Oct. 24, 1967 H. A. HOLBERSON 3,348,406

MOTORIZED PRESS RAM ADJUSTING MEANS

Filed Nov. 12, 1963 3 Sheets-Sheet 1

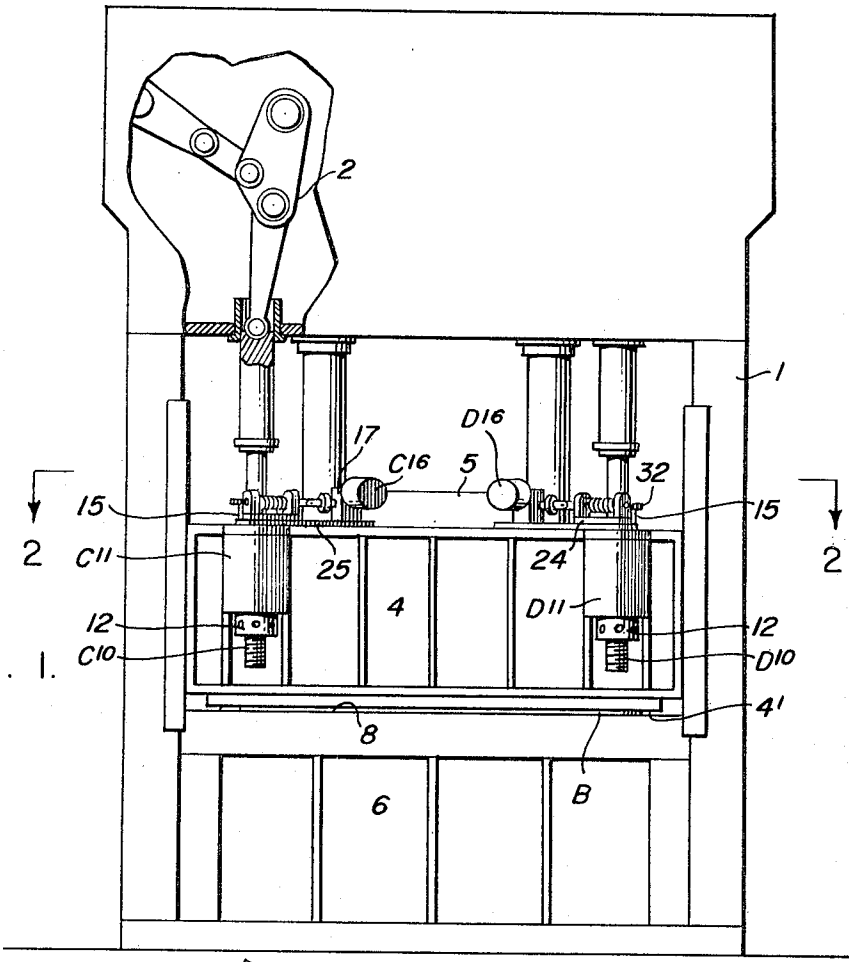

FIG. 1.

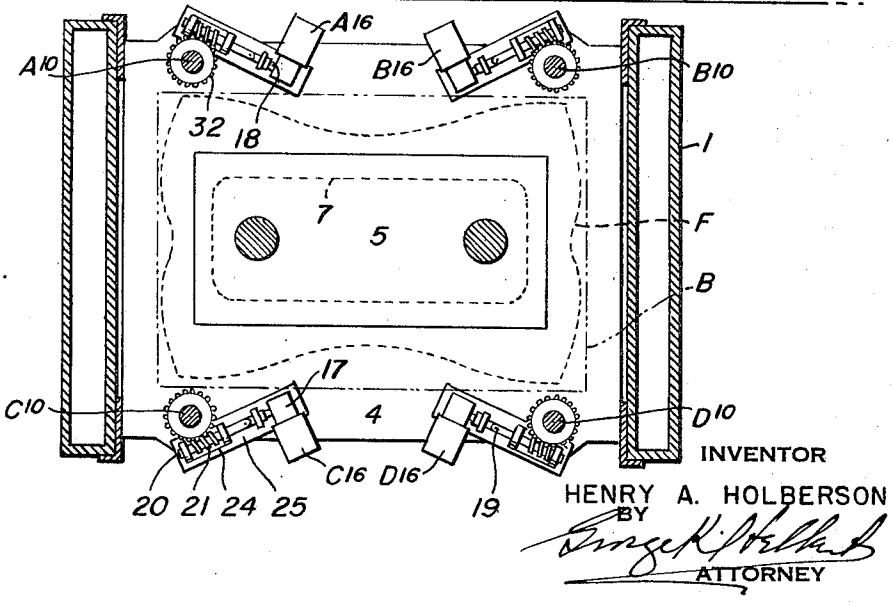

FIG. 2.

