 and 92.

Each side of slide 86 is provided with a guide bar 100 having coaxial first and second portions 102 and 104. Portion 102 of each bar is generally coextensive with the length of slide 86 and is square or rectangular in cross section. The laterally inner portions of bar portions 102 are disposed in a recess along the corresponding side of the slide defined by rib 94 and slide plates 90 and 92. The guide bars are fastened to the slide such as by a plurality of threaded fasteners 106 extending through plates 90 and 92 and into corresponding threaded recesses in bar portions 102, and laterally inwardly extending fasteners 108 which extend through openings in bar portions 102 and into corresponding threaded openings in ribs 94.

The laterally outer portions of bar portions 102 are provided with squared-off bearing surfaces which, in the embodiment disclosed, are defined by upper and lower bronze bearing wear strips 110 and 112, respectively, and an outer bronze bearing wear strip 114. Wear strips 110, 112 and 114 are generally coextensive with the length of bar portions 102 and are suitably aligned with and secured thereto such as by corresponding aligning pins and threaded fasteners, not designated numerically. The outermost surfaces of wear strips 110 and 112 provide vertically spaced apart parallel guide surfaces for the slide, and the outer surface of wear strip 114 provides a vertical guide surface perpendicular to the planes of the upper and lower guide surfaces.

Bar portions 102 and thus slide 86 are supported relative to frame A by corresponding support and guide assemblies 116 mounted on the frame. Each support and guide assembly includes a horizontally extending support plate 118 welded or otherwise secured to the corresponding frame wall together with supporting gusset plates 120. The support and guide assemblies further include an L-shaped gib member 122 and an upper gib member 124 which together define a C-shaped guide structure or channel opening toward slide 86. Upper gib member 124 is suitably secured to member 122 such as by threaded fasteners 126, and member 122 is suitably secured to support plate 118 such as by corresponding fasteners 128 and 130. Further, the upright portion of L-shaped gib member 122 is provided with outwardly extending studs 132 having inner ends in threaded engagement with threaded recesses in the upright portion. The outer ends of studs 132 extend through openings therefor in the side walls of the frame and receive nuts 134, whereby the gib members are further securely interconnected with the frame structure.

Gib members 122 and 124 as well as support plate 118 therebeneath are of a length longitudinally of the frame corresponding generally to the stroke of slide 86 as defined by the throw of crank 44. Moreover, the inner surfaces of upper gib member 124 and the bottom portion of gib member 122 define vertically spaced parallel planar surfaces slidably engaged by the corresponding one of the wear strips 110 and 112, and the inner surface of the upright portion of gib member 122 defines a vertical planar surface slidably engaged by

wear strip **114.** Line **136** represents a horizontal center line through the longitudinal axes of guide bars **100,** and line **136** is coplanar with crank axis **46** and axis **84** of the pivotal connection between connecting rod **70** and slide **86.**

Rod portions **104** are integral with the corresponding rod portion **102** and extend forwardly of slide **86** to a location beyond cross plate **26** of the frame. The latter cross plate is positioned just forwardly of the adjacent end of slide **86** when the latter is disposed at the end of its forward stroke as indicated by line **138.** Rod portions **104** preferably are circular in cross section, and cross plate **26** is provided with corresponding openings **140** through which the forward or free ends of rod portions **104** extend. Further, slide rod bearing blocks **142** are mounted on the front side of cross plate **26** such as by bolts **144** and are provided with suitable bearing sleeves **146** which receive and slidably support guide rod portions **104.**

Doming assembly mounting plates **148** are mounted on end plate **22** of frame A by bolts **150** (see FIG. **1**) for the purpose set forth hereinafter, and the upper ends of mounting plates **148** are interconnected with cross plate **26** by corresponding pairs of support rods **152.** The inner ends of rods **152** are threaded for engagement with threaded apertures in cross plate **26,** and the outer ends of rods **152** extend through mounting plates **148** and are secured thereto by nuts **154** threaded onto the outer ends thereof. To protect guide rod portions **104** from dirt and other foreign matter, slide rod covers **156** are provided between mounting plates **148** and bearing blocks **142** and are retained in place therebetween by having the opposite ends thereof disposed in corresponding recesses in the mounting plates and bearing blocks. During reciprocating movement of slide **86,** guide rod portions **104** stabilize slide movement to minimize the effects of side and vertical thrust resulting from crank displacement and forces exerted back on the slide as a result of movement of the punches and can blanks thereon through the ironing rings.

Punch members **88** extend forwardly from front wall **96** of slide **86** and through corresponding openings **158** provided therefor in cross plate **26** of frame A. Corresponding punch rod bearing block assemblies **160** are mounted on the forward side of cross plate **26** such as by threaded fasteners **162** and are lined with suitable bushings **164** which guide and support reciprocating movement of the punches in response to reciprocation of slide **86.** When the slide is at the rearward end of its stroke as indicated by the solid line positions of the components in FIG. **3,** the forward or free ends of punches **88** are positioned at feed station F of the machine to receive can blanks to be formed. Can blanks can be fed to and positioned on the punches in any desired manner, such as by hand, or by a suitable feed mechanism, the operation of which is coordinated with slide reciprocation to achieve positioning of can blanks on the punch rods when the free ends thereof are positioned at the feed station. The particular manner in which can blanks are introduced onto the punches does not form a part of the present invention and accordingly the feed mechanism is only schematically illustrated.

As mentioned hereinabove, punch rods **88** are removably mounted on slide **86.** The manner and mechanism by which this is achieved will be best understood by referring to the illustrations in FIGS. **5** and **6** together with the showings in FIGS. **3** and **4.** Slide **86** is provided with a punch removal assembly **166** for each of the punch rods **88.** The punch rods and punch removal assemblies are of identical structure and it will be appreciated, therefore, that the following description of one punch rod and its associated punch removal assembly is applicable to both.

