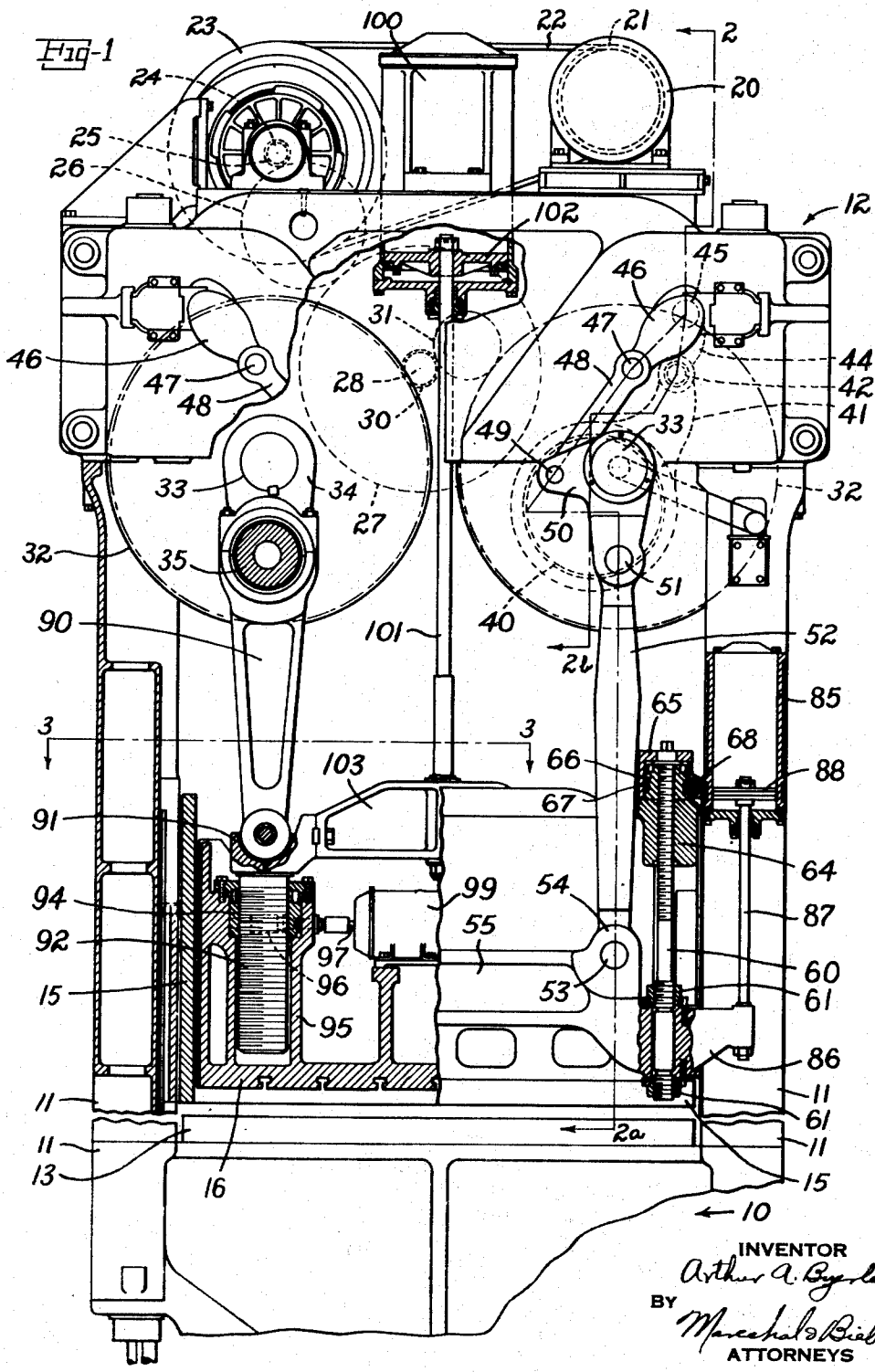
Sept. 19, 1950 A. A. BYERLEIN 2,522,747

PRESS

Filed Aug. 22, 1947 3 Sheets-Sheet 1