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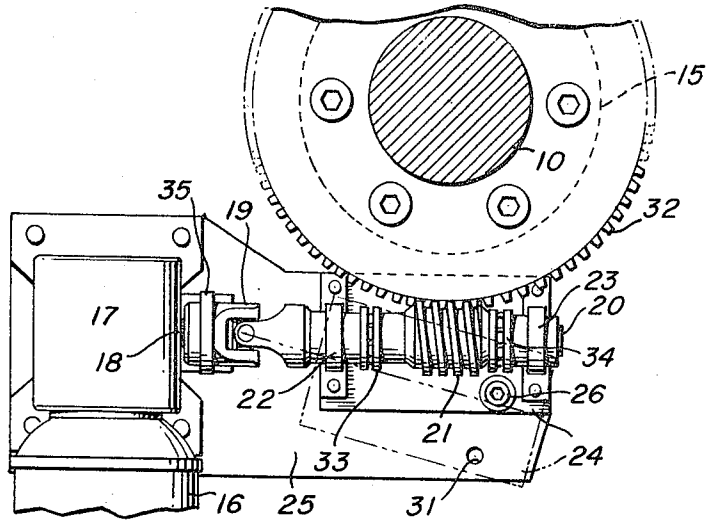

FIG. 3.

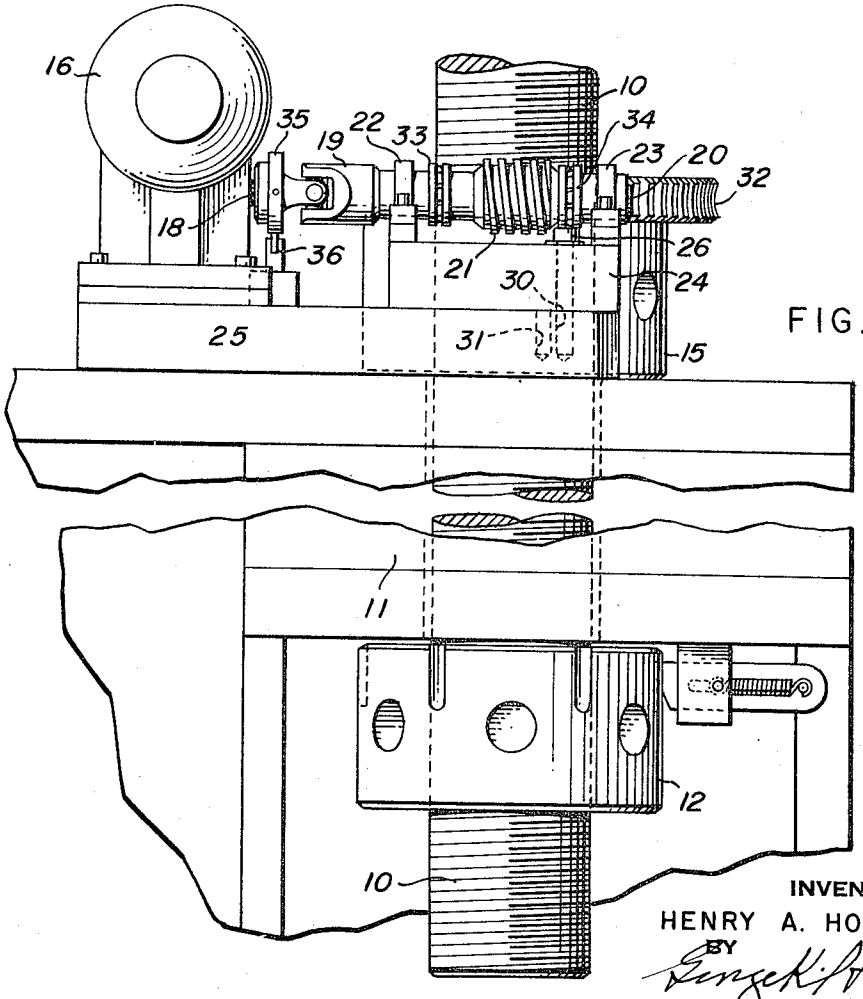

FIG. 4.