The end of punch rod **88** to be engaged with the slide is provided with an externally threaded terminal stem portion **168** and a cylindrical stem portion **170** axially adjacent thereto and separated from the body of the punch by a tapered peripheral flange **172,** the purpose of which is set forth hereinafter. Slide **86** is provided with a support block **174** between slide plates **90** and **92** and which is welded or otherwise secured to the latter slide plates and to front plate **96** of the slide. Front plate **96** and block **174** are provided with an axially extending opening adapted to receive a punch retainer sleeve **176.** Sleeve **176** is internally bored to slidably receive stem portion **170** and to rotatably support a driven sleeve **178.** Sleeve **178** is internally threaded to cooperatively interengage with externally threaded stem portion **168** of the punch.

Retainer sleeve **176** is secured in place with respect to the slide by means of a plurality of threaded fasteners **180** extending into front plate **96** of the slide. The inner end of rotatable sleeve **178** is provided with a stem portion **182,** and a suitable sleeve bearing **184** is interposed between stem portion **182** and the bore in block **174.** A worm gear **186** is mounted on stem portion **182** by means of threaded fasteners **188** and is adapted to be driven to rotate sleeve **178** relative to retainer sleeve **176.** In this respect, top plate **90** of slide **86** and block **174** are provided with a vertical opening **190** adjacent the opening receiving sleeves **176** and **178.** Opening **190** receives a worm shaft **192** having a worm **194** keyed or otherwise secured thereto for rotation therewith. The lower end of shaft **192** is rotatably supported by a flanged bearing sleeve **196** and the upper end of shaft **192** is rotatably supported by a sleeve bearing **198.** Bearing **198** extends from worm **194** and into a recess provided therefor in a worm shaft retainer plate **200** which is secured in place with respect to top plate **90** of the slide by threaded fasteners **202.** Worm **194** meshes with worm gear **186,** and the outer end of worm shaft **192** extends upwardly from the slide and is squared-off in cross section to receive a tool or the like for rotating the worm shaft.

It will be appreciated that rotation of worm shaft **192** and thus worm **194** rotates worm gear **186** and thus sleeve **178** relative to sleeve **176.** Accordingly, by suitably supporting punch **88** against rotation relative to sleeve **176,** the rotation of sleeve **178** provides for the punch to be threadedly engaged or disengaged from sleeve **178** depending on the direction of rotation thereof. The punch can be manually held or, alternatively, suitable holding means, not illustrated, can be provided in connection with support assemblies **160** for the punches to grip the punches and restrain rotation thereof during a punch removal or inserting operation. Any suitable tool such as a manually actuated crank or a pneumatically actuated wrench can be employed to achieve rotation of worm shaft **192.**

During a punch inserting operation, stem portion **170** of the punch and fixed sleeve **176** are cooperable to guide movement of the punch mounting end axially

into the sleeve, and a tapered washer **204** is cooperable with tapered flange **172** on the punch to achieve the desired alignment of the punch axis with regard to the slide path. It is to be noted at this point that a horizontal line transverse to and through the longitudinal axes of the punches is coplanar with line **136** mentioned hereinabove and accordingly with axis **84** of connecting rod pin **82** and the axis of crank pin **74.** Further, while sleeve **178** is disclosed as being internally threaded to receive the externally threaded terminal portion **168** of the punch, it will be appreciated that this structural arrangement could be reversed. Moreover, it will be appreciated that arrangements other than the specific arrangement illustrated and described can readily be provided for rotating the threaded member in the slide relative to the punch to achieve threaded engagement and disengagement therebetween.

IRONING RING ASSEMBLY D

As illustrated in FIGS. **2** and **3** of the drawing, ironing ring assembly D is comprised of a pair of ironing units **210** and **212** supported by the frame in alignment with the path of movement of a corresponding one of the punches **88.** The structure of ironing units **210** and **212** and the structural mounting thereof on frame A is identical. Accordingly, only one of the units, namely unit **210,** will be described in detail.

As best seen in FIGS. **7–12,** ironing ring unit **210** includes a base plate **214** which, in the embodiment illustrated, overlies a bolster plate **215** mounted on horizontal frame plate **30.** A plurality of ironing ring support blocks **216, 218, 220** and **222** are mounted on base plate **214** such as by threaded fasteners **224** extending upwardly through the base plate and into corresponding threaded recesses in the bottoms of the support blocks. The support blocks are axially spaced apart in the direction of punch movement to receive ironing rings therebetween and it will be appreciated that the number of support blocks will vary depending on the number of ironing stages desired. In the embodiment disclosed, the four support blocks receive and support three ironing rings **226, 228** and **230.**

Each ironing ring is an annular component provided on the inner periphery thereof with an integral or attached ironing annulus cooperable with the punch to iron the peripheral side wall of a can body blank on the punch as the latter advances progressively through the rings. As is well known, the desired ironing is achieved by providing for the diameter of each ironing annulus to be smaller than the annulus on the preceding ring. It is essential in order to achieve a uniform wall thickness for the formed can body to provide for the axes of the ironing rings to be accurately aligned relative to one another and to the corresponding punch axis. In accordance with the present invention, such relative alignment of the ironing ring axes is achieved by supporting the lower peripheral portion of each ironing ring on a pair of rotatable eccentrics or cam elements which are independently rotatable about their axes to achieve horizontal and vertical adjustment of the position of the corresponding ring and thus the ring axis relative to the support members, as described more fully hereinafter.

The ironing rings are tightly received between the support blocks on opposite sides thereof and are slidable relative thereto to facilitate movement thereof during an adjustment operation. Further, the rings are biased downwardly into engagement with the corresponding cams by means of spring biased plungers disposed in a cover block **232** overlying the support blocks and pivotally interconnected therewith along one longitudinal edge of the blocks. More particularly, as seen in FIGS. **7** and **9,** the inner longitudinal edges of blocks **218** and **222** and the corresponding edge of cover **232** are provided with hinge assemblies **234.** Each hinge assembly includes a pair of hinge leaves bolted or otherwise secured one to the corresponding mounting block and the other to the cover. The leaves are pivotal about a hinge pin **236** therebetween and, accordingly, cover **232** is adapted to be pivoted upwardly and clockwise as viewed in FIG. **9** to an open position relative to the mounting blocks.

