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Irwin

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[54] **APPARATUS FOR MATCHED-MOLD THERMO-FORMING**

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[52] **U.S. Cl.** **425/144,** 425/150, 425/157, 425/160, 425/168, 425/291, 425/383, 425/398, 425/412

[51] **Int. Cl.** **B29c 3/06**

[58] **Field of Search** 425/415, 406, 291, 157, 425/383, 384, 388, 393, 398, 423, 144, 150, 160, 168, 412

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Primary Examiner—Robert L. Spicer, Jr.

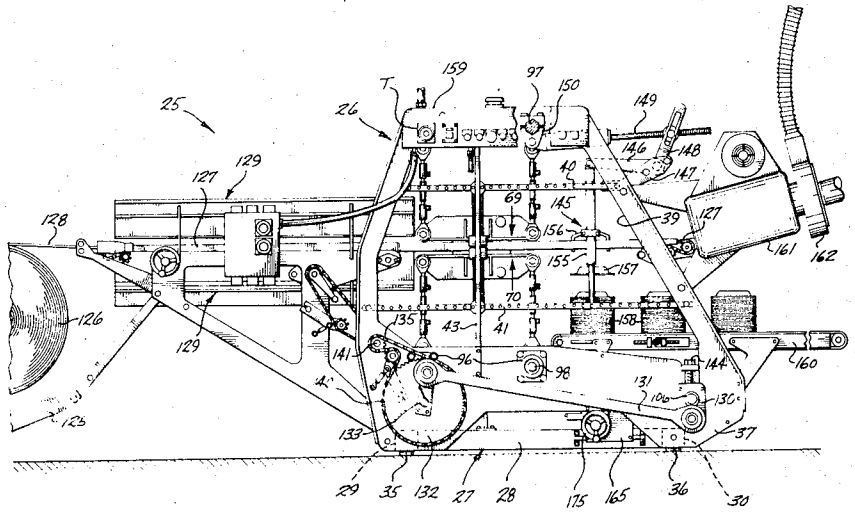
[57] **ABSTRACT**

The method provides matched molds in superimposed relation, cyclically reciprocating vertically each of said molds relative to the other, to first mold a product in a continuous web of heated thermo-plastic material fed cyclically between said molds, halting each cycle just short of its reaching the point of maximum proximity between said molds to allow the material adjacent the periphery of said product to cool prior to performing the trim step, starting the next following cycle with the trim step, the latter being accomplished by continuing the approach of said molds to the point of their maximum proximity, said product being left connected to the web by easily broken tabs and punching the product from the web at a stacking station during a succeeding cycle.

The apparatus embodies a double action automatic press including parallel vertical side frames rigidly united with each other and with a tripod supported base. A pair of massive vertical guide posts fixed at upper and lower ends to inner faces of said frames, vertically guide upper and lower tooling mounting platens, each platen being connected by four adjustable links to arms on one of two pair of rocker shafts, one such pair being above the upper platen, the other pair being below the lower platen. Outside one side frame, short arms are fixed on the upper pair of rocker shafts and double armed bell cranks are fixed on the lower pair of rocker shafts, each of the bell cranks having a long arm and a short arm. A pair of long links connect upper and lower outside short arms and a third link connects said long arms. A pitman connects one of said long bell crank arms to a crank arm fixed on one end of a transversely journaled crank shaft at the forward end of the press. A base mounted constant speed motor is connected through a variable speed transmission and an electro-air controlled clutch brake mechanism to a reduction gear box which is interposed in a gap in said crank shaft and directly drives the latter. Each revolution of the drive shaft accomplishes one production cycle of the press. A separate control device determines at what point in the production each cycle ends to provide a cooling "dwell" between cycles so that the trim step takes place at the beginning of each cycle, thereby improving the product.

A cyclic web feeder and heater is provided on and driven by the press. The tooling employed in the press leaves the product lightly connected with the scrap of the web following each trimming step by several oppositely disposed transfer tabs which may readily be broken by a punching operation when the product arrives at a stacking station. The press embodies and automatically drives a product punch for accomplishing this function. A product stack conveyor receives products thus punched from the web and automatically discharges product stacks of predetermined quantity. A scrap chopper disposes of the scrap left in the web. The press also includes separate means manually operable while the press is running to vary the time period of the cooling dwell and also to vary the distance, short of reaching the point of maximum proximity between the platens, at which each operating cycle concludes.

2 Claims, 18 Drawing Figures



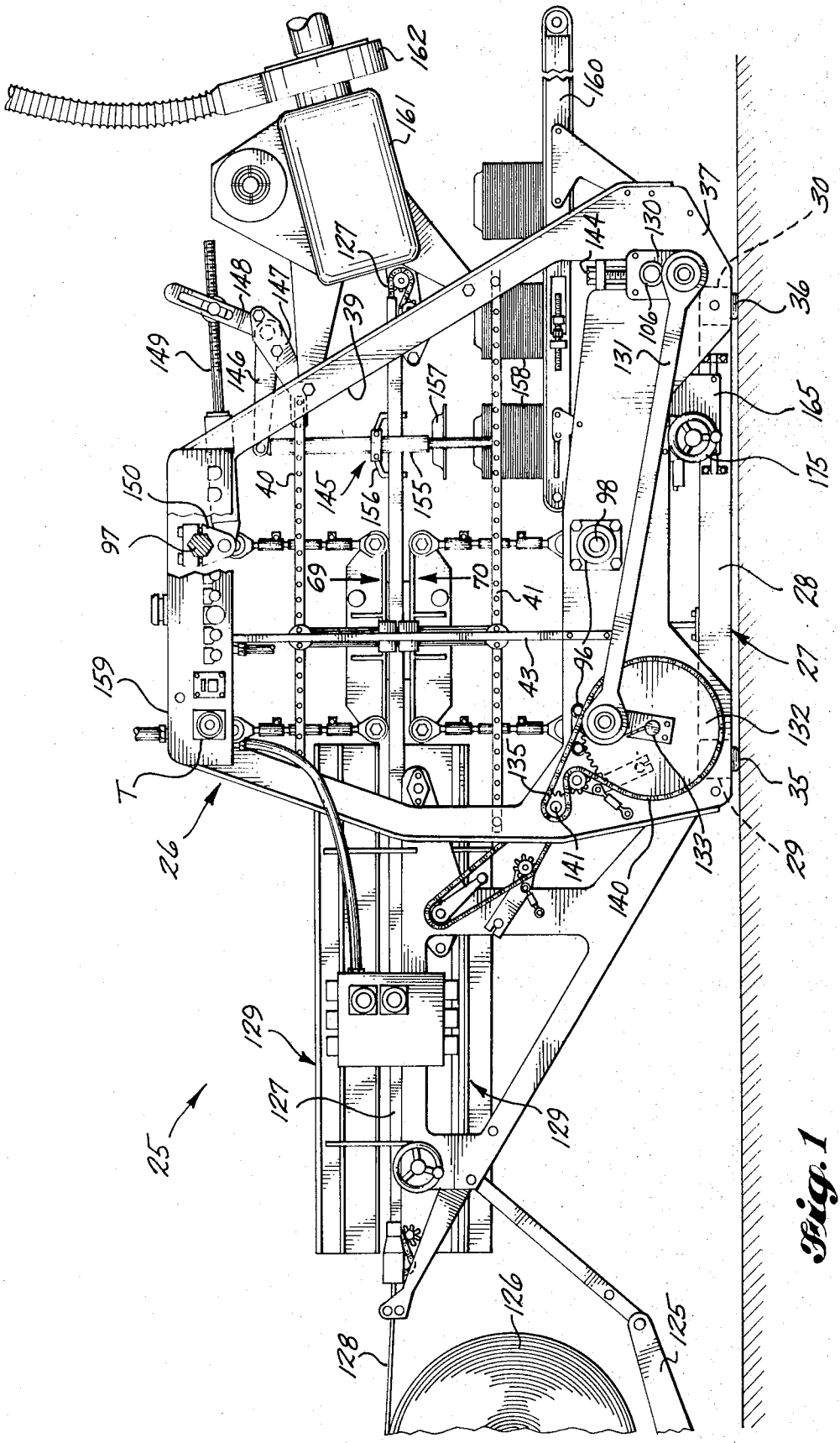

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Fig. 1

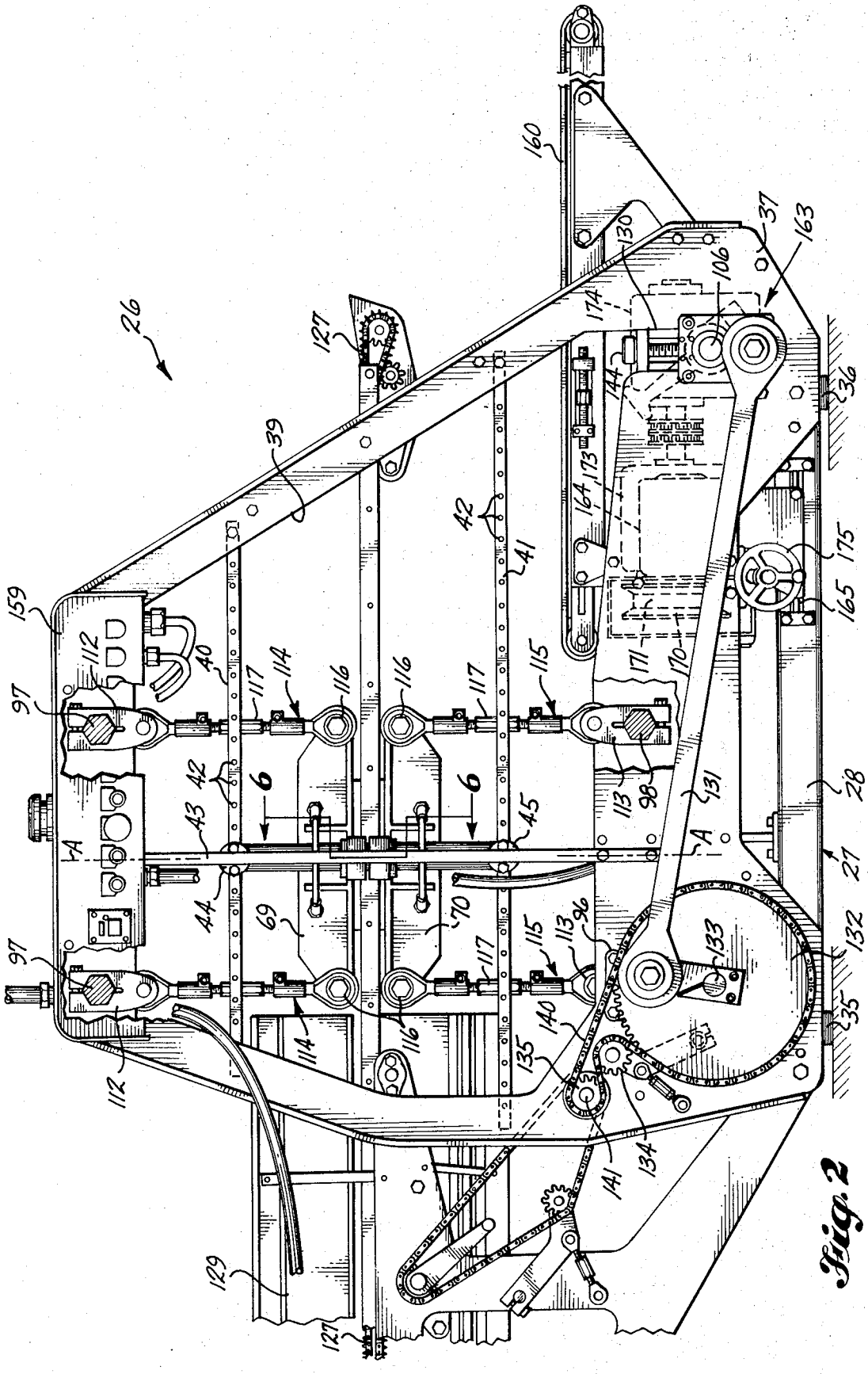
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Fig. 2