Fig-1



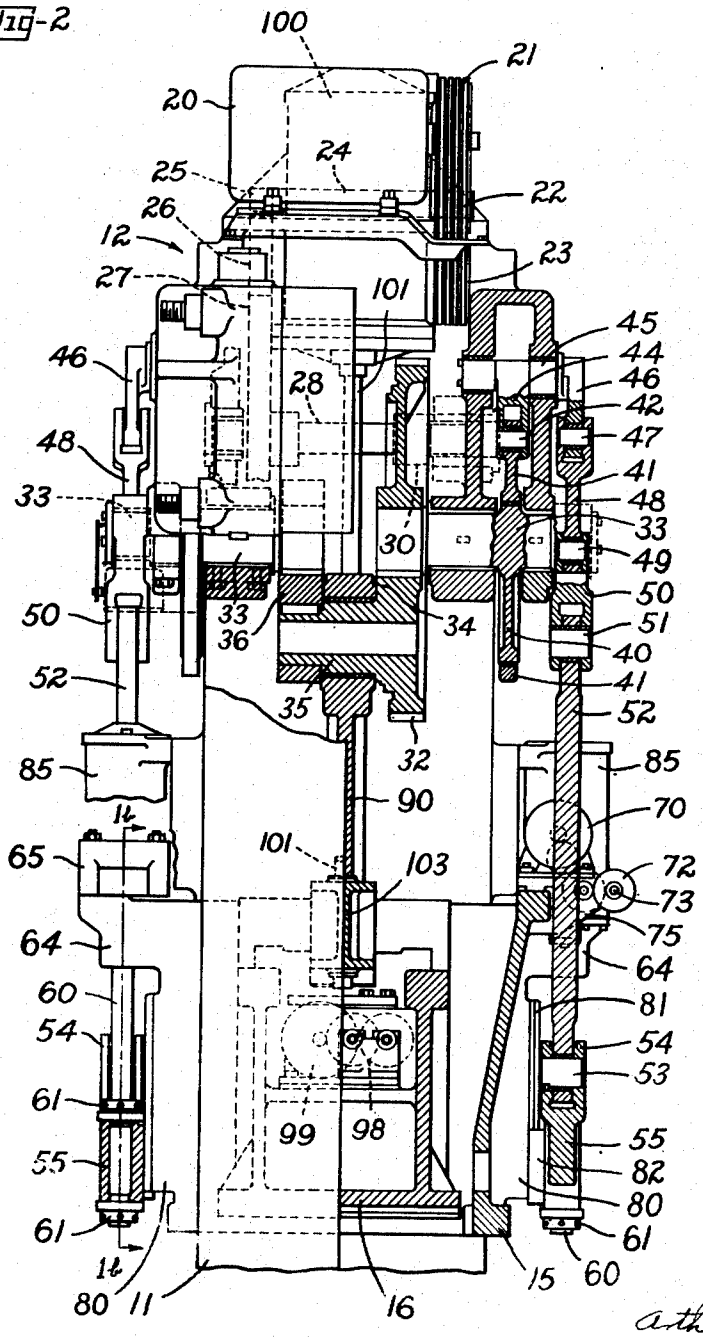
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Fig-2



