Jan. 1, 1935. F. J. RODE 1,986,410

SHEET METAL PRESS

Filed Sept. 24, 1934 5 Sheets-Sheet 1

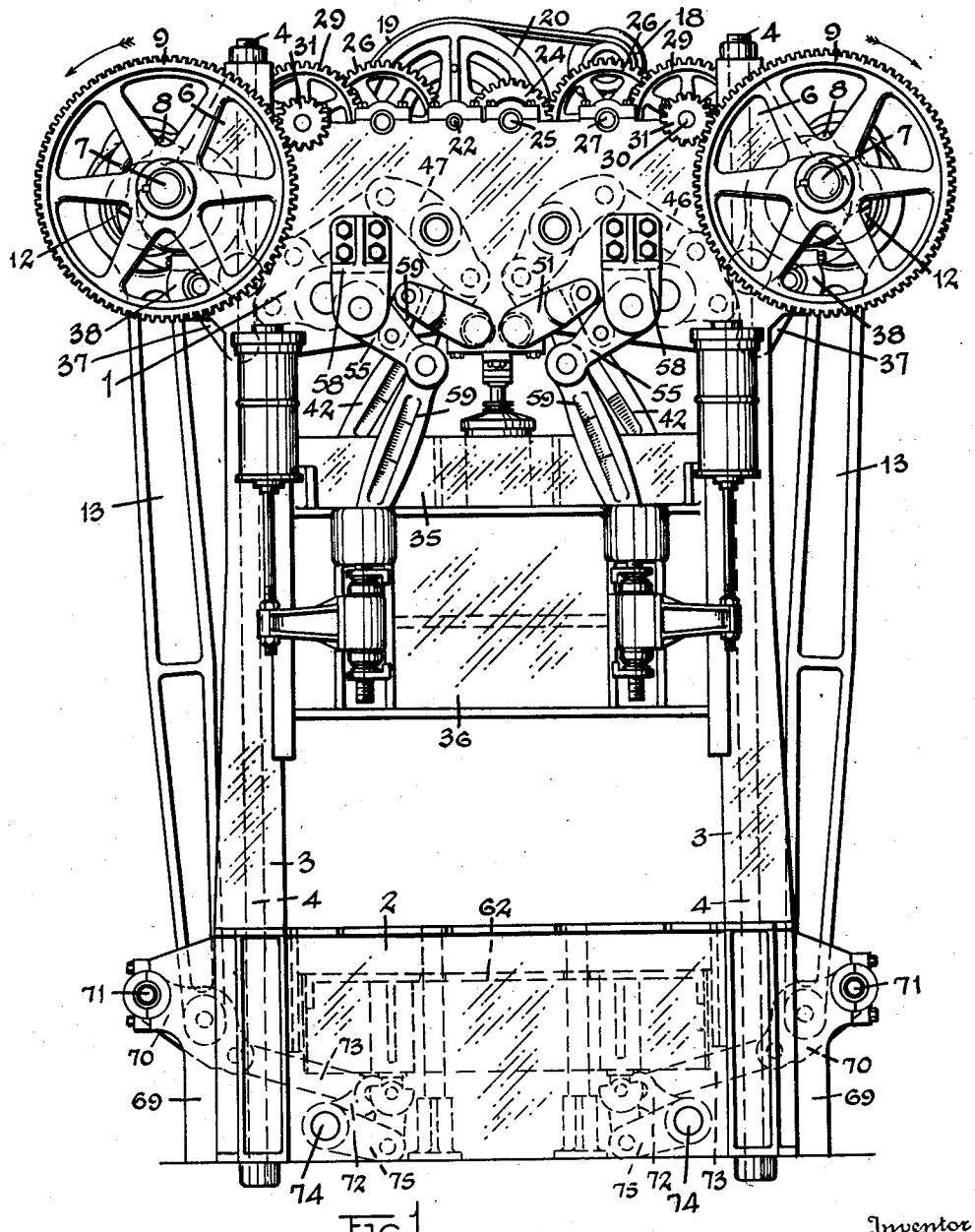


Fig 1

Inventor

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By Frank E. Cranston Attorney