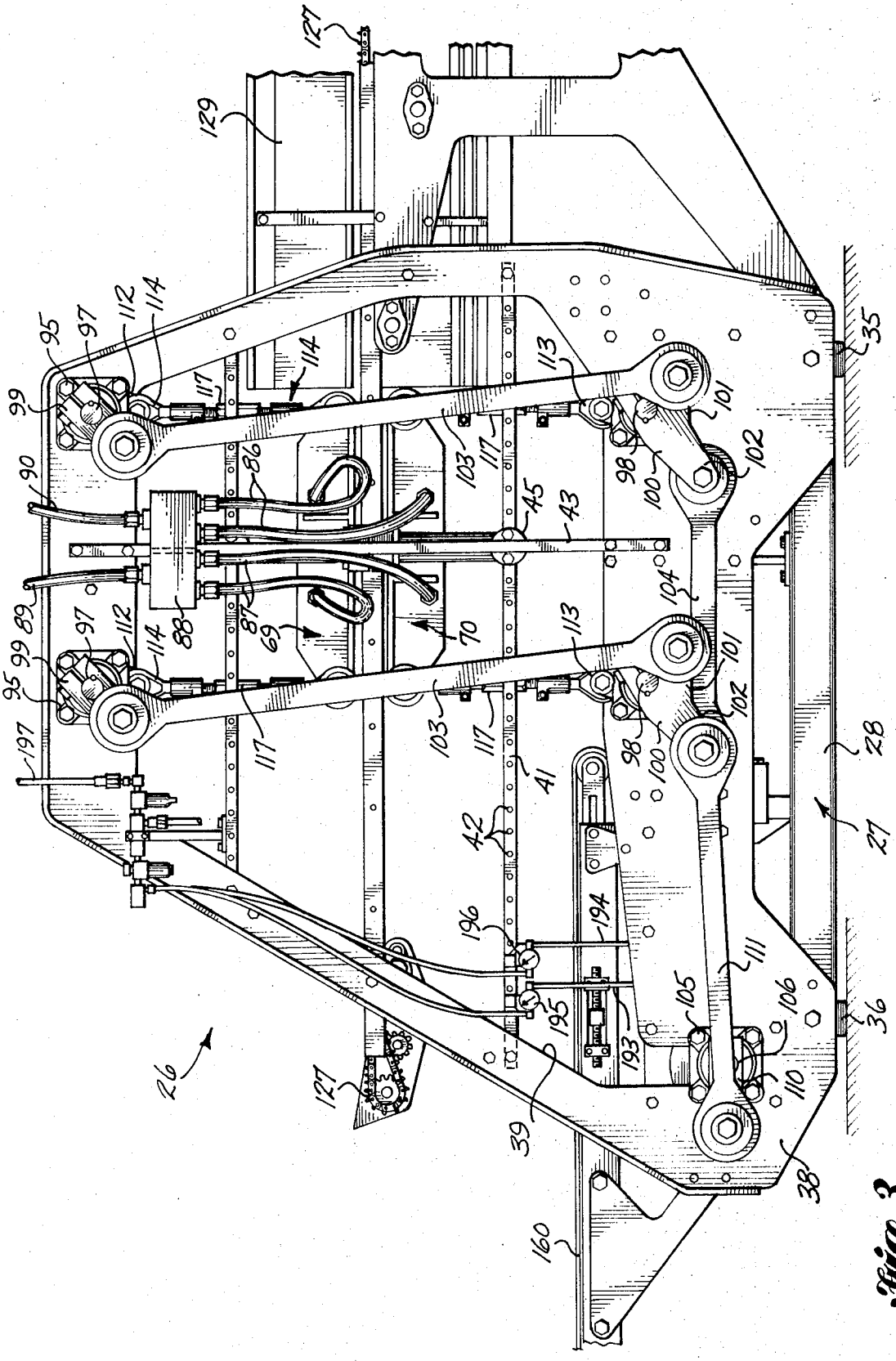
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Fig. 3

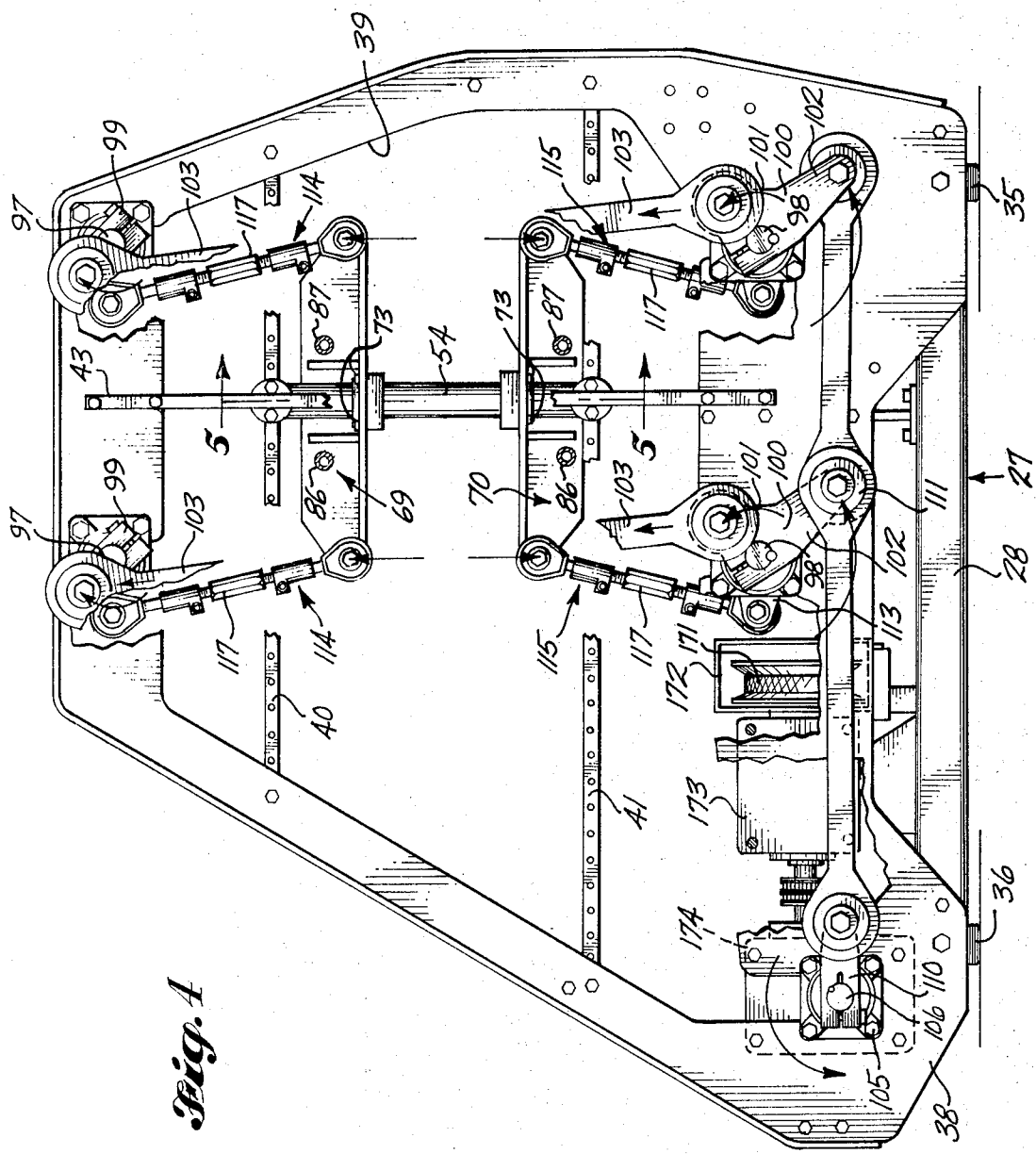
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Fig. 4