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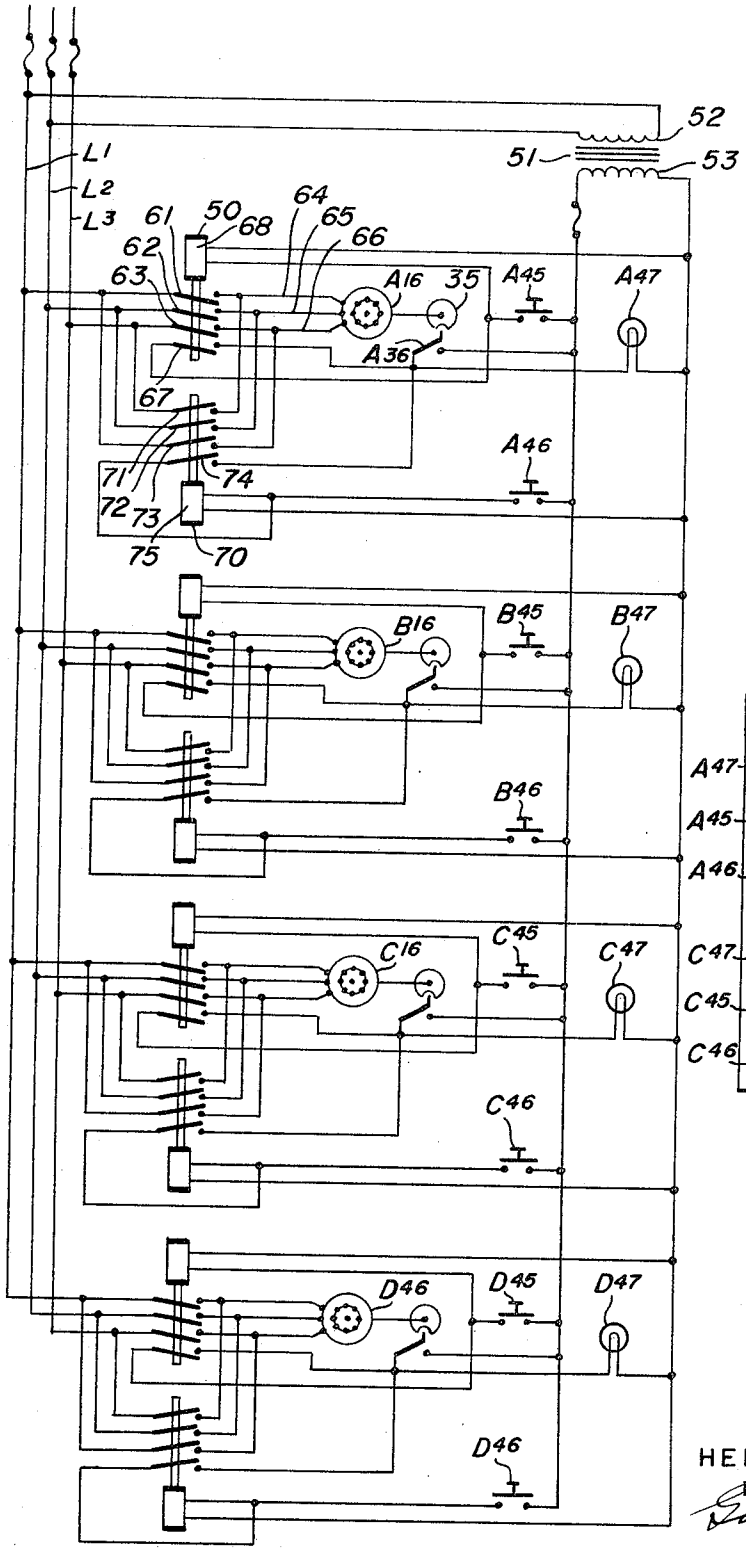
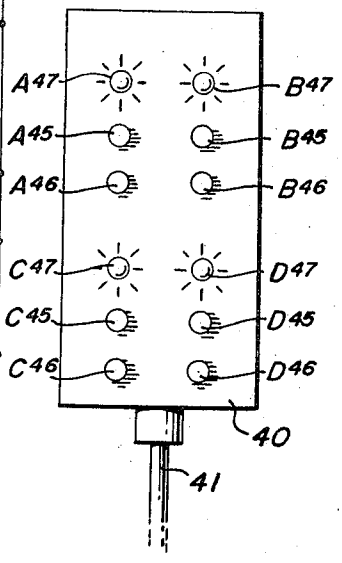


FIG. 5.