Cover **232** is adapted to be releaseably maintained in the closed position thereof overlying the mounting blocks by means of a pair of pivotal clamp assemblies **238.** The clamp assemblies are disposed along the outer longitudinal edges of the mounting blocks and cover. Each assembly **238** includes a threaded rod **240** having a lower end disposed in a recess in a corresponding one of the mounting blocks **218** and **220.** The lower end of each rod **240** is interconnected such as by a pin **242** with the corresponding block for pivotal movement of the rod **240** laterally outwardly relative to cover **232.** The cover is provided with laterally inwardly extending slots **244** for rods **240,** and the upper ends of rods **240** are threaded to receive an internally threaded clamping handle **246.** It will be apparent therefore that by unscrewing handles **246** relative to rods **240** the rods are freed for pivotal movement outwardly of cover **232** to release the cover for pivotal movement about hinge pins **236.** Likewise, by screwing handles **246** downwardly into tight engagement with cover **232** the latter is securely retained in place relative to the underlying mounting blocks.

As best seen in FIGS. **7A** and **9,** cover **232** is provided along the longitudinal center line thereof with a plurality of openings **248** each of which is aligned in overlying relationship with the ring space between adjacent ones of support blocks **216, 218, 220** and **222.** Each opening **248** receives a spring retainer sleeve **250** suitably secured to the cover such as by threaded fasteners **252.** Each sleeve receives and supports a plunger component **254** having an intermediate peripheral flange **256** and a lower end **258** which extends through an opening therefor in sleeve **250** and into engagement with the underlying ironing ring component. A compression spring **260** is disposed between flange **256** and a retainer cap **262** which is threaded or otherwise suitably secured to sleeve **250** to retain the spring therein. Spring **260,** of course, exerts a downwardly biasing force against the underlying ring component to bias the ring component against the underlying adjustment cams.

The supporting and adjusting cams for each ironing ring component are disposed therebeneath in the ring space between adjacent support blocks and are mounted in the blocks for rotation about axes parallel to the ring axis. The cams are laterally spaced apart on opposite sides of the longitudinal center line of base plate **214** so as to be engaged by the corresponding ironing ring at circumferentially spaced points thereabout. Further, the cams are independently rotatable about their axes to achieve adjustment of the ironing ring axis in a horizontal and/or vertical direction. In the

embodiment disclosed, as best seen in FIG. **8**, cams **264** and **266** are disposed in the space between mounting blocks **216** and **218** to support ironing ring **226**, cams **268** and **270** are disposed in the space between mounting blocks **218** and **220** to support ironing ring **228**, and cams **272** and **274** are disposed in the space between mounting blocks **220** and **222** to support ironing ring **230**.

Each of the six cam components is independently rotatable about its axis by means of a gear mechanism associated therewith as described hereinafter. The six cam components are identical in cross-sectional configuration and are of an axial length corresponding to the space between the adjacent mounting blocks. Further, the manner in which each set of cams and the gear mechamisms therefor are associated with the corresponding mounting blocks is similar. Accordingly, only one set of the cams and the gear mechanisms therefor are described in detail herein and it will be appreciated that the description is applicable to the remaining sets of cams and associated gear mechanisms.

As best seen in FIGS. **8–10**, cam **272** is disposed in the space between mounting blocks **220** and **222** and is provided with camshaft portions **276** and **278** extending from the opposite ends thereof and into corresponding bores provided in the mounting blocks. Shaft portions **276** and **278** are integral with cam **272**, and suitable bearing sleeves **280** and **282** are interposed between the shaft portions and corresponding mounting block bores to support the cam for rotation about a horizontal axis **284** which is parallel to the ring axis. Cam surface **286** of cam **272** is circular in cross section, and axis **288** of surface **286** is laterally offset and parallel to the axis of rotation **284** of the cam.

Mounting block **220** is provided with an axially extending recess **290**, and a worm gear **292** is disposed in recess **290** and is pinned or otherwise mounted on shaft portion **276** for rotation therewith. Mounting block **220** is further provided with a transversely extending bore **294**, and a gear drive shaft **296** is supported in the bore for rotation relative to mounting block **222** by suitable bearing sleeves **298**. The inner end of shaft **294** is provided with a worm wheel **300** and the corresponding end of bore **296** is enlarged to receive the worm wheel which is pinned or otherwise secured to shaft **296** for rotation therewith. Worm gear **292** and worm wheel **300** are disposed in meshing engagement, and an adjusting nut **302** is mounted on the outer end of shaft **296** by a pin **304** whereby rotation of the adjusting nut imparts rotation to worm wheel **300** through shaft **296** to rotate worm gear **292** and thus cam **272** about axis **284**. Adjusting nut **302** is provided with a plurality of radially extending apertures **306** adapted to receive an appropriate tool for manually rotating shaft **296**. Preferably, a spring biased plunger **308** is mounted on base plate **214** of the ironing ring nut unit by means of a support bracket **310** to engage adjusting nut **302** to frictionally restrain unintended rotation of shaft **296**.

Cam **274**, as best seen in FIGS. **8**, **9**, **11** and **12**, is similar to cam **272**. In this respect, cam **274** includes camshaft portions **312** and **314** extending into corresponding bores in mounting blocks **220** and **222**. Bearing sleeves **316** and **318** support the shaft portions and accordingly cam **274** for rotation about an axis **320** which is parallel to the axis of rotation **284** of cam **272** and the ironing ring axis. Further, the outer or cam surface **322** of cam **274** is circular in cross section, and axis **324** of surface **322** is offset and parallel with respect to axis **320**. Mounting block **222** is provided with a recess **326** and a worm gear **328** is disposed in the recess and is pinned or otherwise secured to shaft portion **312** for rotation therewith.