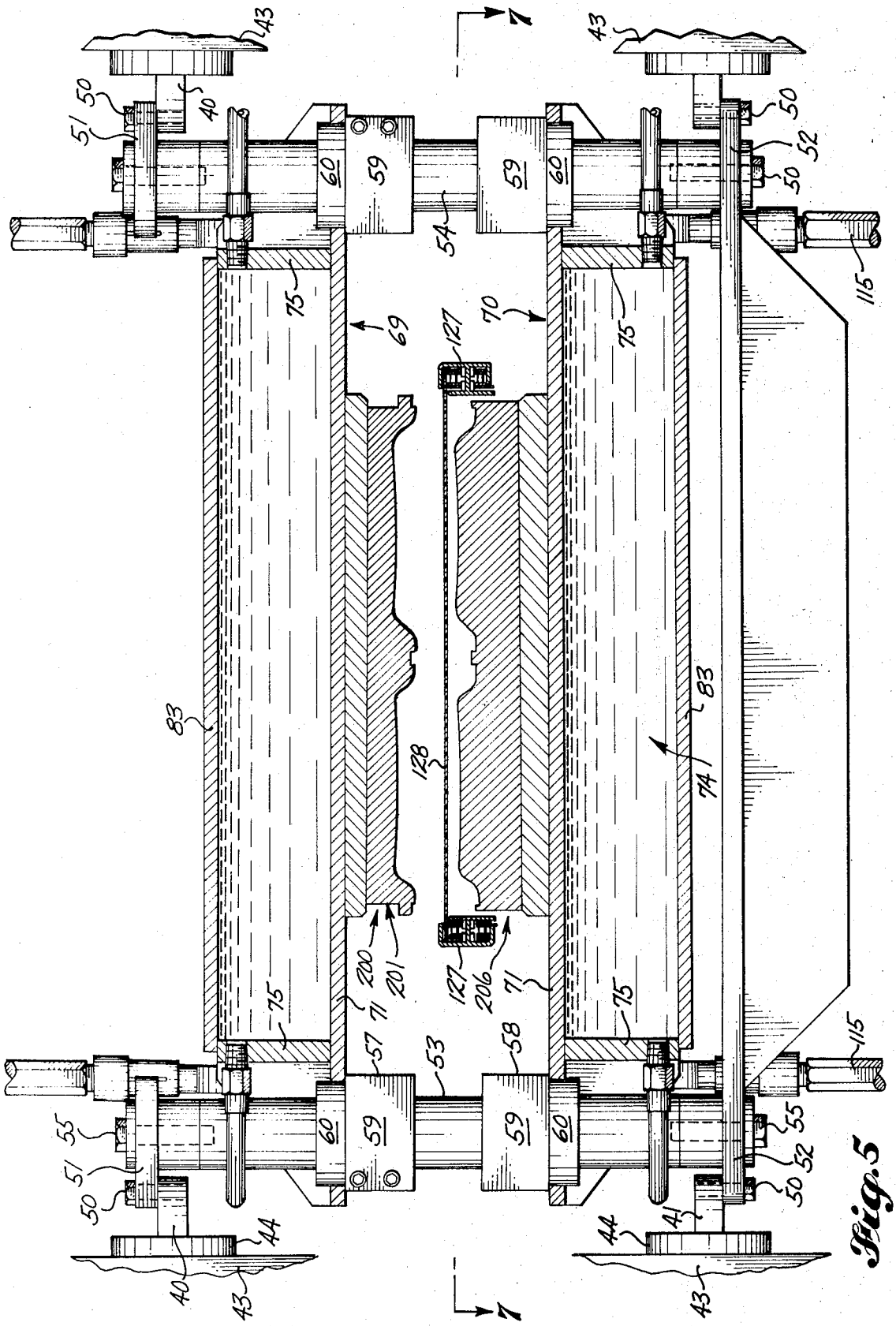
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Fig. 5

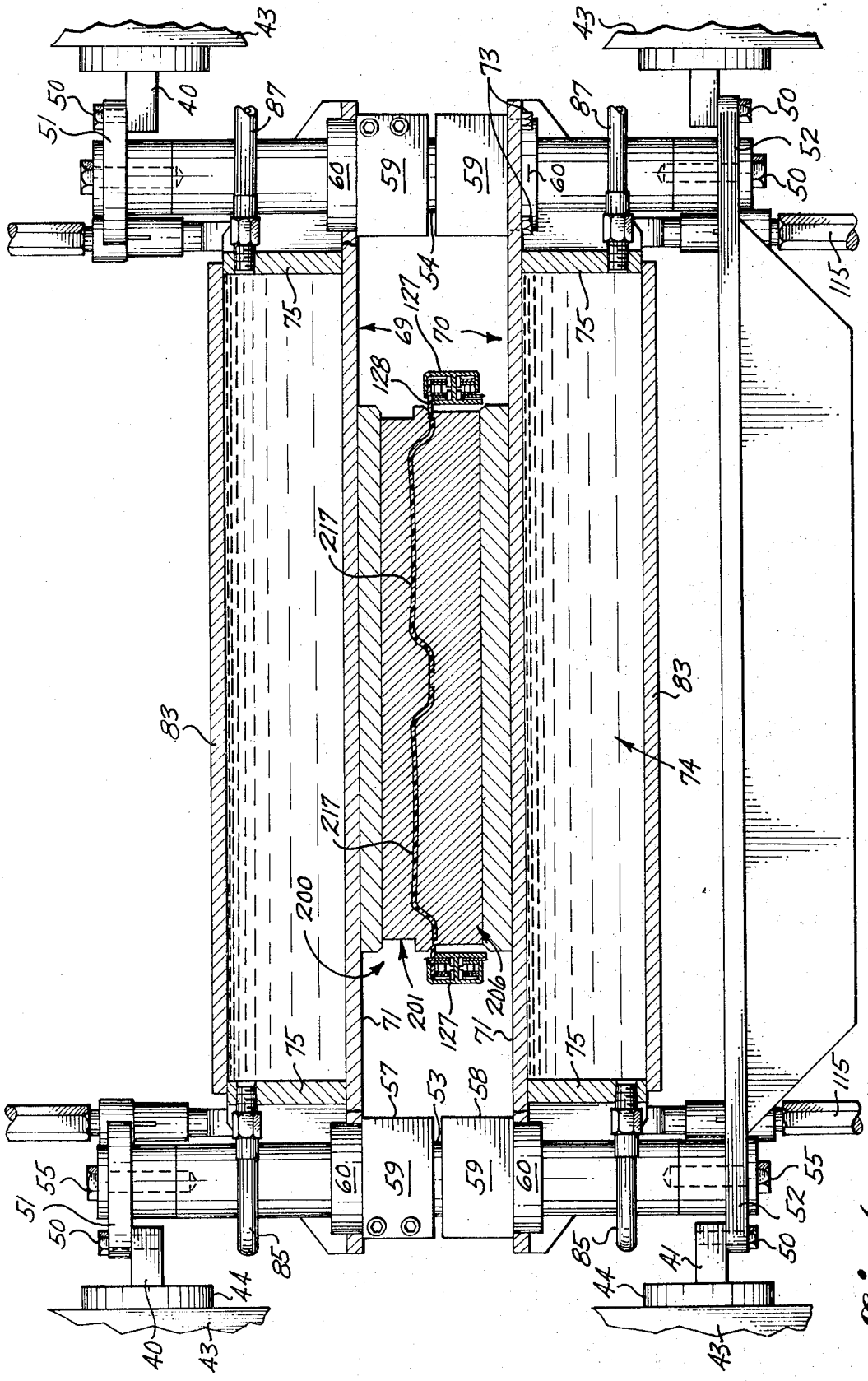
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Fig. 6