FIG. 6.



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MOTORIZED PRESS RAM ADJUSTING MEANS

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This invention relates to the art of forming shapes by drawing or pressing sheet material such as sheet steel in the manufacture of receptacles of various kinds and is more specifically directed to improvements in a drawing press such as those now employed in making bathtubs, sinks, fuel tanks and the like.

In drawing or pressing sheets in the manufacture of articles of this character presses capable of delivering great thrust are utilized and when the article is to have a cavity or depression of considerable depth in relation to the thickness of the sheet or blank from which it is to be formed it is essential certain edge portions of the blank be restrained in a controlled manner in their movement relative to the draw die while the cavity is being formed, as if the blank edges can move too readily toward the die cavity wrinkles may form in the product while if they are too firmly restrained operation of the press may overdraw the blank or even fracture it.

It is therefore of extreme importance the pressure of the blank holding means, hereinafter called the outer ram, against the blank near its edges cooperating with the draw die to frictionally restrain it be susceptible of delicate control and variable in increments of a few thousandths of an inch or less to compensate for differences in blank thickness, its surface hardness, the lubricant used to minimize die friction and wear, the condition of the die and other factors.

It has been the practice in the operation of presses of the character mentioned to make adjustments of the outer ram manually and by trial and error methods in accordance with which the pressman on observing that an adjustment of the ram is needed for best results signals his wishes to an operative, or in some instances more than one, and a manual repositioning of the appropriate pressure applying collar threaded on a reciprocable plunger is then effected to modify the axial relation of the ram to the plunger and hence locally adjust the "down" position of the ram relatively to the subjacent draw die to control the pressure exerted by the ram when a sheet to be drawn is interposed between the ram and the die.

To maintain an economically high rate of production, the press, producing a drawn article with each stroke of its die, is normally operated at several strokes per minute and it is therefore evident substantial production may be lost if the operation of the press is frequently interrupted to afford opportunity for manual adjustment; on the other hand if the press is operated for a considerable period while in need of adjustment many sub-standard and unacceptable articles may be produced with resultant consignment of excessive amounts of metal to scrap.

It is therefore a principal object of the present invention to provide in combination with a draw press comprising a reciprocable die member and an outer ram surrounding it cooperable with a complementary female die to form from a flat sheet or blank an article suitable for further processing to produce a receptacle or the like mean operable from a station apart from the press for incrementally modifying the relation between the ram and its actuating mechanism, whereby the pressure exerted locally by the ram against the blank while disposed on said complementary die can be suitably controlled to frictionally resist to a desired degree transverse movement of correspondingly localized portions of the blank relatively to the ram and die during the forming operation.

Another object is to provide mechanical means for independently actuating threaded collars carried by the plungers of a press of the character aforesaid and utilized for applying downward pressure to the blank holding ram of the press whereby slippage of the blank, and particularly the corners of a rectangular one, during the forming operation may be appropriately controlled.

A still further object is to provide a micrometer-like adjustment for the pressure applying means associated with an outer ram in a draw press which is self-locking save during positive actuation and which can be disengaged when major adjustment is required as when the dies are changed or a large difference in the thickness or gage of successive sheets is to be accommodated.

Yet another object is the provision of novel means for effecting adjustments of the character in question which lend themselves to ready installation in and association with existing draw presses comprising threaded adjusting plungers without necessitating material or relatively expensive alterations of the press itself.