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Fig-3

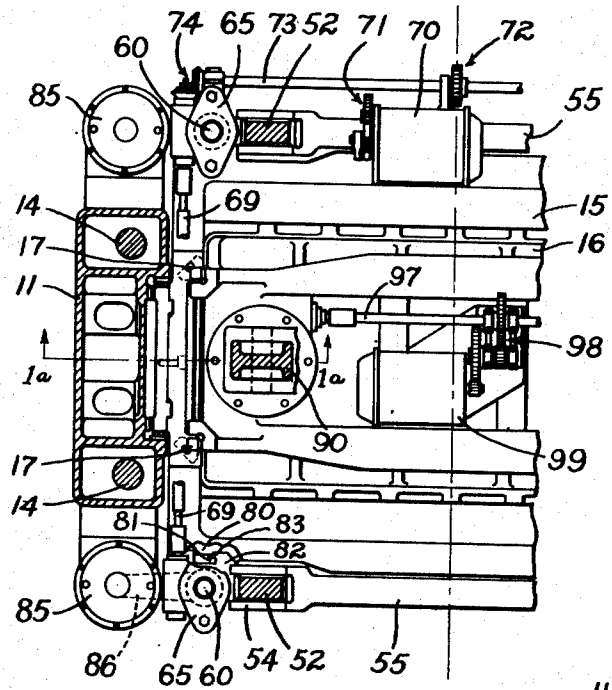
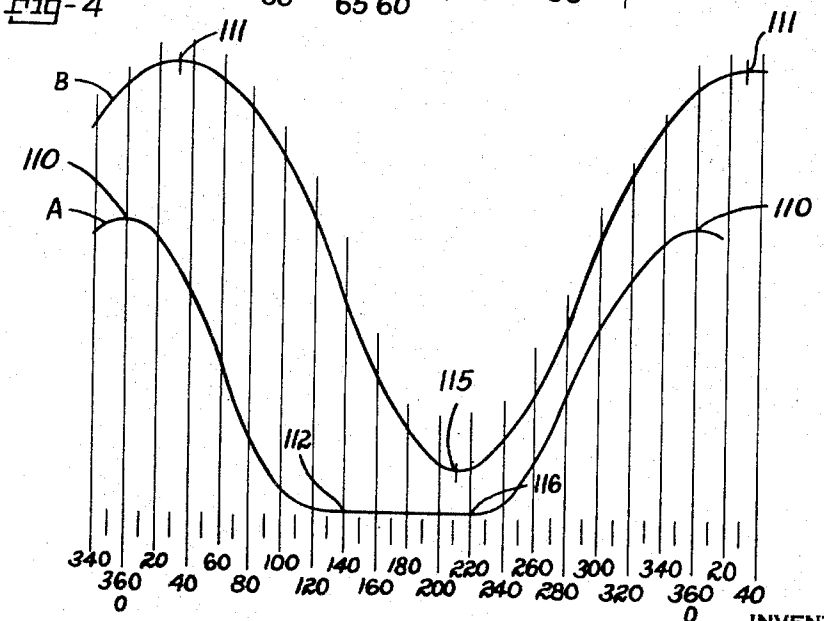


Fig-4



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UNITED STATES PATENT OFFICE

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PRESS

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Application August 22, 1947, Serial No. 770,003

5 Claims. (Cl. 113—38)

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This invention relates to presses, and more particularly to drawing, forming and stamping presses such as are used for forming metal sheets in the manufacture of automobile bodies and parts therefor, and the like.

One of the principal objects of the invention is to provide a multiple action drawing press constructed with the drive mechanism in the upper portion of the frame and having the blank holder mechanically connected with the drive mechanism in such manner that it will adjust itself automatically to variations in the thickness of the metal sheets being formed, to develop uniformity in the formed products notwithstanding such variations in sheet thickness.

Another object is to provide a multiple action drawing press having its drive mechanism mounted in the upper portion of the frame and wherein power is transmitted from the drive mechanism to the slide which serves as a blank holder by pulling down the lower ends of screws or tie rods having their upper ends connected to the blank holder, thus placing these screws in tension to pull the blank holder against the work and providing for automatic adjustment of the blank holder by elastic deformation of the tie rods in accordance with variations in thickness of the sheet material being formed.

It is also an object of the invention to provide such a multiple action drawing press wherein the blank holder is connected by tie rods to horizontal beams which are in turn so connected through toggle linkages to the drive mechanism in the upper portion of the press frame that when these linkages are straightened out parallel to the tie rods, the beams are forced downwardly and pull the tie rods uniformly downwardly to operate the blank holder during the downward stroke and dwell thereof.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings, in which like characters of reference designate like parts throughout:

Fig. 1 is a view in front elevation of a double action press constructed in accordance with the invention, part of the left-hand portion of the press being in section on the line 1*a*—1*a* of Fig. 3 and part of the right-hand portion of the press being in section on the line 1*b*—1*b* of Fig. 2;

Fig. 2 is a view in end elevation of the press shown in Fig. 1, with parts broken away to illustrate structural details and with the right-hand side and part of the center portions in section

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on the lines 2—2*a* and 2—2*b*, respectively, of Fig. 1;

Fig. 3 is a fragmentary view in horizontal section taken approximately on the line 3—3 of Fig. 1; and

Fig. 4 is a graph showing diagrammatically the relative sequential travel of the slides of the press shown in Figs. 1 to 3 during a complete cycle thereof.