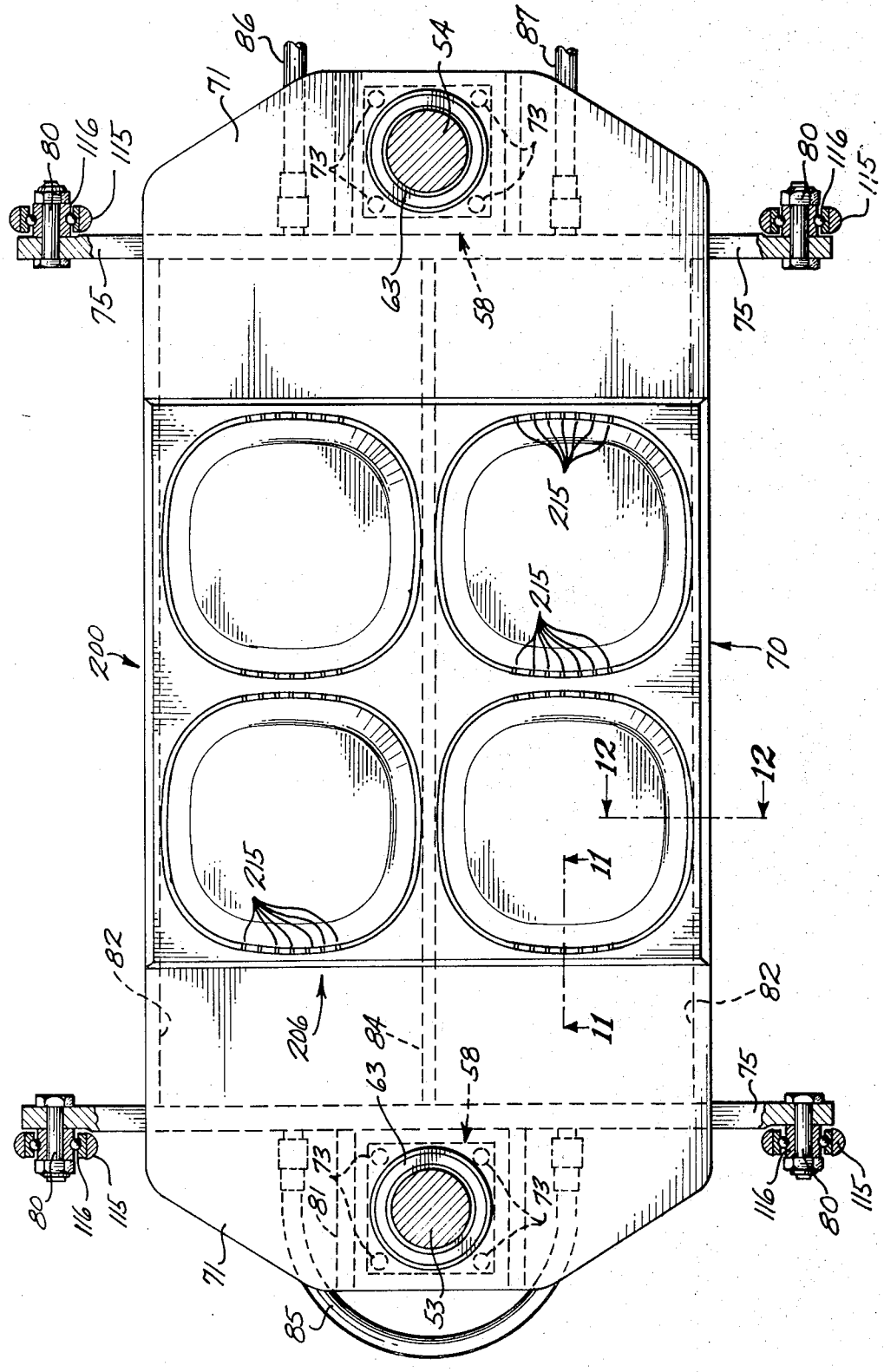

Fig. 7

Fig. 9

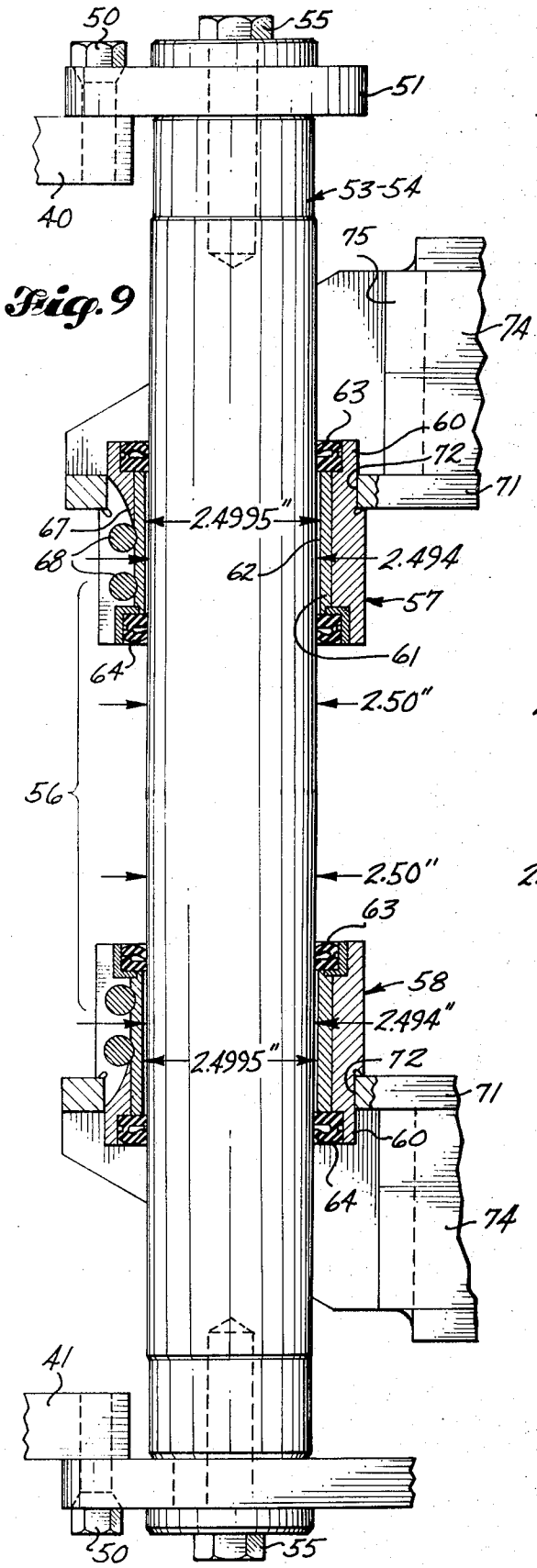
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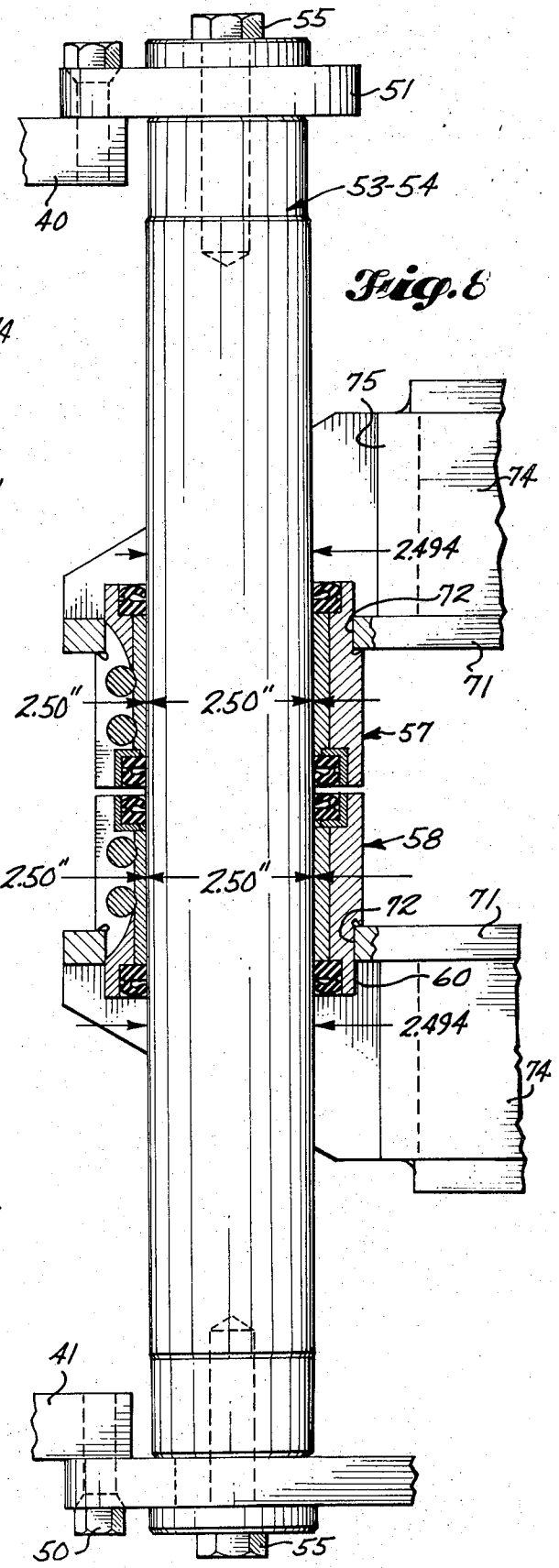
Fig. 6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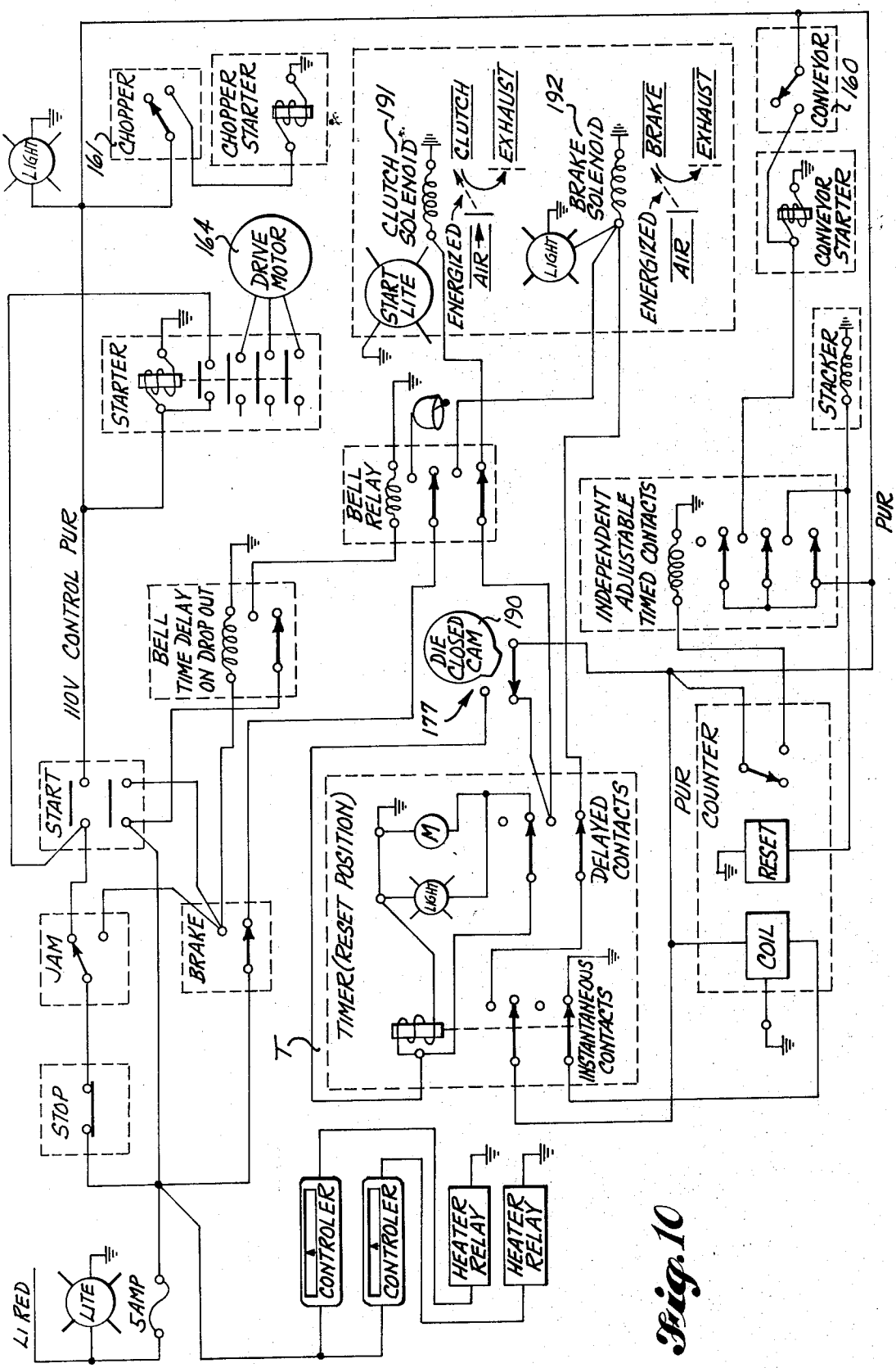
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CHOPPER
CHOPPER STARTER
DRIVE MOTOR
STARTER
CLUTCH SOLENOID
START LITE
ENERGIZED
AIR
CLUTCH
EXHAUST
BRAKE SOLENOID
LIGHT
BRAKE
EXHAUST
CONVEYOR
CONVEYOR STARTER
STACKER
BELL RELAY
BELL TIME DELAY ON DROP OUT
110V CONTROL PUR
DIE CLOSED CAM
INDEPENDENT ADJUSTABLE TIMED CONTACTS
PUR
START
JAM
BRAKE
STOP
TIMER (RESET POSITION)
M
LIGHT
DELAYED CONTACTS
INSTANTANEOUS CONTACTS
PUR COUNTER
RESET
COIL
LI RED
LITE
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CONTROLER
CONTROLER
HEATER RELAY
HEATER RELAY
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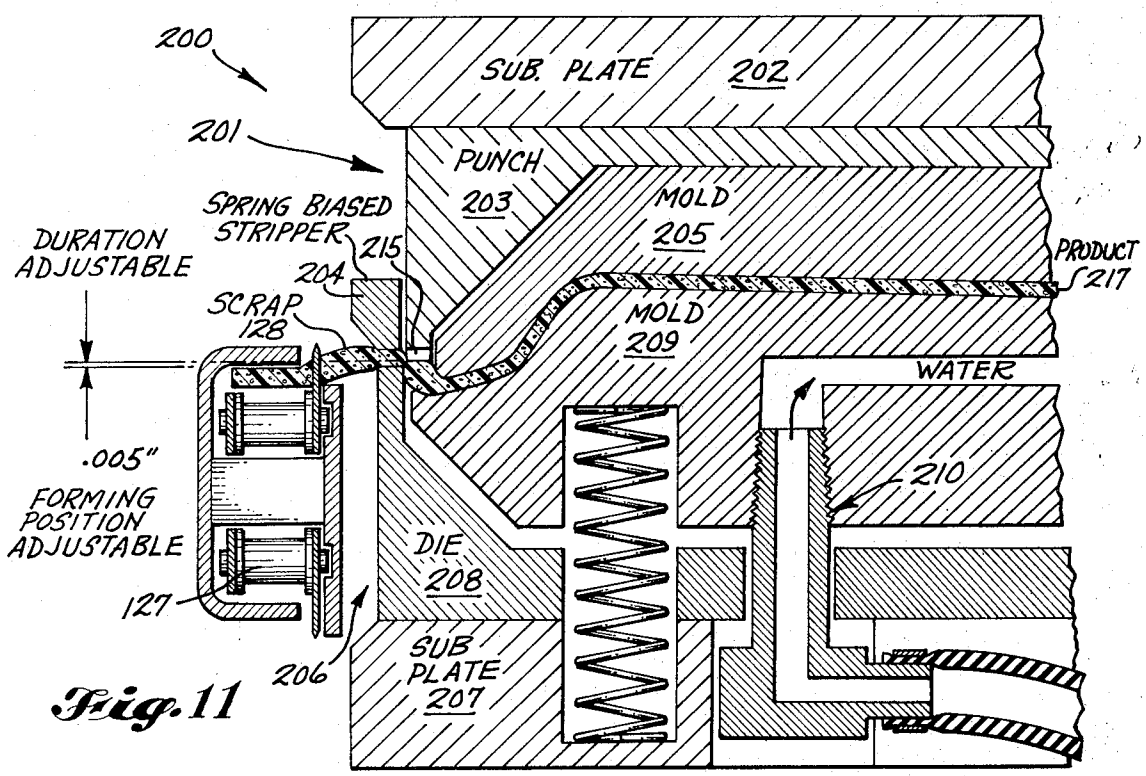
Fig. 10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SCRAP 128
PRODUCT 217
MOLD 209
WATER
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FORMING POSITION ADJUSTABLE
DIE 208
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SUB PLATE 207