Mounting block **222** is further provided with a transversely extending bore **330** disposed beneath and communicating with bore **326**. A gear shaft **232** is disposed in bore **330** and is supported therein for rotation relative to mounting block **222** by an inner bearing sleeve **334** and an outer bearing sleeve **336** mounted in the bore by an apertured support plate **338**. A worm wheel **340** is disposed in bore **330** in meshing engagement with worm gear **328** and is pinned or otherwise mounted on shaft **332** for rotation therewith. The outer end of shaft **332** is provided with a radially apertured adjusting nut **342** similar to adjusting nut **302** and which is mounted on shaft **332** by means of a pin **344**. The outer ends of gear shafts **296** and **332** are disposed on a common side of the mounting blocks, and bracket **310** described hereinabove is of a length sufficient for the bracket to support a second spring biased plunger **346** which engages adjusting nut **342** in the manner and for the purpose set forth hereinabove with regard to pin **308** associated with adjusting nut **302**.

From the foregoing description, it will be appreciated that cams **272** and **274** are independently rotatable about their axes and that such rotation displaces the respective eccentric axes **228** and **324** about axes of rotation **284** and **320**. It will be further appreciated that such independent rotation of the cams provides for selectively shifting the axis of ironing ring **230** horizontally and/or vertically in a plane transverse to the ring axis. As mentioned hereinabove, each cam of the three sets disclosed is provided with a corresponding gear mechanism for rotating the cam and, preferably, the gear mechanisms of each cam are actuable from a common side of the mounting blocks and preferably from the side of the blocks adjacent the corresponding side of the press frame as illustrated herein.

Adjustment of the ironing ring axes relative to one another in the foregoing manner advantageously enables accurate alignment of the ironing ring axes with one another and with the corresponding punch axis. In accordance with another feature of the present invention, base plate **214** of each ironing ring unit is mounted on the frame for pivotal movement in a horizontal plane about a vertical axis at one end of the base plate and which axis intersects the axis of the corresponding punch member. Further, the ring supporting blocks are preferably keyed to base plate **214** along the longitudinal center line of the base plate, which center line intersects the pivot axis for the base plate and vertically underlies the ironing ring axis. These features, structurally described hereinafter, provide for the ironing ring support blocks to be accurately positioned on the base plate with respect to one another and the longitudinal center line of the base plate, and provide for the base plate center line and ironing ring axes to be angularly adjusted laterally relative to the corresponding punch axis.

The foregoing alignment features are applicable to each ironing ring unit and therefore it will be appreciated that the following description of these features in connection with one of the ironing ring units is applicable to the other. As best seen in FIGS. **7**, **7A**, **8** and **9**, base plate **214** has a longitudinal center line **348** and is

provided with a keyway **350** which is longitudinally symmetric with respect to center line **348.** Ironing ring support blocks **216, 218, 220** and **222** are provided on the bottom sides thereof with corresponding keyways **352, 354, 356** and **358.** Each of the latter keyways is disposed laterally centrally of the corresponding support block to overlie keyway **350** in base plate **214,** and the opposed keyways receive a unitary key strip **360.** The keyed interrelationship between the base plate and ironing ring support blocks enables the support blocks to be positioned on the base plate in the desired laterally aligned relationship with respect thereto and to one another and for this relationship to be maintained when the mounting blocks are bolted in place on the base plate.

As mentioned hereinabove, base plate **214** is adapted to rest on bolster plate **215** which is mounted on horizontal frame plate **30.** The end of base plate **214** which is the exit end with regard to plunger movement through the ring unit is provided with a pin recess **362** having a vertical axis **364** which intersects longitudinal center line **348** of the base plate. Bolster plate **215** is provided with a pin recess **366** having a vertical axis **368** which intersects the longitudinal axis of a corresponding punch member **88.** Base plate **214** and bolster plate **215** are pivotally interconnected by a pin **370** having a peripheral flange **372** intermediate the opposite ends thereof and which is received in a corresponding recess **374** in bolster plate **215.** Pin **370** is secured to the bolster plate by means of a plurality of fasteners **376** extending through flange **372,** and the pin includes coaxial upper and lower portions **378** and **380** disposed respectively in pin recesses **362** and **366.** It will be appreciated, therefore, that base plate **214** and thus the corresponding ironing unit is horizontally pivotal about axis **364** to achieve lateral angular alignment of the ironing ring axes with the corresponding punch axis.

Preferably, pviotal movement of the ironing ring unit about axis **364** is achieved through an adjusting screw mechanism **382** interengaging bolster plate **215** and base plate **214** of the ironing ring unit. Any suitable adjusting screw arrangement can be employed and, in the embodiment illustrated, the mechanism includes an adjusting screw **384** having a T-shaped head **386** which is circular in cross section and is received in a vertical T-slot **388** in base plate **214.** The outer end of the adjusting screw is provided with a tool head **390,** and a portion of the screw between heads **386** and **390** is threaded and extends through a corresponding threaded opening **392** in a support block **394** mounted on bolster plate **215** by threaded fasteners **396.** Accordingly, it will be appreciated that rotation of screw **384** relative to block **394** displaces the screw axially of opening **392** to pivot the ironing ring unit about axis **364.** Once the ironing ring unit is pivoted in this manner to align the ring axes with the corresponding ram axis, base plate **214** is clamped in the desired position. In the embodiment disclosed, such clamping is achieved by means of a pair of clamping elements **398** and corresponding threaded fasteners **400** disposed along the leading edge of the base plate. In addition to providing for horizontal pivotal adjustment of the ironing ring unit as described above, pin **370** provides a single component which bears the entire thrust generated by movement of the punch and a can blank thereon through the ironing ring unit. Ideally, pin axis **364,** the axes of the corresponding ironing rings and the axis of the corresponding punch are coplanar in a vertical plane through longitudinal center line **348** of the ironing ring unit. The ironing ring and ironing unit adjustments described hereinabove maximize the capability of achieving and maintaining the desired relationship.