Referring to the drawings, which illustrate the preferred embodiment of the present invention, the press bed is designated generally by the reference character 10. Spaced uprights or side frame portions 11 are mounted on the bed and connected by an upper or arch portion 12. These side and upper frame portions are rigidly secured together by means such as the tie rods 14 shown in Fig. 3, and they support and guide two slides for reciprocating movement with respect to the bed and the usual bolster plate 13 thereon. The outer slide or blank holder 15 is shown as hollow and open at both its upper and lower ends, and the inner slide or plunger 16 is mounted within the blank holder for movement with respect to the blank holder to and from the bed and bolster plate, suitable gibs or guides being provided between the two slides as indicated generally at 17 in Fig. 3.

In the operation of this press, the blank holder and plunger reciprocate in timed relation with respect to the bed and bolster plate. The blank holder carries out its downward stroke first, during which it descends to a predetermined position above the bed and then dwells to hold the work against the lower die or dies during the forming stroke of the plunger, which descends after the blank holder and performs its working stroke during the period of dwell of the blank holder. Thereafter the two slides return to their uppermost positions in preparation for the next working cycle, these operations being illustrated by the curves shown in Fig. 4 of the drawing, which illustrate the relative sequential movements of the two slides during a complete cycle of the press, the curve A representing the blank holder 15 and the curve B representing the plunger 16.

The main drive motor 20 for the press is shown as mounted on the upper portion 12 of the press frame, and its shaft carries a pulley 21 which is in driving connection through multiple belts 22 with a pulley 23 mounted on drive shaft 24. This shaft 24 carries a pinion 25 meshing with an intermediate gear 26 which in turn meshes with the large gear 27 on intermediate shaft 28. The shaft 28 carries a drive pinion 30 meshing with

an intermediate gear 31 which meshes with the large gear 32 on one of the crankshafts 33. As shown in Figs. 1 and 2, there are four of these crankshafts, positioned in coaxial pairs at opposite sides of the press, and the gear 32 is formed with a boss portion 34 forming a crank pin 35 which is connected through crank arm 36 with the other crankshaft 33 of the pair. The train of gears from shaft 28 to the other gear 32 and pairs of crankshafts 33 is similar but not shown.

Referring particularly to Fig. 2, each crankshaft 33 is journaled in the upper portion 12 of the frame and includes an eccentric wheel 40 carrying an eccentric strap 41 which is pivotally connected at 42 to the bifurcated end of a crank arm 44 integrally formed with or otherwise secured to a rock shaft 45. Each of these shafts 45 extends to the outside of the frame and is provided with an additional crank arm 46 in fixed angular relation with its crank arm 44 as shown in Fig. 1. Arm 46 is pivoted at 47 to one end of a link 48 having its other end in pivotal connection at 49 with one arm of a bell crank lever 50 mounted on the outer end of crankshaft 33. The other arm of lever 50 is pivoted at 51 to the upper end of an elongated link 52, which extends downwardly and is pivotally connected at 53 with an upstanding forked portion 54 of a beam 55 which extends across the press from side to side. It will be understood that this construction is duplicated at both the front and back of the press as shown in Figs. 1 and 2, with the eccentrics, links and levers combining to form toggle linkages effective upon rotation of crankshafts 33 to cause reciprocal movement of beams 55, and with these linkages being constructed and arranged to provide a dwell at the lower dead center position of the beams.

The beams 55 are connected with the blank holder 15 by means of four tie rods or adjusting screws 60. As shown, the beams lie approximately at the level of the lower end of the blank holder, and two tie rods 60 have their lower ends secured in each beam by means such as lock nuts 61, this arrangement providing for positioning the two tie rods 60 and two links 52 which are connected with each beam 55 all in substantially the same vertical plane as shown in Figs. 2 and 3. The upper end of each tie rod 60 is connected to the blank holder 15, and preferably by connection means providing for relative axial adjustment of the tie rods and blank holder to vary the depth of the stroke of the blank holder.

As shown in Figs. 1 and 2, the blank holder is formed adjacent each corner with an outwardly extending boss 64 to which is bolted or otherwise secured a cup-like housing 65 enclosing a nut 66 which is in threaded engagement with the upper end of the tie rod. This nut is formed on its outer surface with worm teeth 67 which mesh with a worm gear 68 on a shaft 69 driven as shown in Fig. 3 by a motor 70 through the gears indicated generally at 71 and 72, the shaft 73 which extends across the back of the press, and the bevel gears 74 on shafts 69 and 73, this motor being mounted on a bracket 75 on the back side of the blank holder as shown in Figs. 2 and 3. This construction provides for simultaneous axial adjustment of each of tie rods 60 relative to the blank holder to vary the relative vertical positions of the blank holder and beams 55, and it is similar in construction and operation to that illustrated in Patent No. 2,378,062, issued June 12, 1945, to A. A. Byerlein and assigned to the same assignee as this application.