Jan. 1, 1935. F. J. RODE 1,986,410

SHEET METAL PRESS

Filed Sept. 24, 1934 5 Sheets-Sheet 2

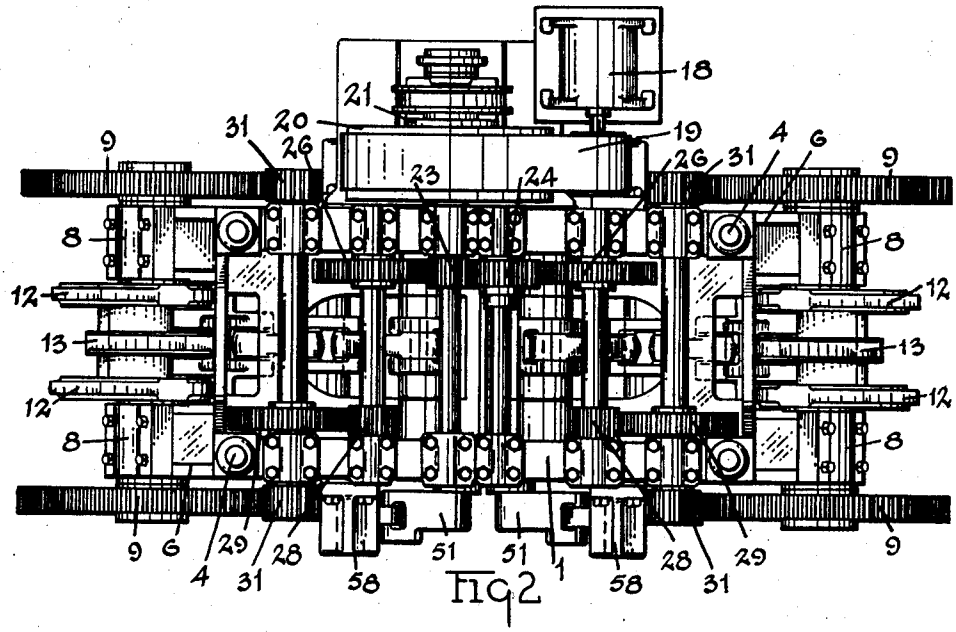


Fig 2

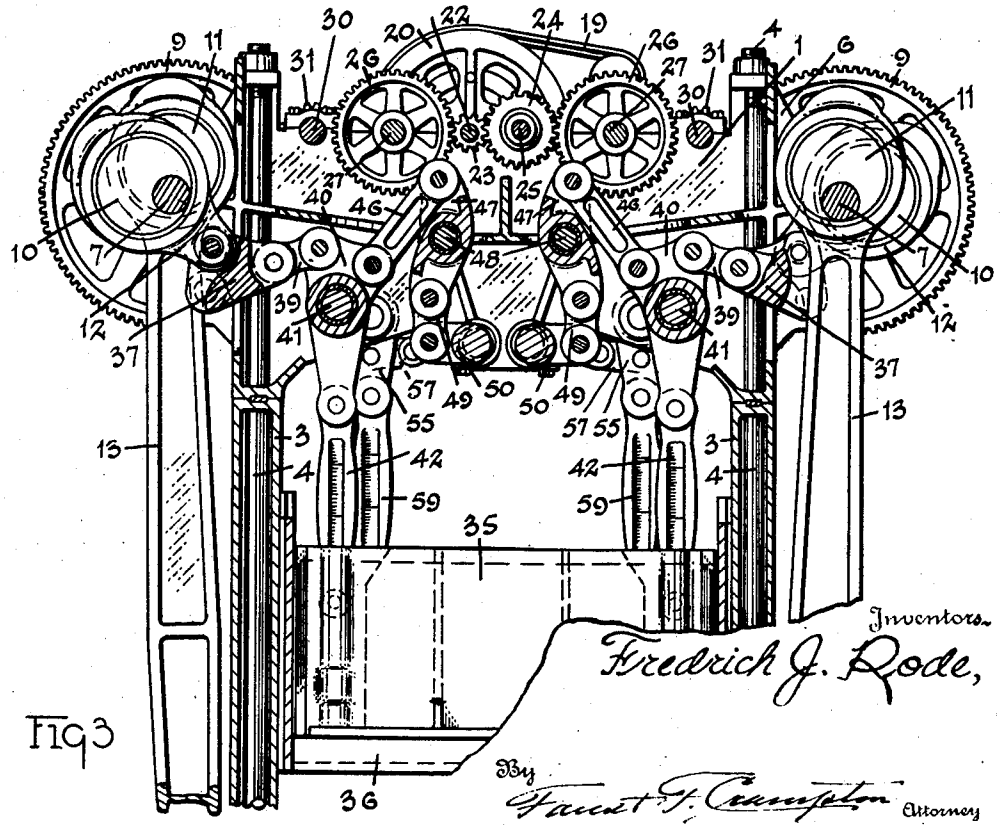


Fig 3

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Jan. 1, 1935. F. J. RODE 1,986,410