DOMING ASSEMBLY E

As best seen in FIGS. **3, 13** and **14,** doming assembly E is comprised of a pair of doming units **402** mounted on a transverse support bar **404** for each of the doming units to be axially aligned with the corresponding one of the punches **88.** As is well known, following movement of a punch and a can blank thereon through the corresponding ironing ring unit to elongate and thin the side wall of the can, the plunger moves into engagement with the corresponding doming unit to dome the closed end of the can blank axially inwardly of the can side wall. Any suitable doming unit structure can be employed for this purpose and in the preferred embodiment illustrated herein the doming units are identical and of the structure illustrated in FIG. **15.** Accordingly, the following description of the doming unit illustrated in FIG. **15** is applicable to both units.

As seen in FIG. **15,** cross bar **404** is provided with an opening **406** therethrough which is axially aligned with the corresponding punch axis. The doming unit is securely mounted on cross bar **404** for the moving components of the unit to be coaxial with the punch axis. The doming unit includes an axially reciprocable doming head assembly **408** comprised of a doming head member **410,** collar member **412** and air line stem **414,** all of which components are releaseably interconnected by a plurality of threaded fasteners **416.** A piston **418** surrounds air stem **414** and is disposed in a cup-shaped cylinder member **420** secured to cross bar **404** by means of threaded fasteners **422.**

Piston **418** is reciprocable relative to cylinder member **420** and the end wall of the cylinder is provided with a passageway **424** through which air under pressure is introduced into the cylinder behind piston **418** to bias the latter toward the corresponding punch. Movement of piston **418** and accordingly doming head assembly **408** in the direction of the end wall of cylinder member **420** is limited by a stop collar **426** which is externally threaded for engagement with an internally threaded support collar **428** mounted on the end wall of the cylinder by threaded fasteners **430.** Accordingly, stop collar **426** is axially adjustable relative to cylinder member **420** to adjust the stopping point of piston **418** and doming head assembly **408.**

Opening **406** in cross bar **404** is provided with a cylindrical bushing **432** which is retained in place with respect to the cross bar by a retainer ring **434** secured to the cross bar by threaded fasteners **436.** An axially reciprocable liftout ring **438** is interposed between bushing **432** and doming head member **410,** and the doming head member and air stem **414** are provided with air passageways **440** and **442,** respectively, through which air under pressure is introduced behind lift-out ring **438** to bias the latter toward the corresponding punch member. It will be appreciated, of course, that air stem **414** and air passageway **424** in cylinder member **420** are adapted to be connected to a source or sources of air under pressure, not illustrated.

In operation, an ironed can blank W on punch **88** is advanced into engagement with doming head member **410** and lift-out ring **438,** the latter of which engages

the peripheral end edge between the can side wall and end wall. Upon engagement of the can end wall with the latter components, the end wall is domed by continued advancement of the ram. During such advancement, doming head member **410** is displaced in the direction of ram movement against the bias of air under pressure behind piston **418**, and lift-out ring **438** is displaced in the direction of ram movement against the bias of air under pressure therebehind. During the doming operation the doming head and lift-out ring components are displaced to the broken line positions in FIG. **15**. Following the doming operation, ram **88** retracts relative to the doming unit and the doming head and lift-out ring components are biased to the solid line positions illustrated in FIG. **15** by the air under pressure behind piston **418** and the lift-out ring. The lift-out ring, of course, serves to assure separation of the domed can blank from the doming unit components to prevent retention of the can blank by the doming unit as the ram retracts.

It will be appreciated that in conjunction with the production of a particular can design doming of the closed end wall thereof may not be desired. Moreover, it will be appreciated that maintenance and/or replacement operations are periodically required with regard to the doming units. Accordingly, it becomes desirable to provide for the doming units to be readily accessible for maintenance and replacement operations and to be readily removed from an operational interrelationship with the punch members. In accordance with the present invention, this is achieved by mounting cross bar **404** on the press frame for pivotal movement which facilitates positioning the doming units adjacent one or the other of the sides of the frame. More particularly, as seen in FIGS. **3**, **13** and **14**, doming block mounting plates **148** described hereinabove are provided with annular support blocks **444** and **446**, which blocks are provided with corresponding annular flanges **448** and **450** secured thereto such as by welding and interconnected with the corresponding mounting plate such as by threaded fasteners **452**. Guide bar portions **104** of slide guide bars **100** extend axially beyond mounting plates **148** when the slide is in its forwardmost position and openings are provided in plates **148** for bar portions **104**, and the inner diameter of support blocks **444** and **446** is sufficient to permit movement of the ends of the guide bar portions **104** thereinto.

The outer end of support block **444** is closed by a plate **454** which is secured thereto such as by welding. Plate **454** is provided with a stud **456** extending axially therefrom and threaded at its outer end to receive a nut **458**. The outer end of support block **446** is similarly closed by a plate **460** welded or otherwise secured thereto. Plate **460** is provided with a hinge arm **462** extending axially therefrom and provided with a vertical pin opening **464** therethrough. Bar **404** extends horizontally across the press frame and one end of the bar is laterally notched to provide a pair of arms **466** and **468**, respectively, overlying and underlying hinge arm **462**. Arms **466** and **468** are provided with openings aligned with opening **464**, and a pivot pin **470** extends through the arm openings to pivotally interconnect cross bar **404** with hinge arm **462**. The openings in arms **466** and **468** are provided with suitable sleeve bearings **472** for the corresponding ends of the pivot pin. A washer **474** overlies the upper end of pin **470** and is fastened thereto by threaded fastener **476**. The diameter of washer **474** is greater than that of the opening through arm **466**, whereby the washer engages the upper surface of the arm to axially retain pin **470**. Further, pin **470** is held against rotation relative to hinge arm **462** such as by a set screw **478** extending through the arm and into engagement with the pivot pin.