Since the beams 55 and blank holder 15 are thus made relatively movable, the invention provides guide means for limiting this movement to a vertical plane and generally for maintaining proper alignment between the beams and blank holder. As shown in Figs. 2 and 3, the blank holder is formed below each boss 64 with an outwardly projecting vertical flange 80 formed on its outermost edge with an additional flange or tongue 81 extending at right angles thereto and in the direction of the width of the press, the tongues 81 at opposite sides of the press being turned to face each other. Each beam 55 is formed with a somewhat similar flange or boss 82 having a laterally projecting portion or tongue 83 turned in the opposite direction from the adjacent tongue 81 and thus adapted to overlap and cooperate therewith as shown in Fig. 3 to maintain both the vertical and lateral alignment between the beam and blank holder.

It will be seen that this arrangement of beams 55 and tie rods 60 relative to the drive mechanism and blank holder 15 provides for causing the blank holder to follow substantially the same operating cycle as the beams. When the press is operated, the various toggle linkages will be straightened out into the positions shown in Fig. 1, thus pushing downwardly on beams 55 until the latter reach their lower dead center positions shown in Fig. 1. During this downward movement of the beams, they will place the tie rods 60 in tension to pull the blank holder down towards the bed and to hold the blank holder during its dwell period. Beams 55 also provide convenient means for attachment to fluid pressure cylinders for counterbalancing the slide. As shown, such cylinders 85 may be mounted at opposite corners of the press on the sides 11 of the frame, and each beam 55 is shown as extended at its ends beyond the points of connection to tie rods 60 to form arms 86 to which are connected the piston rods 87 for the pistons 88 in these cylinders.

The drive mechanism for the inner slide or plunger 16 is seen most clearly in Figs. 1 and 2. Referring to Fig. 2, the pin 35 on each gear 32 receives the upper end of a connecting rod 90 having its lower end pivoted in the bifurcated upper end 91 of an adjusting screw 92. This screw is in threaded engagement with a nut 94 mounted in a housing 95 formed integrally in the plunger 16 as shown in Fig. 1, this construction being duplicated at opposite sides of the press. Each nut has worm teeth on its outer surface which mesh with a worm gear 96 driven through the shaft 97 and train of gears indicated generally at 98 by a motor supported within the plunger. This construction is generally similar to the adjustable connection between the upper ends of tie rods 60 and the blank holder, and it provides for axial adjustment of the adjusting screws in the same manner as described in the above Patent No. 2,378,062. A large fluid pressure cylinder 100 for counterbalancing the plunger is shown as mounted in the upper portion of the frame, and the rod 101 of its piston 102 is connected at its lower end with a beam 103 bolted or otherwise mounted across the upper portion of plunger 16 as shown in Fig. 1.

It will accordingly be seen that in the operation of the press and during the entire downward stroke and dwell of the blank holder, the downward force from the drive mechanism is trans-

mitted directly to the beams **55**, which in turn place the tie rods **60** in tension to pull down and hold down the blank holder. In addition, since the elongated links **52** of the toggle linkages are connected to the beams **55**, rather than to the blank holder itself as in the usual construction of such presses, the angular forces exerted on the toggles in operation are absorbed within the beams, thus limiting the forces on the tie rods to a direct pull in line with their length and under balanced tension, to pull the blank holder downwardly with minimum lateral thrust.

It should also be noted that since the tie rods **60** are in tension during the dwell period of the blank holder, the latter is able to adjust itself automatically to the thickness of the metal sheets being formed, even though this thickness may vary over a range of several thousandths of an inch for sheet of an average thickness of 0.040 inch, thus minimizing spoilage and providing for uniform results notwithstanding such variations in thickness. In presses of this type as heretofore constructed, and wherein the blank holder is operated mechanically through screws which are in compression during the dwell period, the operating mechanism for the blank holder commonly requires highly accurate adjustment in accordance with the thickness of the sheets to be drawn, and unless this adjustment is properly controlled to compensate for variations in sheet thickness as they occur, spoilage of the sheet may result. Thus if a sheet should be run which is as little as 0.005 inch over the thickness for which the blank holder is set, it may be torn during the forming stroke of the press as a result of too great pressure by the blank holder to permit proper drawing. Conversely, a sheet which is as little as 0.005 inch under the thickness to which the press is adjusted may be drawn in too easily and wrinkled as a result of insufficient pressure by the blank holder. Thus in the absence of constant attention to the adjustment of the blank holder of such a press relative to the sheet thickness, a substantial amount of spoilage may result.