SHEET METAL PRESS

Filed Sept. 24, 1934 5 Sheets-Sheet 3

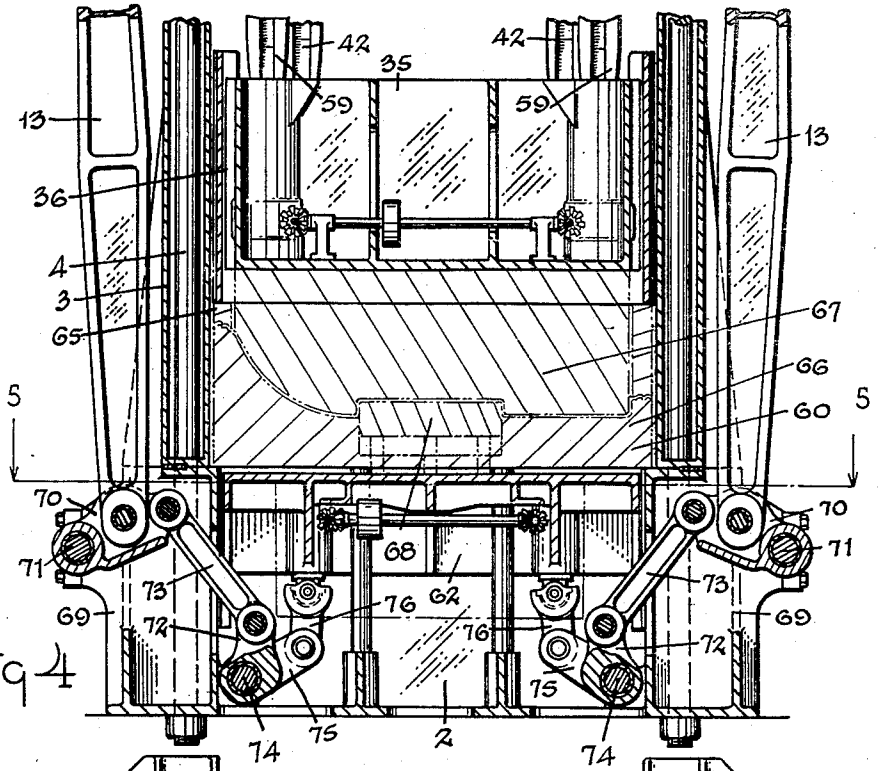


Fig 4

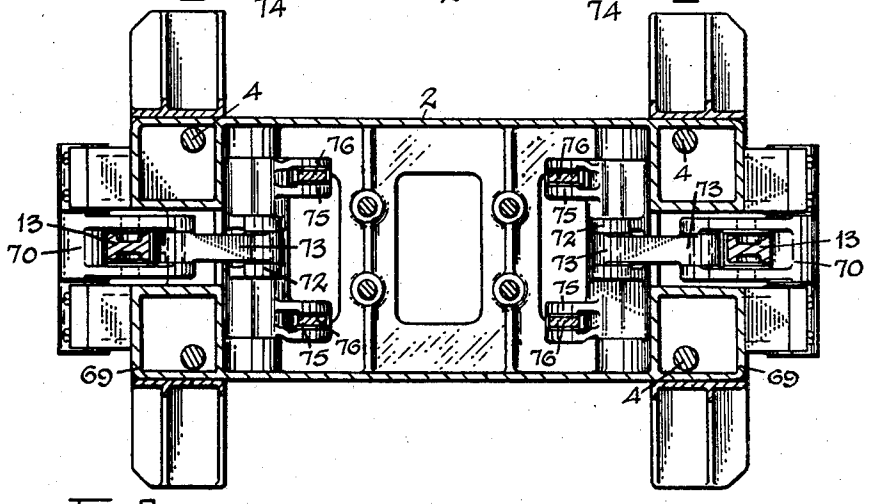


Fig 5