The end of cross bar **404** adjacent support block **444** is provided with a laterally extending recess **480** through which stud **456** extends. A washer **482** is interposed between nut **458** and cross bar **404**, and it will be appreciated that nut **458** is adapted to be screwed onto the threaded portion of stud **456** to draw the corresponding end of cross bar **404** into tight engagement with plate **454** and mounting block **444**. Likewise, it will be appreciated that removal of nut **458** from stud **456** releases cross bar **404** for horizontal pivotal movement about the vertical axis of pivot pin **470**, whereby the doming units **402** carried by the cross bar can be displaced to a position adjacent one side of the machine. Accordingly, the doming units become readily accessible as does the ironing ring units and discharge components disposed therebehind when the cross bar and doming units are in their inoperative positions.

DISCHARGE ASSEMBLY G

Following the doming operation the punches are retracted toward the initial positions thereof and, during initial movement of the punches in the direction of retraction, the formed can blanks are stripped therefrom and discharged from the machine. In accordance with the present invention, discharge of the formed can blanks is achieved by a unique indexed discharge star wheel **484** positioned between the ironing ring units and doming assembly, as best seen in FIGS. **1**, **13** and **16** of the drawing. Star wheel **484** is supported by end plate **22** of the frame for rotation about a horizontal axis **486** which is parallel to the punch axes. More particularly, a support bracket assembly **488** is welded or otherwise mounted on frame plate **22** and provided with a gear box **490** having an output shaft **492** on which star wheel **484** is suitably mounted for rotation by the output shaft.

Support bracket **488** further supports an indexing transmission unit **494** having an input shaft **496** and an output shaft **498** and which unit, in a well known manner, is adapted to translate constant input rotation through shaft **496** to intermittent rotation of output shaft **498**. Any suitable indexing transmission can be employed for this purpose. Input shaft **496** is suitably coupled with shaft **66** which, as described hereinabove, is adapted to be rotated at a constant speed through the drive arrangement for the press. Output shaft **498** is suitably coupled with input shaft **500** to index the latter shaft, and gear box **490** operates to transmit the indexing rotation of input shaft **500** to a corresponding indexing rotation of shaft **492** and star wheel **484**, the axis of which is perpendicular to the axis of input shaft **500**.

It will be appreciated that the drive mechanism for discharge star wheel **484** is driven in synchronism with reciprocating movement of the slide and punches to coordinate indexing of the discharge wheel with the positions of the rams relative thereto. More particularly in this respect, indexing wheel **484** is provided with twelve pockets **502** spaced equidistant about the periphery of the wheel, and each pocket is arcuately contoured to receive a formed can body blank during retracting

movement of the punches. The diameter of the discharge wheel and the spacing of pockets **502** thereabout is such as to provide for two of the pockets **502** to be positioned to receive formed can blanks upon retraction of punches **88**, and for two pockets **502** to be disposed between the latter can blank receiving pockets. Further, the indexing wheel drive mechanism provides for the indexing wheel to step 60° clockwise as seen in FIG. **16** about axis **486** following the reception of can blanks from the punches. The formed cans are discharged from the right hand side of the frame as viewed in FIG. **16** and, accordingly, the star wheel pockets approaching the left hand punch member **88** during indexing movement of star wheel **484** are always empty. It will be appreciated therefore that each indexing step of 60° displaces cans deposited in star wheel pockets to positions out of alignment with the punches and simultaneously displaces empty pockets into alignment with the punches to receive formed cans therefrom. As cans are displaced clockwise with the star wheel they are retained therein by a retaining wall **504** until the corresponding star wheel pocket reaches the location of a discharge chute **506** leading from the machine.

As mentioned hereinabove, the formed can blanks are stripped from the punch members during initial movement thereof in the direction of retraction with respect to the doming units. The formed can blanks can be stripped from the punches in any desired manner and, generally, stripping devices **508** are associated with each of the ironing ring units at the discharge ends thereof as illustrated in FIG. **13**. As is well known, such can strippers are operable to permit a formed can blank on the corresponding punch to pass therethrough with the punch as the latter moves in the direction toward the corresponding doming unit. When the trailing edge of the can wall passes beyond the stripper unit the latter is operable to engage the trailing edge of the can in response to movement of the corresponding punch away from the doming unit, whereby the punch is withdrawn from the formed can blank allowing the latter to drop by gravity. The stripper mechanism does not form a part of the present invention, and any suitable mechanism can be employed to achieve the stripping function. In the embodiment disclosed, the formed can blank is deposited in an underlying pocket of the star wheel upon withdrawal of the corresponding punch from the can blank, and it will be appreciated that the star wheel is indexed following complete displacement of the punch members from the formed can blanks and prior to the succeeding movement of the punch members and can blanks thereon beyond the discharge ends of the ironing ring units.

While considerable emphasis has been placed herein on the specific structure of the various components of the preferred embodiment of the horizontal ironing press of the present invention, it will be appreciated that many changes and modifications can be made with regard to the components as disclosed and described without departing from the principles of the present invention. Such changes and modifications of the preferred embodiment will be obvious to others upon reading and understanding the foregoing description. Accordingly, as many embodiments of the present invention can be made and as many changes can be made in the embodiments herein illustrated and described, it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the present invention and not as a limitation.

What is claimed is:

1. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, punch means supported by said frame for reciprocation between first and second positions along a linear path, ironing ring means coaxial with said punch means and supported by said frame between said first and second positions, said punch means receiving a can blank in said first position and being cooperable with said ironing ring means to form said blank upon movement of said punch means to said second position, and means to reciprocate said punch means between said first and second positions, the improvement comprising: said punch means including slide means reciprocable along said path, said slide means having spaced apart horizontally parallel sides, opposed guide channel means on said frame receiving a corresponding one of said slide sides, each said guide channel means including horizontally extending vertically spaced parallel planar guide surfaces and a vertically extending planar guide surface therebetween and perpendicular thereto, each of said slide sides including corresponding follower surfaces slidably engaging said horizontally and vertically extending guide surfaces, said slide sides each including bar means having first and second end portions, said follower surfaces being on said first end portions, each said guide channel means having an end in the direction from said first position toward said second position, said second end portions of said bar means extending from said first end portions in said dirsction, and apertured bearing means fixed relative to said frame adjacent said ends of said guide channel means receiving and slidably supporting said second end portions of said bar means.