Fig. 11

Fig. 12

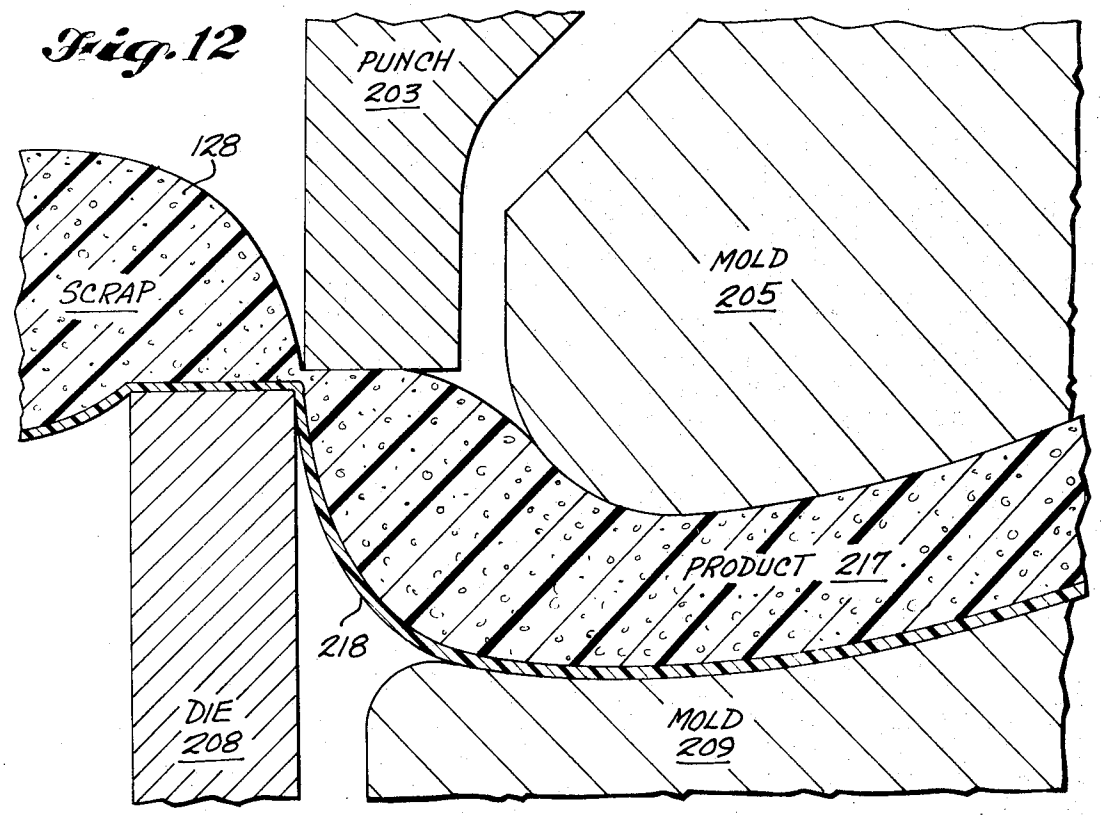
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Fig. 13

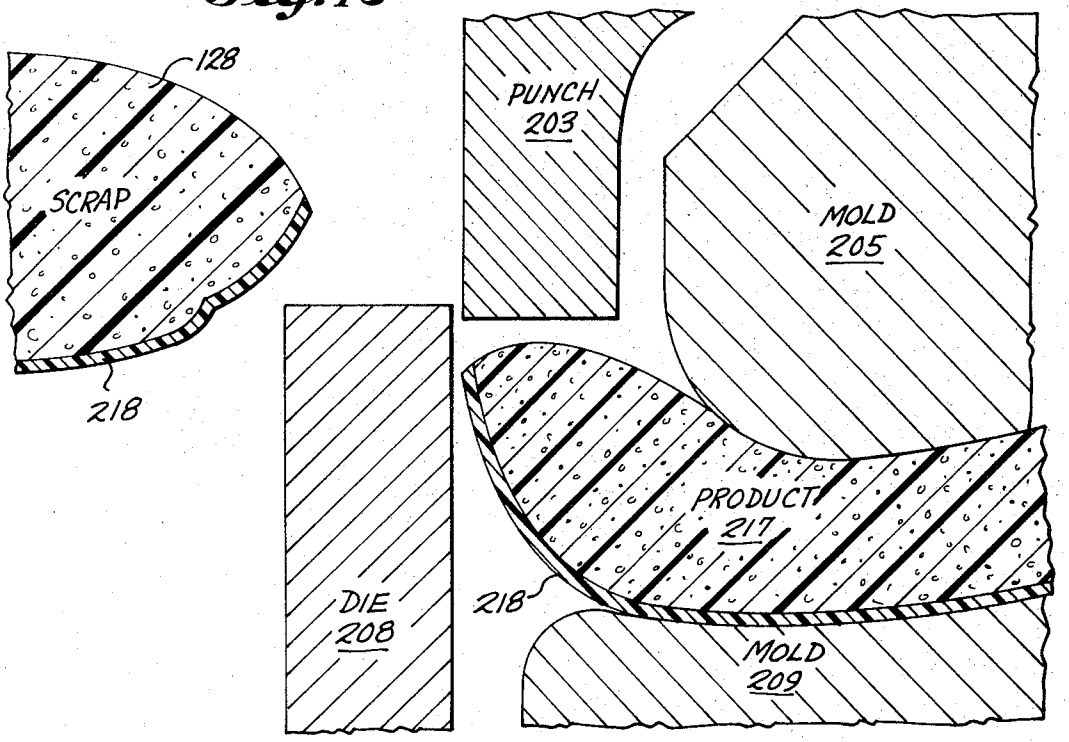


Fig. 14

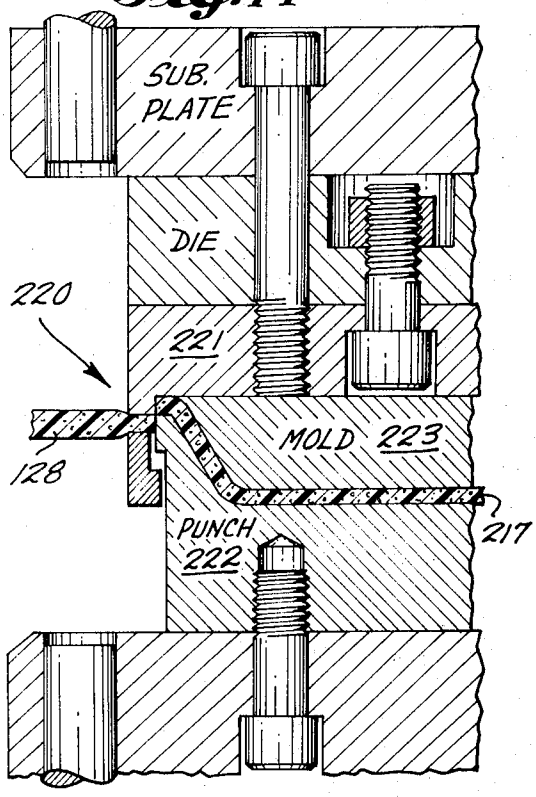


Fig. 15

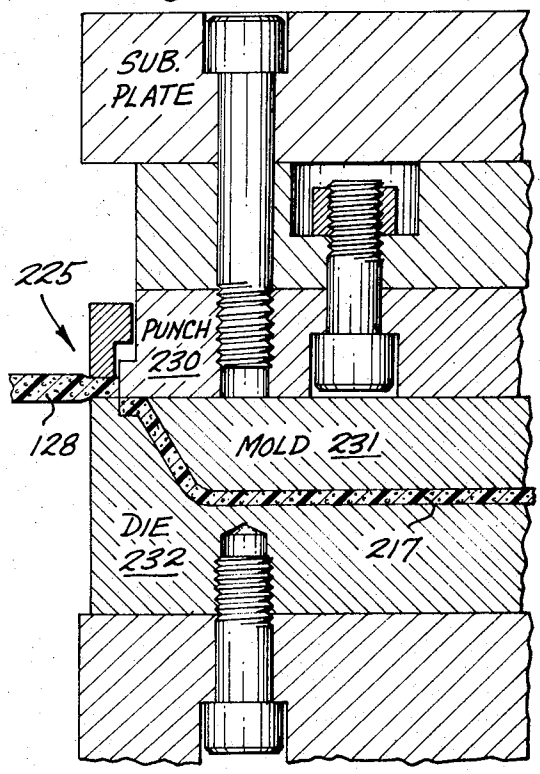
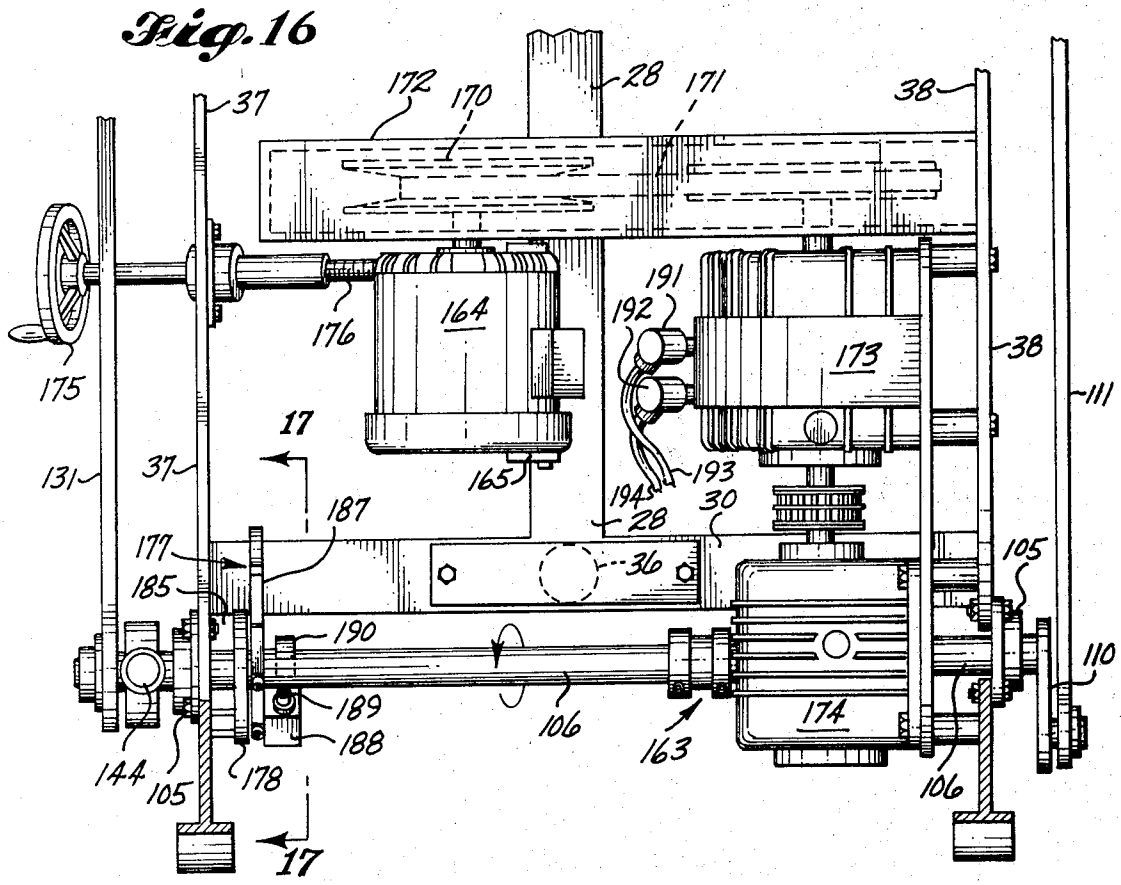