In the operation of the present press as described and shown in Figs. 1 to 3, when the pressure on the sheet between the blank holder and the lower die or dies is greater than that for which the press is initially set, it will be compensated for by elastic stretching of the tie rods **60**. Furthermore, this adjustment will take place either individually or collectively, as the thickness of a particular sheet may require, and it will occur without the necessity for special manual or mechanical adjustment of the press. In fact, the blank holder can be initially set to provide proper pressure on a sheet of the minimum thickness expected, and in operation such variations as may occur in sheet thickness above this minimum will be compensated for by elastic deformation of tie rods **60** to provide proper pressure on all sheets and thus to avoid tearing or wrinkling and resulting spoilage.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A drawing press of the character described comprising, in combination, a frame including a bed, inner and outer slides mounted in said frame above said bed for vertical reciprocating movement relative to said bed, vertically arranged tie rods connected at their upper ends to one of said slides and extending downwardly therefrom, drive means for said one slide mounted in the upper portion of said frame, and means reciprocable in conjunction with said slide and located entirely above said bed forming an operative connection between the lower ends of said tie rods and said drive means effective to place said tie rods in vertical tension upon operation of said drive means in pulling said slide towards said bed.

2. A drawing press of the character described comprising, in combination, a frame including a bed, a slide mounted in said frame above said bed for vertical reciprocating movement relative to said bed and adapted to serve as a blank holder, a pair of beams positioned on opposite sides of said frame for vertical reciprocating movement relative to said frame and slide, a plurality of tie rods each connected adjacent its lower end to one of said beams and adjacent its upper end to said slide, drive means mounted in the upper portion of said frame, and means extending upwardly from said beams to said drive means and located entirely above said bed to form operative connections between said drive means and said beams constructed to cause vertical reciprocating movement of said beams with a dwell in their movements and to develop tension in said tie rods in pulling said slide towards said bed.

3. A drawing press of the character described comprising, in combination, a frame including a bed, inner and outer slides mounted in said frame above said bed for vertical reciprocating movement relative to said bed, drive means for said slides mounted in the upper portion of said frame and including vertically reciprocable links extending downwardly therefrom in laterally overlying relation with said outer slide to operate said slide with a dwell in its movements, and tie rods each connected adjacent its lower end to said links and adjacent its upper end to said outer slide in position to be placed in tension upon downward movement of said links in pulling said slide towards said bed.

4. A drawing press of the character described comprising, in combination, a frame including a bed, a slide mounted in said frame above said bed for vertical reciprocating movement relative to said bed, drive means for said slide mounted in the upper portion of said frame, a plurality of tie rods for operating said slide, means connecting the upper end of each of said tie rods to said slide, a pair of beams positioned at opposite sides of said outer slide for movement relative to said slide, means connecting each said beam to the lower ends of two of said tie rods, connecting means extending upwardly from said beams to said drive means for effecting vertical reciprocation of said beams to develop tension in said tie rods in pulling said slide toward said bed, and guide means carried by each said beam and said slide cooperating to limit relative movement of said beams and slide to directions parallel to the length of said tie rods.

5. A drawing press of the character described comprising, in combination, a frame including a bed, a slide mounted in said frame above said bed for vertical reciprocating movement relative to said bed, means extending outwardly from said slide to provide for attaching tie rods thereto, tie rods having their upper ends secured to said outwardly extending means and extending downwardly therefrom, beams positioned on op-

posite sides of said frame above said bed and each connected to the lower ends of a plurality of said tie rods, links pivotally connected to each of said beams and extending upwardly therefrom in substantially the same plane as those of said tie rods connected to said beam, and drive means mounted in the upper portion of said frame effective to cause vertical reciprocating movement of said links and corresponding vertical reciprocating movement of said beams to develop tension in said tie rods upon downward movement of said beams in pulling said slide towards said bed.

ARTHUR A. BYERLEIN.

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