Other objects, purposes and advantages of the invention will hereinafter more fully appear or will be understood from the following description of one embodiment of it in association and combination with a draw press of a well known type as more or less diagrammatically illustrated in the accompanying drawings in which:

FIG. 1 is a front elevation of the press, with a portion broken away to disclose internal construction, showing in general the relationship of prime movers and other mechanisms embodying the invention with respect to the overall structure of the press as a whole;

FIG. 2 is a horizontal section on line 2—2 in FIG. 1;

FIG. 3 is an enlarged fragmentary detail of FIG. 2 showing one of the four substantially identical ram adjusting elements and associated mechanisms included therein;

FIG. 4 is a fragmentary front elevation of the structure illustrated in FIG. 3;

FIG. 5 is a diagrammatic representation of electrical circuits suitable for energizing the prime movers included in the apparatus and for controlling from a station removed from the press their operation in predetermined increments, and

FIG. 6 is a diagrammatic front view of a control panel such as may be employed at such station for activating the circuits shown in FIG. 5.

It may be stated primarily the principal operating elements and associated structures of the press as a whole may be of any specific character, forming no part of my invention, and the latter may be utilized in association with presses specifically different from that illustrated in the drawings while the electrical circuits represented in FIG. 5 are but typical of circuits which may be devised for attaining the desired results.

Moreover, while the controls and other mechanisms associated with but one of the four prime movers I employ will be hereinafter particularly described it is to be understood those for the others are identical therewith and the elements thereof consequently are assigned the same reference numerals, being distinguished from each other where appropriate by prefix letters A, B, C, D designating the several units respectively associated with the corners of the outer ram.

Thus referring more particularly to the drawings the press in general comprises a main frame 1 the upper part of which affords an enclosure for the die and ram operating mechanisms constituting no part of the invention; in the drawings these are exemplified by toggle train 2 as one of those arranged to actuate plungers respectively interconnected with the corners of the outer ram 4 the lower face 4' of which is presented by a part which may

be integral with the superjacent body of the ram or separable therefrom as preferred. The inner or male die **5** is reciprocated by other mechanism (not shown) likewise carried by the main frame and constituting no part of the invention while the draw die **6**, into which inner die **5** projects a blank B for forming a drawn article, is removably positioned in the lower part of the press frame with its cavity **7** in registry with die **5**. It presents an upper flat surface **8** on which a blank is disposed when inner dle **5** projects a blank B for forming a drawn article, is cooperates to restrain the blank edges while the center portion of the blank is being forced into die cavity **7** which this surface surrounds. Outer ram **4** is supported from plungers A^{10}, B^{10}, C^{10}, D^{10} respectively actuated by a gear toggle train such as train **2** associated with each in turn actuated from a prime mover (not shown).

The several plungers **10** are threaded for a considerable distance from their lower ends and project through sleeves A^{11}–D^{11} at the corners of the outer ram, a lower threaded collar **12** on each plunger affording support to the ram from the plunger when the latter is retracted; an upper threaded collar **15** transmits downward pressure to the outer ram from the plunger while a blank is being formed. As thus far described the press as a whole is typical of those of the prior art with which mechanism embodying the invention may be associated and combined and this mechanism in such association and combination will now be described with greater particularity; as the mechanical elements employed for adjusting the relation between collar **15** and sleeve **11** at each corner of the outer ram are identical at the several corners a description of one of them, illustrated in detail in FIGS. 3 and 4, will suffice for all.

Adjacent the corners of the ram prime movers A^{16}, B^{16}, C^{16}, D^{16}, preferably reversible electric motors, are energized and controlled through suitable circuits (FIG. 5). Each is connected with a speed reducer **17** of any appropriate type having on its output shaft **18** a universal joint **19** the latter being connected in turn with a shaft **20** carrying a worm gear **21**. This shaft is journaled in bearings **22**, **23** mounted on a block **24** which rests on a plate **25** seated on the outer ram and movably secured thereto for adjustment about the vertical axis of the universal joint conveniently by a cap screw **26** which can be entered into either of two threaded holes **30**, **31** in the plate to hold the block in position to maintain worm gear **21** in mesh with an annular worm gear **32** on adjacent collar **15** or retracted to the broken line position indicated in FIG. 3 to clear the worm from the gear and permit manual actuation of collar **15**.