Fig. 16



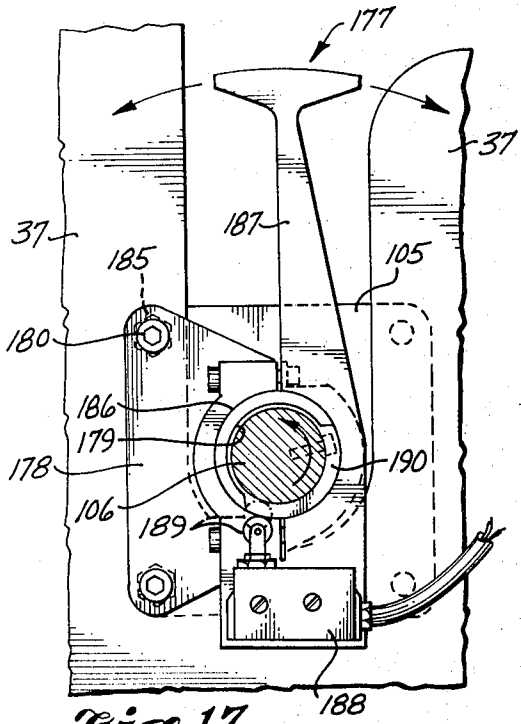
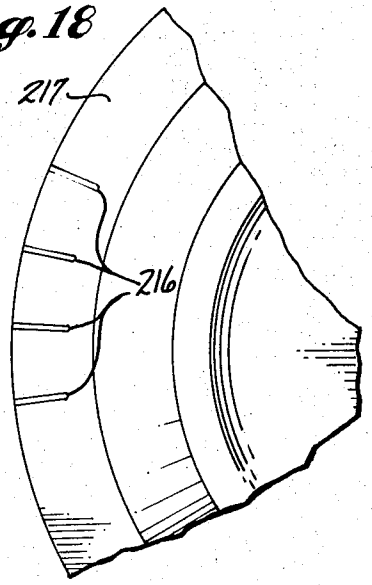


Fig. 17

Fig. 18



APPARATUS FOR MATCHED-MOLD THERMO-FORMING

SUMMARY OF THE INVENTION

In developing the present invention, one of the outstanding objects kept in view was to provide an automatic press adapted for matched mold thermo-forming which is simple, quick, smooth, dependable, quiet, versatile and easy to operate.

Another object was to produce such an automatic press which can efficiently produce a variety of products at a relatively low cost.

Another object was to produce such an automatic press by which thermo-plastic products of a higher quality than hitherto available could be produced in large volume at low cost.

Another object of the invention is to provide a method of and apparatus for producing in large volume thermo-plastic products at a low cost in which the periphery of the individual product has a smooth pleasingly rounded contour.

Still another object of the invention is to provide such a method and apparatus by which such a product might be produced in which the upper surface of the product is coated with a very thin lamination of solid styrene which extends around the rounded edge of the product to the extreme periphery thereof and is cleanly trimmed to provide a continuously smooth edge to the product.

A yet further object of the invention is to provide such an automatic press in which the length of the time dwell in each cyclic operation and the distance short of maximum proximity between the platens at the moment each operation of the cycle is halted are manually variable while the press is running, whereby product quality control may be exercised in accordance with observations made of the character of the product coming from the press and without stopping the operation of the press.

Still another object of the invention is to provide an automatic press in which the form trim step may be accomplished for each product in a single cycle of operation and in which transport tabs are simultaneously provided connecting the product with the web whereby the punching of the product from the web and the stacking of the same is reserved for a subsequent cycle thereby simplifying the production of the product and greatly decreasing the force required and tooling needed for the punching step and permitting all three steps to be performed in a single press.

Another very important object of the present invention is to provide an automatic press for matched mold thermo-forming which is capable of operation at relatively slow speeds and at relatively high speeds and at any in-between speed and which provides vertically juxtaposed flat platens which are guided vertically relative to each other particularly as they approach the point of their maximum proximity and which is the most critical point in each operational cycle, with a very high degree of precision and at the same time maintaining said platens in practically perfect horizontal parallelism with each other and spaced apart at said point of maximum proximity, a precisely predetermined distance under which conditions the tooling attached to said platens is designed to function with almost absolute precision in the formation of the product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic side elevational view of a preferred embodiment of the automatic press of the invention taken from one side thereof on which is mounted the control panel at the top of the machine and the automatic web feeding mechanism at the bottom of the machine. This view also shows diagrammatically the web heating elements and the web advancing chains and the automatic product punching device, and the automatic product stack receiving conveyor which functions only in response to stacks of a predetermined size being deposited thereon by the punch mechanism, and the scrap chopper which disposes of the scrap left in the web as it leaves the press.

FIG. **2** is a fragmentary enlarged elevational view of the automatic press of the invention, portions of which are broken away to better illustrate certain parts otherwise hidden, and illustrating in broken lines the power plant of the press.

FIG. **3** is a view with the same scale as FIG. **2** taken from the opposite side of the press and illustrating the linkage employed in connecting the power plant to the vertically reciprocating platens on which the tooling is carried. In each of FIGS. **1, 2** and **3**, the press of the invention is illustrated with the said platens disposed at the point of their maximum proximity.

FIG. **4** is a view similar to FIG. **3** and with the adjacent side frame partly broken away to reveal otherwise hidden elements of the operating mechanism of the machine with all the various operating elements shown as these are positioned with the platens of the machine disposed in horizontal parallelism at the point of their maximum separation.

FIG. **5** is an enlarged fragmentary transverse sectional view taken on the line **5—5** of FIG. **4** and showing the upper and lower platens of the press of the invention equipped with male and female tooling, the latter being shown diagrammatically by broken lines in outline only and with said platens as they are positioned when approaching each other during a production cycle to bring said tooling simultaneously into contact with a heated thermo-plastic web shown in this view as suspended between said upper and lower tooling.

FIG. **6** is a view similar to FIG. **5** and illustrates said upper and lower platens and the tooling mounted thereon at the conclusion of the trim step at the beginning of a cycle of production in which said platens are located at the point of their maximum proximity.

FIG. **7** is a fragmentary horizontal sectional view taken on the line **7—7** of FIG. **5** and illustrating the four cavity character of the tooling illustrated diagrammatically in FIGS. **5** and **6.**

FIG. **8** is an enlarged diagrammatic vertical sectional view taken on the line **6—6** of FIG. **2** and particularly illustrating the squeeze fit of the vertical guide bearings provided on the superimposed platens of the press when said platens are located at the point of maximum proximity between said platens.

FIG. **9** is a view similar to FIG. **8** and may be said to be taken on the line **5—5** of FIG. **4** and illustrates the relatively sloppy fit of said slide bearings on the vertical guide posts provided therefor when the platens are at their point of maximum separation as shown in FIG. **4.**

FIG. 10 is a schematic wiring diagram of the electrical elements of the press of the invention.

FIG. 11 is a fragmentary diagrammatic enlarged sectional view taken on the line 11—11 of FIG. 7 and illustrating the details of the tooling shown diagrammatically in FIGS. 5, 6 and 7 with the platens carrying such tooling halted at the end of a given production cycle with said platens short of arrival at the point of their maximum proximity, in other words, with said platens spaced apart a distance in excess by 0.005 of an inch above the spacing between said platens which exists at their point of maximum proximity and which will occur at the beginning of the next succeeding production cycle in the accomplishing of the trimming step which will separate the entire periphery of the product from the web with the exception of the relatively fragile transfer tabs, means for forming which are illustrated in FIG. 11.

FIG. 12 is a greatly enlarged fragmentary operational cross sectional view taken on the line 12—12 of FIG. 7 and a portion of the tooling illustrated in the latter view which is not provided with means for forming transport tabs as is the case in the portion of the tooling illustrated in FIG. 11. FIG. 12 however is taken at the same instant in an operational production cycle as FIG. 11 is taken, to wit: as the tooling supporting platens are located approximately 0.005 of an inch short of the point of their maximum proximity, this halting of the platens in the press of the invention continuing throughout a time dwell period (and which is adjustable in length) for the purpose of permitting cooling of the thermo-plastic material of the web being fed between the platens and being formed by the tooling in the production of a product.

FIG. 13 is a view similar to FIG. 12 and is taken at the instant in the initial portion of the next following cycle that the trim step is accomplished by the overlapping of the die and punch mounted respectively on the upper and lower platens of the press when the latter reach the point of their maximum proximity. As shown in this view, the scrap portion of the web snaps away from the product portion to effect this trimming operation which separates the product from the web entirely excepting for those portions of the periphery of the product which comprise the transporting tabs aforementioned.