2. The improvement according to claim **1**, wherein said second end portions of said bar means are circular in cross section and said apertured bearing means includes corresponding sleeve bearing means for each said second end portions.

3. The improvement according to claim **2**, wherein said follower surfaces on said slide sides are bearing strips mounted on said first end portions of said bar means.

4. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, slide means supported by said frame for reciprocating movement along a linear path between first and second positions, at least one punch rod mounted on said slide means for movement therewith, ironing ring means supported by said frame and positioned coaxial with said punch rod for a can blank received on said punch rod to be formed by movement of said punch rod through said ring means during movement of said slide means from said first to said second position, and means to reciprocate said slide means, the improvement comprising:

said punch rod having a mounting end interengagable with said slide means, and means removably interengaging said punch rod and slide means, said interengaging means including a member supported by said slide means for rotation relative thereto about an axis, cooperatively interengagable thread means on said member and said mounting end of said punch rod, and operating means supported by

said slide means for rotating said member in opposite directions about said axis, said operating means being selectively actuable independent of said means to reciprocate said slide means.

5. The improvement according to claim 4, wherein said operating means for rotating said member includes first gear means mounted on said member for rotation therewith, second gear means supported by said slide means for rotation relative thereto in meshing engagement with said first gear means, and means for rotating said second gear means.

6. The improvement according to claim 5, wherein said cooperatively interengagable thread means is defined by external threads on said mounting end of said punch rod and an internally threaded recess in said rotatable member.

7. The improvement according to claim 4, wherein said slide means has spaced apart horizontally parallel sides, each of said sides including bar means having a first portion nearest said first position and a second portion nearest said second position, said first portions of said bar means each including vertically spaced parallel planar bearing surfaces and a laterally outer planar bearing surface perpendicular thereto, opposed guide channel means on said frame each slidably receiving a corresponding one of said first portions of said bar means, each said guide channel means having guide surfaces engaging said vertically spaced and outer bearing surfaces, each said guide channel means having an end in the direction from said first position toward said second position, and apertured bearing means fixed relative to said frame adjacent said end of each guide channel means, each said apertured bearing means receiving and slidably supporting said second portion of the corresponding bar means.

8. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, punch means supported by said frame for reciprocation between first and second positions along a linear path, at least one ironing ring, means supporting said ironing ring on said frame between said first and second positions for a can blank received on said punch means in said first position to be formed by movement of said punch means through said ironing ring to said second position, and means to reciprocate said punch means between said first and second positions, the improvement comprising: said support means for said ironing ring including a pair of support members axially spaced apart to receive said ring therebetween, a pair of rotatable cam members in the space between said support members and positioned to underlie said ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to one another and to the axis of said ring, and means to independently rotate said cam members.

9. The improvement according to claim 8, and cover means overlying said support members and including a portion overlying said space therebetween, and spring biased plunger means supported by said cover means and depending therefrom into said space to engage and bias said ring into engagement with said cam members.

10. The improvement according to claim 8, wherein said means supporting each said cam members for rotation includes corresponding camshaft means, said means to rotate said cam members including first gear means on said camshaft means of each cam member for rotation therewith, second gear means for rotating each said first gear means, and corresponding gear shaft means supporting each said second gear means for rotation relative to said support members.

11. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, punch means supported by said frame for reciprocation between first and second positions along a linear path, at least one ironing ring, means supporting said ironing ring on said frame between said first and second positions for a can blank received on said punch means in said first position to be formed by movement of said punch means through said ironing ring to said second position, and means to reciprocate said punch means between said first and second positions, the improvement comprising: said support means for said ironing ring including a pair of support members axially spaced apart to receive said ring therebetween, a pair of cam members in the space between said support members and positioned to underlie said ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to one another and to the axis of said ring, means to independently rotate said cam members, said punch means including slide means and at least one punch member mounted on said slide means for movement therewith, said slide means having spaced apart horizontally parallel sides, each of said sides including bar means having a first portion nearest said first position and a second portion nearest said second position, said first portions of said bar means each including vertically spaced parallel planar bearing surfaces and a lterally outer planar bearing surface perpendicular thereto, opposed guide channel means on said frame each slidably receiving a corresponding one of said first portions of said bar means, each said guide channel means having guide surfaces engaging said vertically spaced outer bearing surfaces, each said guide channel means having an end in the direction from said first position toward said second position, and apertured bearing means fixed relative to said frame adjacent said end of each guide channel means, each said apertured bearing means receiving and slidably supporting said second portion of the corresponding bar means.

12. The improvement according to claim 10, wherein each said gear shaft means has an outer end exposed on a common side of said support members, and means on each of said outer ends for manually rotating the corresponding gear shaft means.

13. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, punch means supported by said frame for reciprocation between first and second positions along a linear path, at least one ironing ring, means supporting said ironing ring on said frame coaxial with said punch means for a can blank received on said punch means in said first position to be formed by movement of said punch means through said ironing ring to said second position, and means to reciprocate said punch means between said first and second positions, the improvement comprising: said support means for said ironing ring including a horizontal base plate generally parallel to the axis of said ring and support plate means underlying said base

plate, said base plate having opposite ends in the direction between said first and second positions and a longitudinal axis in said direction, pin means interconnecting said base plate with said support plate means for said base plate to pivot about a generally vertical axis through said longitudinal axis and at one of said opposite ends, and releaseable means holding said base plate against pivotal movement relative to said support plate means.

14. The improvement according to claim **13**, wherein the one of said opposite ends of said base plate is the end furtherest from said first location in said direction.