When the plate is in normal position with cap screw **26** entered in hole **30** and worm gear **21** therefore meshing with worm gear **32** operaiton of the motor rotates collar **15** and thereby adjusts its position axially of the ram plunger, antifriction thrust bearings **33**, **34** restraining the worm gear shaft against axial movement, while a cam **35** on universal joint **19** and rotatable with it is disposed to operate a limit switch **36** the functions of which will later appear. It may here be noted, however, that this switch as shown in FIG. 5 is connected in the motor control circuits in such manner as to interrupt the energizing circuit to the adjacent motor at the completion of one revolution of the worm gear following energization of the motor. Hence, the gear is actuated in increments and is most advantageously proportioned in relation to the pitch of the cooperative threads on plunger **10** and collar **15** in such manner that one revolution of worm gear **21** moves collar **15** axially along the plunger but a few thousandths of an inch, preferably about .003". As will hereinafter more fully be explained in connection with the electrical circuits diagrammed in FIG. 5, the motors are energized independently from push buttons, arranged together in a movable panel or console **40** having a multiple-conductor flexible cable **41** conecting it with the instrumentalities it controls. Diagrammatically shown in FIG. 6 this panel is desirably disposed at a convenient station near the front or exit side of the press where a pressman operating it readily can observe results produced by the press. Thus for each motor the panel carries an "up" push button A^{45}–D^{45} adapted to energize the corresponding motor in the direction to return the collar along the plunger in an upward direction, a "down" push button A^{46}–D^{46} for lowernig it and a signal light A^{47}–D^{47} connected to indicate that the respective circuits are in operation.

Ordinarily after the relation of the outer ram and its four plungers has been adjusted to afford approximately the desired pressure on a blank of a given thickness when the ram is lowered, lower collars **12** are backed off to provide a slight clearance of, say, about ⅛" from the lower end of adjacent ram sleeve **11** which of course is taken up when the plungers are raised to lift the ram above the die to permit removal of a formed article and introduction of a succeeding blank to the press. As the worm gear drive or collar **15** is self-locking the setting up of the lower collar against the sleeve to lock the upper one is obviated while with the lower collar may be asociated a spring actuated latch to prevent its appreciable turning.

The electrical controls for the several motors as diagrammed in FIG. 5 include main leads L^1, L^2, L^3 providing a 3-phase 220-volt power source to which motors A^{16}–D^{16} are connected through the contacts of four pole relays A^{50}–D^{50} while a 100 v.-a. transformer **51** has its primary winding **52** connected across leads L^1 and L^2 to deliver a 100 v.-a. current from its secondary winding **53** as a power source for the said relays and the signal lights A^{47}–D^{47}.

As the connections more closely related to the respective motors are identical the following description is to be considered as representative of all of them, those individually identified in FIG. 5 with the control elements applicable to operation of motor A^{16} being duplicated in the circuits to the other motors.

More specifically relay **50** has three normally open contacts **61**, **62**, **63** for connecting the motor leads **64**, **65**, **66** with line leads L^1, L^2, L^3 to drive the motor in one direction, for example "up" to raise collar **15**, and a fourth normally open contact **67** adapted when closed to complete a circuit through the secondary winding of transformer **51**, relay solenoid **68** and limit switch A^{36} which after one revolution of the worm opens and breaks this circuit; "up" push button A^{45} parallels this limit switch to initiate operation of the motor while signal light A^{47} is connected in parallel with the solenoid and so is lighted concurrently with energization of the latter to give visible indication the adjusting means are functioning.

A "down" relay **70** has similar connections with light A^{47} but its motor energizing contacts **71**, **72**, **73** are connected in motor leads **64**, **65**, **66** to reverse the polarity of the motor and drive it in the opposite direction and hence to turn collar **15** downward on its plunger when these contacts are closed. Limit switch A^{36} when the fourth contact **74** of this relay is closed is placed in circuit with the relay solenoid **75** and light A^{47} as well, so the light when on indicates the motor circuit is energized regardless of the direction in which the motor is being driven, the terms "up" and "down" being used herein as relating respectively to operations for decreasing and increasing the pressure of the adjacent corner of the ram on the blank at the succeeding down stroke of the former.

Preferably all four pairs of push buttons are located with their associated signal lights on panel **40** (FIG. 6), flexible cable **41** carrying the several conductors essential to the motor circuits and the pressman can therefore readily control the adjustment of all four collars selectively and, if desired, concurrently. Thus if he determines collar A^{15} should be raised and collar B^{15} lowered he has but to actuate push buttons A^{45}, B^{46} and the corresponding motors are energized to cause the collars to be turned

in the appropriate directions for one turn each of the respective worms 21. If a single increment of adjustment is insufficient he may again actuate the appropriate button as soon as the light associated with it is extinguished and can repeat this operation as often as necessary or he may hold the button depressed for as many revolutions of the worm as he wishes. Furthermore, if it is found an excessive travel in one direction has been accomplished it may readily be compensated by pushing the button reversing the direction of adjustment to retract the collar or collars a suitable number of turns.