FIG. 14 is a fragmentary diagrammatic vertical sectional view of a modified form of tooling which is adapted for use in the press of the invention for the manufacture of a meat tray, the tooling being here shown at the point of maximum proximity between the upper and lower platens of the press which accomplishes the trim step separating the product completely from the web excepting for those restricted areas in which transporting tabs are formed.

FIG. 15 is a view similar to FIG. 14, illustrating a second modified form of tooling adapted for use in the press of the invention in the formation of said meat tray. This figure also shows said modified form of tooling just as it reaches the point of their maximum proximity where the trim step is accomplished and the platens and the tooling attached thereto start to withdraw from that point in pursuance of the next succeeding production cycle.

FIG. 16 is a fragmentary horizontal sectional view taken on the line 16—16 of FIG. 2 and illustrating the power plant of the press of the invention. This view also illustrates the manual control for actuating the chain speed transmission of said power plant as well as the manually operable adjustment means for modifying the point in the rotation of the drive crank shaft at which a production cycle stops and starts.

FIG. 17 is an enlarged view taken on the line 17—17 of FIG. 16 and illustrates the switch and adjustment means therefor which is operable during the running of the press to modify the point in each rotation of the drive crank shaft at which each of the successive production cycles starts and stops.

FIG. 18 is a fragmentary bottom plan of a product showing the transporting tabs formed thereon.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention includes a method and an apparatus 25 which is required for practicing said method commercially. A detailed description of the apparatus will therefore precede the description of the method.

The apparatus 25 includes an automatic press 26 having an H-shaped base 27 formed by welding a longitudinal square tubular member 28 to similar cross members 29 and 30, the cross member 29 having a pair of widely spaced cylindrical foot plates 35 and the cross member 30 having a single centrally located foot plate 36, thus furnishing a tripod support for the press 26.

Rigidly fixed to opposite ends of cross members 29 and 30 of base 27 are vertical, parallel side frames 37 and 38, these frames being substantially reverse duplicates of each other and being shaped as shown in FIGS. 1, 2, 3 and 4. The frames 37 and 38 have corresponding large openings 39 through which access may be had to the interior of the press. Bars 40 and 41 are secured at their opposite ends to inner faces of marginal portions of the frames 37 and 38, each of these bars being furnished with a series of horizontal holes 42 for securing other elements of the press or accessories to the side frames 37 and 38. Secured at their upper and lower ends to side frames 37 and 38 at points above and below the openings 39 so as to be centered upon the same transverse vertical plane A—A is a pair of supplemental frame reinforcing bars 43. Bars 43 are connected respectively to the horizontal mounting bars 40 and 41 by discs 44 and 45. Secured to upper and lower faces of horizontal mounting bars 40 and 41 by screws 50 are plates 51 and 52, between which a pair of massive cylindrical guide posts 53 and 54 are mounted by axial screws 55. The posts 53 and 54 are thus held in vertical parallel relation with their axes disposed in the aforesaid vertical transverse plane A—A. These posts are preferably made of cylindrical tool steel shafting with a net diameter of 2½ inches in a central portion 56 thereof (approximately 6 inches long), the diameter of said posts decreasing upwardly and downwardly from said area 56 to a diameter of 2.494 inches, for reasons to be made clear hereinafter. (See FIGS. 8 and 9).

Vertically slideable on each of the posts 53 and 54 is a pair of upper and lower square slide blocks 57 and 58 all of which are identical in construction and each of which includes a square body 59 having a turned down neck 60. Each block is provided with a bore 61 for receiving a bronze sleeve 62, opposite ends of bore 61 being counter bored to provide recesses for mounting resilient oil retaining seals 63 and 64 in opposite ends of the block. One side of each body 59 is partially sev-

ered by a deep kerf **67** and is provided with a pair of screws **68** by which the body **59** may be contracted to compress sleeve **66** so as to actually reduce the internal diameter of the latter to closely control the fit of said sleeve when it is slid over one of the guide posts **53** or **54** onto the central area **56** thereof. In practice, the screws **68** are tightened so as to produce a normal inside diameter in the bronze sleeve **66** of 2.4995 inches, which is to say, one-half one-thousandth of an inch smaller in diameter than the external diameter of the central 6 inch section **56** of the guide posts **53** and **54.** This means that a considerable amount of force is required to press each of the slide blocks **57** and **58** onto the central areas **56** of maximum diameter of the guide posts **53** and **54** as shown in FIG. **8** of the drawings.

The press **26** also includes a pair of platens **69** and **70,** each of which includes a flat plate **71** having holes **72** in its opposite ends which are formed of the proper size and center spacing to snugly receive the necks **60** of slide blocks **57** and **58,** these side blocks then being held in assembled relation with the plates **71** of the respective platens **69** and **70** by corner screws **73.** The platens **69** and **70** include coolant boxes **74** embodied with the respective plates **71** of said platens and extending respectively upwardly and downwardly therefrom, each of said boxes including a pair of end plates **75** which are located just inwardly from and close to holes **72** in plates **71** and are secured to said plates so as to extend short distances forward and rearward from the corners of plates **71** as shown in FIG. **7,** where end portions of end plates **75** are apertured to receive bolts **80.** End plates **75** are reinforced outwardly by triangular gusset plates **81** and are connected lengthwise along front and rear edges of plates **71** by coolant box walls **82.** Each coolant box **74** is completed by a cover plate **83** which is secured at its edges to end plates **75** and coolant box walls **82.** Each coolant box **74** has a central medial dividing wall **84.** At one end of each coolant box **74** the spaces on opposite sides of the medial wall **84** thereof are connected by a hose **85** while at the opposite end of said box the spaces on opposite sides of said medial wall are connected to separate hoses **86** and **87,** opposite ends of which connect to a water circulating manifold box **88** which is centrally divided into two chambers which individually connect with water circulating hoses **89** and **90** which lead to and from a cooling water source, not shown.

Mounted in upper and lower portions of side frames **37** and **38** are heavy ball bearings **95** and **96,** the axes of which are horizontal, parallel and lie in the vertical planes of the bolts **80** shown in FIG. **7.** Journalled in these bearings are upper and lower pairs of rocker shafts **97** and **98,** the major portions of these shafts being hexagonal in cross section and being turned down at their end portions to cylindrical cross section where they extend through said bearings. Certain end portions of said rocker shafts extend outwardly beyond side frame **38** where upper rocker shafts **97** receive short arms **99** and lower rocker shafts **98** receive bell cranks **100,** each of which includes a short arm **101** and a long arm **102.** The short arms **99** and **101** connect pivotally at their outer ends to the opposite ends of two parallel links **103.** The outer ends of bell crank long arms **102** are pivotally connected to opposite ends of a link **104.**

Journalling in heavy ball bearings **105** mounted at one end of the press **26** on side frames **37** and **38** is a drive crank shaft **106** carrying a crank arm **110** and the outer end of this crank and the outer end of the adjacent bell crank long arm **102** are pivotally connected to opposite ends of a pitman **111,** so that for each rotation of the drive crank shaft **106,** each of the rocker shafts **97** and **98** is rocked through an angle of 90°.

Mounted on the hexagonal middle portions of rocker shafts **97** and **98** are short arms **112** and **113** which are slidable lengthwise on said rocker shafts and are in the form of clamps which permits them to be set in an adjusted position lengthwise of said shafts. Pivotally connected at their ends to bolts **80** of upper platen **69** and to the ends of upper rocker arms **112** are longitudinally adjustable links **114.** In a like manner, opposite ends of four links **115** are pivotally connected to bolts **80** of lower platen **70** and to the ends of lower rocker arms **113.** The rocker arms **112** and **113** are so set on rocker shafts **97** and **98** that at one extreme in each cyclic revolution of drive crank shaft **106,** as shown in FIG. **3,** rocker arms **112** are extending directly downwardly from upper rocker shafts **97,** and lower rocker arms **113** are extending directly upwardly from lower rocker shafts **98.** At the opposite extreme in each cyclic revolution of drive crank shaft **106,** shown in FIG. **4,** short arms **112** and **113** extend exactly horizontally in the same direction from the respective rocker shafts **97** and **98** on which said short arms are mounted. As before noted, the position of the operating parts just discussed and shown in FIG. **3** results in upper and lower platens **69** and **70** being located at the point of their maximum proximity whereas the opposite point in each cyclic revolution of drive crank shaft **106,** shown in FIG. **4,** results in said platens being located at the point of their maximum separation.

It is to be noted that the links **114** and **115** above described are uniformly comprised of self-aligning bearings **116** at each of the opposite ends thereof, and a turnbuckle **117** connecting said bearings. Each of these turnbuckles preferably employs at each of its ends, threads pitched in the same direction but slightly differing as to the number of threads per inch so as to render each of these trunbuckles capable of making a very fine adjustment in the length of the link in which it is embodied. This is a vitally important feature of the present invention inasmuch as only with such a precise adjustment available in determining the exact length of these links would it be possible to set up the press **26** so as to obtain the high degree of precision and quality in the product of which it is capable.

Referring again to FIG. **1,** the press **26** is here shown as equipped with a support **125** for a roll **126** of sheet thermo-plastic material and a pair of feeder chains **127** for withdrawing a web **128** from said roll and feeding it through a heater unit **129** along a horizontal path extending practically midway between platens **69** and **70** and terminating at the opposite end of the press **26.**

The web feeder chains **127** are driven by an adjustable radius crank arm **130** on the opposite end of drive crank shaft **106** from the crank arm **110.** The tip of crank arm **130** is pivotally connected to one end of a pitman **131,** the opposite end of which pivotally connects to a large diameter sprocket **132** which is mounted on an idle shaft **133** mounted in suitable bearings on side frames **37** and **38.** Trained around the sprocket **132,** an idler sprocket **134** and a sprocket toothed unidirectional clutch **135** is an endless chain **140.** The clutch **135** turns freely in one direction on a

shaft **141** but when turned in the opposite direction by chain **140**, it rotates the shaft **141** to drive a shaft **142** through a chain **143** so as to drive web feeder chains **127** to carry web **128** an adjustable distance towards and through the press **26**. This distance is adjustably determined by manual rotation of a screw **144** on the adjustable radius crank arm **130**. This can be done while the press is running at all normal production speeds.

The press **26** is also equipped with a mechanism **145** for punching the product from said web after it has been formed and trimmed between platens **69** and **70** and during a cycle subsequent to that in which the product was molded. This mechanism includes a bell crank **146** rockably mounted on brackets **147** mounted on the side frames **37** and **38** and including an upwardly extending arm **148** which is connected pivotally and adjustably to a link **149** which connects to a short arm **150** which is clamped onto an adjacent one of the rocker shafts **97** so that with each production cycle of the press **26** the bell crank **146** is rocked so as to impart a vertical reciprocation from the bell crank **146** to a telescopic member **155** carrying a tool **156** designed for lightly engaging and punching from the web **128** one or more products **157** previously formed and trimmed in a preceding operation cycle of the press. Individual products **157** thus punched from said web gravitate downwardly as shown in FIG. **1** to form stacks **158** until such a stack contains a predetermined number of individual products whereupon a relay provided in a control panel **159** mounted on the upper end of side frame **37** energizes a conveyor **160** causing this to remove the stack **158** just formed beneath the product punch **145** so as to leave room on the conveyor to start another stack.