15. The improvement according to claim **14**, and adjusting screw means at the other of said opposite ends of said base plate for pivoting said base plate relative to said support plate means.

16. The improvement according to claim **14**, wherein said punch means includes slide means and at least one punch member mounted on said slide means for movement therewith, and wherein said slide means has spaced apart horizontally parallel sides, each of said sides including bar means having a first portion nearest said first position and a second portion nearest said second position, said first portions of said bar means each including vertically spaced parallel planar bearing surfaces and a laterally outer planar bearing surface perpendicular thereto, opposed guide channel means on said frame each slidably receiving a corresponding one of said first portions of said bar means, each said guide channel means having guide surfaces engaging said vertically spaced and outer bearing surfaces, each said guide channel means having an end in the direction from said first position toward said second position, and apertured bearing means fixed relative to said frame adjacent said end of each guide channel means, each said apertured bearing means receiving and slidably supporting said second portion of the corresponding bar means.

17. The improvement according to claim **16**, wherein said support means for said ironing ring further includes a pair of support members on said base plate and spaced apart in said direction to receive said ring therebetween, a pair of cam members in the space between said support members and positioned to underlie said ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to one another and to the axis of said ring, and means to independently rotate said cam members.

18. The improvement according to claim **14**, wherein said support means for said ironing ring further includes a pair of separate upright support members on said base plate and longitudinally spaced apart to receive said ring therebetween, said base plate and support members including opposed longitudinally extending key and recess means cooperable to laterally align said support members and ring on said base plate.

19. The improvement according to claim **18**, and a pair of cam members in the space between said support members and positioned to underlie said ironing ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to the axis of said ring, and means to independently rotate said cam members.

20. The improvement according to claim **19**, wherein said means supporting each said cam members for rotation includes corresponding camshaft means and bearing means therefor in said support members, said means to rotate said cam members including first gear means on said camshaft means of each cam member for rotation therewith, second gear means for rotating each said first gear means, and corresponding gear shaft means supporting each said second gear means for rotation relative to said support members.

21. In a machine for forming a can body having a closed end and a peripheral side wall extending therefrom and which machine includes a frame, punch means supported by said frame for reciprocation between first and second locations along a linear path, ironing ring means supported by said frame between said first and second locations, end forming means, means supporting said end forming means on said frame at said second location, said punch means receiving a can blank at said first location and being cooperable with said ring means to form said blank upon movement of said punch means through said ring means and being cooperable with said end forming means to form said closed end when said punch means reaches said second location, and means to reciprocate said punch means between said first and second locations, the improvement comprising: said support means for said end forming means including a support member extending transverse to said linear path and having opposite ends, said end forming means being on said support member between said opposite ends, means interconnecting one of said opposite ends of said support member with said frame for pivotal movement of said support member and end forming means relative to said frame, means releaseably interengaging the other of said opposite ends of said support member with said frame, said one end of said support member being interconnected with said frame for pivotal movement about a vertical axis, said punch means including slide means and at least one punch member mounted on said slide means for movement therewith, said slide means having spaced apart horizontally parallel sides, each of said sides including bar means having a first portion nearest said first location and a second portion nearest said second location, said first portions of said bar means each including vertically spaced parallel planar bearing surfaces and a laterally outer planar bearing surface perpendicular thereto, opposed guide channel means on said frame each slidably receiving a corresponding one of said first portions of said bar means, each said guide channel means having guide surfaces engaging said vertically spaced and outer bearing surfaces, each said guide channel means having an end in the direction from said first location toward said second location, and apertured bearing means fixed relative to said frame adjacent said end of each channel means, each said apertured bearing means receiving and slidably supporting said second portion of the corresponding bar means.

22. The improvement according to claim **21**, wherein said ironing ring means includes at least one ironing ring and means supporting said ironing ring on said frame, said support means for said ironing ring including a base plate generally parallel to the axis of said ring and support plate means underlying said base plate, said base plate having a first end nearest said second location and a longitudinal axis underlying said ring axis, pin means pivotally interconnecting said first end of said base plate and said support plate means, said pin

means having a vertical axis intersecting said longitudinal axis of said base plate, and releaseable means holding said base plate against pivotal movement relative to said support means.

23. The improvement according to claim **21**, wherein said ironing ring means includes at least one ironing ring and means supporting said ironing ring on said frame, said support means for said ironing ring including a pair of support members axially spaced apart to receive said ring therebetween, a pair of cam members in the space between said support members and positioned to underlie said ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to one another and to the axis of said ring, and means to independently rotate said cam members.

24. The improvement according to claim **23**, wherein said support means for said ironing ring further includes a pair of support members on said base plate and spaced apart in said direction to receive said ring therebetween, a pair of cam members in the space between said support members and positioned to underlie said ring at circumferentially spaced locations thereabout, means supporting each of said cam members for rotation relative to said support members about axes parallel to one another and to said ring axis, and means to independently rotate said cam members.

25. The improvement according to claim **11**, wherein said punch member has a mounting end interengagable with said slide means, and means removably interengaging said punch member and slide means, said interengaging means including a component supported by said slide means for rotation relative thereto about an axis, cooperatively interengagable thread means on said component and said mounting end of said punch member, and means supported by said slide means for rotating said component in opposite directions about said axis.

26. The improvement according to claim **17**, wherein said punch member has a mounting end interengagable with said slide means, and means removably interengaging said punch member and slide means, said interengaging means including a component supported by said slide means for rotation relative thereto about an axis, cooperatively interengagable thread means on said component and said mounting end of said punch member, and means supported by said slide means for rotating said component in opposite directions about said axis.

27. The improvement according to claim **24**, wherein said punch member has a mounting end interengagable with said slide means, and means removably interengaging said punch member and slide means, said interengaging means including a component supported by said slide means for rotation relative thereto about an axis, cooperatively interengagable thread means on said component and said mounting end of said punch member, and means supported by said slide means for rotating said component in opposite directions about said axis.

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