Diagrammatically indicated in dotted lines at 7 in FIG. 2 is the shape, corresponding to the convexity of the inner or male die, of the cavity in a bathtub produced on the press and bounded by an adherent "flash," likewise shown in dotted lines F, comprising the peripheral portion of the original rectangular blank B from which the tub was drawn and demonstrating the deformation of the edges of the blank resulting from the drawing operation. This flash is normally trimmed off to produce a desired peripheral shape such as one for the flange of the bathtub before the drawn article is subjected to further processing to condition it for the market.

From the foregoing it will be apparent that with the aid of apparatus embodying my invention a pressman stationed at a point apart from the press but from which he can adequately observe the effects of its operation on the successive flat blanks as they are drawn to 3-dimensional shape can control with a high degree of precision the pressure exerted by the outer ram upon the blank to clamp it to the surface of the outer die and thus prevent excess as well as inadequate slippage of the blank relatively to the die during the forming operation and further that when occasion for variation of this pressure arises, as indicated to him by his general knowledge of and experience in the art, he can by appropriate actuation of the various push buttons make the necessary adjustments in small increments, controlling the pressure exerted on the blank at each corner of the outer ram independently of the others and may simultaneously adjust one corner in one direction and one or more of the others in the same or the opposite direction as deemed appropriate. I have herein suggested such increments may conveniently be of the order of .003" but it will be obvious that by modification of the worm and worm gears to change the speed ratios transmitted or of the limit switches to provide either more or less than a single revolution of the worm each time its actuating motor is energized larger or smaller increments may be produced.

Hence while I have herein described the invention with considerable particularity as embodied in the apparatus illustrated in the drawings it will be understood I do not desire or intend to be limited or confined thereto or thereby in any way and as changes and modifications in the form, structure, arrangement and relationship of the parts of the mechanical components as well as in the electrical circuits in instrumentalities included therein will readily occur to those skilled in the art and may be utilized if desired without departing from he spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. In a draw press comprising a vertically disposed frame, a die proximate the lower end thereof having a cavity and a flat surface about the perimeter thereof, a ram vertically reciprocal in the frame having an under face cooperative with said surface to clamp a blank thereon, an externally threaded plunger proximate each corner of the ram and a collar threaded thereon adapted to bear on the adjacent corner of the ram, that improvement which comprises a gear on each collar, an element cooperative therewith to rotate the collar and electrically actuated means for driving said element, a control station apart from the press, and electrical instrumentalities between said station and each said driving means selectively operable to actuate each of the latter independently to thereby move the collars in either direction axially of their respective plungers.

2. In a draw press comprising a vertically disposed frame, a die proximate the lower end thereof having a cavity and a flat surface about the perimeter thereof, a ram vertically reciprocal in the frame having an under face cooperative with said surface to clamp a blank thereon, an externally threaded plunger proximate each corner of the ram and a collar threaded thereon adapted to bear on the adjacent corner of the ram, that improvement which comprises means for individually rotating each collar relatively to the adjacent plunger including an electric motor, gearing interposed between it and the collar, a control panel removed from the press, electrical instrumentalities interconnecting the panel and the motors operable from the panel to selectively actuate the motors in either direction to move any collar axially in either direction and another collar simultaneously in opposite direction.

3. A draw press comprising a die having a cavity and a plane surface extending thereabout adapted to support a blank over the cavity, a male die substantially complementary to the cavity and reciprocal with respect thereto, a substantially rectangular outer ram surrounding the male die, overlying said surface and reciprocal with respect thereto, a sleeve carried by the ram adjacent each of its corners, a vertically movable threaded plunger extending through each sleeve and a pair of internally threaded collars on each plunger respectively above and below the sleeve, means for reciprocating the plungers, a worm gear on each of the upper collars, a worm engageable with each said gear, a reversible prime mover interconnected with each worm for driving it in either direction, and electrical means operable from a station removed from the press for selectively and independently energizing said prime movers to thereby modify the axial relation of the plungers and their respective upper collars to correspondingly vary the pressure exerted through said collars on the sleeves when the ram is resting on a blank disposed on said surface.

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