Just beyond the point at which the feeder chains **127** terminate, a scrap chopper **161** is mounted which automatically responds to the delivery thereto of scrap remaining in the web **128** as the latter is discharged from the press **26** to reduce this to small chips which can be readily carried away by an airblower **162** to a place of storage.

The drive crank shaft **106** is driven by a power plant **163** which is clearly illustrated in FIGS. **1–4** and **16**. Included in this are an electric motor **164** which is pivotally mounted at **165** so that a drive pulley **170** provided thereon extends into and is connected by a belt **171** of a variable speed transmission **172** to the input end of an electro-air controlled "posidyne" clutch/brake drive unit **173**. Unit **173** is the product of Force Control Industries, 3660 Dixie Highway, Hamilton, Ohio **45014**. The output shaft of this unit connects in turn to a reduction gear unit **174** which is mounted in a gap in drive crank shaft **106** and thus forms a connecting link in said shaft and directly drives the latter at a reduced speed of **1** to **15**. The variable speed transmission **172** preferably has the capacity to vary the speed ratio between the motor **164** and the clutch/brake unit **173** from **1-1** to **3-1**. Modification of the latter speed ratio is effected by a manual crank wheel **175** mounted on the outer end of a threaded control shaft **176** which effects said control by rocking the motor **164** about its pivot mount **165**.

The drive crank shaft **106** is equipped with a manual cycle control mechanism **177** which includes a triangular plate **178** having a bore **179** which receives drive crank shaft **106**, the plate **178** being mounted by screws **180** and spacer tubes **185** on the inner face of side frame **37**. Formed on plate **178** and extending inwardly therefrom and bordering the bore **179** is an annularly recessed sleeve **186** on which a flat control handle **187** is clamped so as to rotate on sleeve **186**, a lip on said control arm fitting the recess in sleeve **186** to retain said arm in assembled relationship with plate **178**.

Mounted on a lower portion of control arm **187** is a switch **188** having a spring biased roller **189** which is spring propelled into a position close to shaft **106** except when said roller is depressed by a cam **190** provided on said shaft for the express purpose of depressing said roller and then releasing said roller to actuate said switch immediately upon the cam passing out of contact with said roller.

Clutch/brake **173** is preferably operated through electric solonoid valves **191** and **192**, the first being for the brake and the other for the clutch. The switch **188** is connected electrically to the solonoids **191** and **192** whereby, as soon as the roller **189** rides off the cam **190** as the latter moves past said roller, the unit **173** is immediately actuated to disengage the clutch and set the brake thereof. Also connected electrically in the circuits of the solonoid valves **191** and **192** is a "series GP" plug-in automatic reset delay/interval (timer) model number GP-6S which is manufactured by Singer Industrial Timer Division, U.S. Highway 287, Parsippany, N.J. **070754**. This timer is located in control panel **159** and is designated therein by the letter T. The Singer timer is energized by the actuation of the switch **188** (which stops rotation of the drive crank shaft **106**) to start a timer motor embodied therein to advance a timer hand to alignment with the position of a manual setting hand from which it then returns automatically in short jumps at one-tenth second intervals, step-by-step, to the zero position, thereby consuming the time period of the delay for which the timer is manually set. At the conclusion of this time period, the timer closes the clutch/brake air valve circuit which starts another cyclic revolution of the drive crank shaft **106**.

Referring now to FIG. **3**, hoses **193** and **194** are there shown as leading upwardly from solonoid valves **191** and **192** and being connected through pressure regulators **195** and **196** to a hose **197** leading to an air compressor (not shown). By manipulation of the pressure regulators **195** and **196**, the pressure delivered through hoses **193** and **194** to the solonoid valves **191** and **192** can be varied thereby softening or hardening the force with which the clutch and brake of the unit **173** are shifted from open to set positions and visa versa.

The distance between opposed flat faces of upper and lower platens **69** and **70** when these are at the point of maximum proximity is preferably 5.125 inches. Matched tooling including various combinations of punches and dies, male and female molds and spring biased strippers and jig plates are assembled on and united with the flat plates **71** of the upper and lower platens, this tooling embracing upper and lower tooling elements which are spaced apart during most of each production cycle and then cooperate with each other to mold a product, or a group of products, from web **128** as the platens **69** and **70** approach the point of their maximum proximity. Of the wide variety of various types of tooling suitable for use in the press **26** of the invention, the tooling **200** shown in FIG. **11** has been associated with some of the finest results obtained in high quality production realized in the operation of

the press **26.** This tooling includes an upper element **201** which is mounted on upper platen **69** and this element includes a sub plate **202,** a punch **203,** a spring biased stripper **204,** and a female mold **205,** said sub plate, punch and female mold being rigidly secured together.

Tooling **200** also includes a lower element **206** which is mounted on lower platen **70** and includes a sub plate **207** and a die **208,** which are united with each other and with the lower platen, and a male mold **209** which is normally spring biased upwardly above the upper edge of the die **208** so as to come into molding relation with the female mold **205** and mold a product substantially in its final form between said two molds before die **208** advances upwardly relative to male mold **209** as shown in FIG. **11.** As shown in this view, means **210** are provided for circulating cold water through the internal passages formed in male mold **209** so as to enhance the capacity of this mold to cool the peripheral portion of a product being formed between the female mold **205** and the male mold **209.** The section illustrated in FIG. **11** was taken at a point where the lower end of punch **203** which is its cutting edge, has formed therein a series of narrow grooves **215** which permits at each of the places occupied by these grooves the escape of a small amount of material from the web upwardly in these grooves, at the time the trim step is accomplished, to form tabs **216.** These tabs continue to connect the web with a product **217** and serve to transport the product **217** with the web from the product molding and trimming station located between the platens **69** and **70,** to the product punching and stacking station which is located at the punch **145.**

FIG. **11** illustrates the relationship of the upper element **201** and the lower element **206** of the tooling **200** as these two tooling elements are precisely related at the instant rotation of drive crank shaft **106** is halted by the opening of the switch **188.** As before pointed out, the normal operation of the press **26** requires an adjustment of the control arm **187** so that when switch **188** closes, the reciprocative relative movement between the platens **69** and **70** instantly stops with said platens short of reaching the point of their maximum proximity. FIG. **11** illustrates the distance short of maximum proximity at which the press is halted with the upper tooling element **201** and the lower tooling element **206** yet to travel 0.005 inches in order to accomplish the trim step which will sever the product **217** from the web **128** at all points about the periphery of the product excepting where the tabs **216** are located.

One of the finest products tried out for production on the invention to date is made of expanded styrene coated on the upper surface with a clear film of pure styrene. The method of the invention exhibits tremendous merit in the production of this commodity and it is for this reason that FIG. **12** is shown to illustrate in enlarged detail what is taking place in the tooling **200** illustrated in FIG. **11** at the same instant as illustrated in the latter view, but with a section taken elsewhere than opposite one of the tab forming grooves **215.** FIG. **12** shows the molding of the rounded peripheral lip of the product with this being covered neatly by the shaping of a coating **218** of pure styrene with which the web was laminated prior to the web being fed between the tooling elements.

It is to be noted that a substantial portion of the rounded lower and outer edge portions of the upper surface and lower surface of the periphery of product **217** shown in FIG. **12** is not dependent on its being molded but is produced by the material being stretched between tangential points of contact with the upper and lower molds and the pinching action of the cutting edges of the die and punch. The coincidental interruption of the operation of the press for a short interval to permit relative cooling of the material as thus shaped has the effect, when the trim step occurs, of preserving the form thus imparted to the edge portion of the product.

At the conclusion of the dwell time period which can vary between one-fifth of a second and 6 seconds, the next cycle commences with the consummation of the interrupted movement of the two platens toward their relative maximum proximity which causes the die **208** and the punch **203** to overlap as shown in FIG. **13.** While the action of the die and punch at the instant of their accomplishing the trim step is hidden from view, ample evidence obtained from studying the product indicates that the trim step does not function as a true shearing action but rather by a cracking of the web along the edge of the die as this starts to overlap the corresponding cutting edge of the punch. The wide separation of the edge of the product from the edge of the scrap shown in FIG. **13,** of course, cannot take place at the points where the scrap and the product are still held integrally joined by tabs **216.** The retention of the smoothly rounded surfaces produced on the peripheral portions of the product **217** at the conclusion of the trim step is clearly shown in FIG. **13.**

In a similar manner plates, saucers and dishes of various kinds made by the press **26** by the method of this invention without the web being coated as shown in FIGS. **12** and **13,** present a remarkably smooth rounded edge throughout the periphery of the product excepting where the tabs **216** appear and which are too small to be objectionable.

FIG. **14** illustrates a modified form of tooling **220,** the upper element of which includes a die **221** and the lower element a punch **222** which itself forms a female mold that cooperates with a male mold **223** embodied with the die **221.**

FIG. **15** illustrates another modified form of tooling **225** in which the upper tooling element carried by the upper platen embraces a punch **230** and has a male mole **231** associated therewith, while the lower tooling element embraces a die **232** which embodies in itself a female mold cavity which cooperates with the mold **231** in the formation of the product.

One of the significant differences between the modified forms of tooling **220** and **225** over the tooling **200** shown in FIG. **11** is that a further compression of the product takes place incidental to the performance of the trim step because of the fact that the latter requires a relative movement between the two tooling elements which form the product in order to bring the cutting edges of the die and punch into shearing relation with the web. The forms of tooling **220** and **225** therefore are suitable in more rapid production where a relatively short cooling period between cycles is both practical and desirable.

I claim:

1. An automatic press for employing matched molding-trimming tooling in thermo-forming thermo-plastic material, said press comprising:

a pair of platens mounted in parallel spaced relation and constituting mounts for a pair of matched tooling elements;

means for automatically transmitting a series of consecutively cyclic reciprocative relative movements to said platens, between the points of maximum separation and maximum proximity of said platens;

automatic means for halting each reciprocating movement just short of the point of maximum proximity of said platens being reached,

automatic means for resuming said reciprocating after a delay to produce a cooling time period dwell while a product unit is being molded in said press,

thereby facilitating a trim step, when said movement resumes, in which the spacing between said platens is further decreased to the point of maximum proximity,

said reciprocation when resumed continuing without interruption into the next reciprocation, where it halts at the cooling time period dwell thereof in the same manner as said first mentioned reciprocation; and

means manually operable while said press is running to adjust said automatic platen movement halting means to precisely and selectively determine at what distance apart said platens will be halted by said means.

2. A press as recited in claim **1,** in which said dwell length modifying means is operable manually while said press is running, to precisely increase or decrease the time period of said dwell.

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