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Jan. 1, 1935. F. J. RODE 1,986,410

SHEET METAL PRESS

Filed Sept. 24, 1934 5 Sheets-Sheet 4

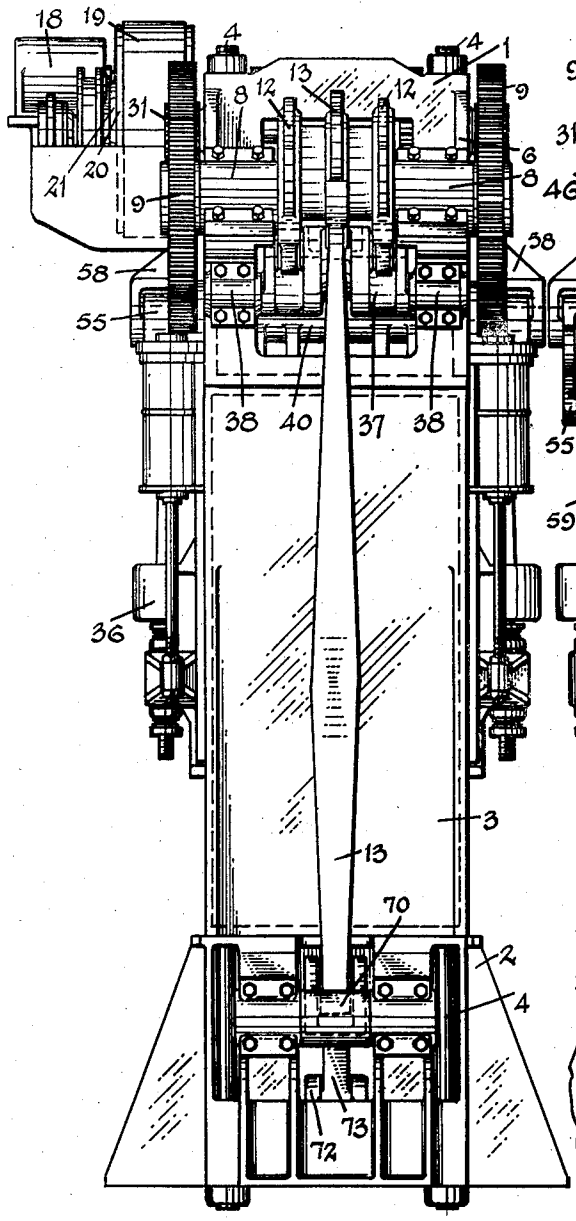


Fig 6

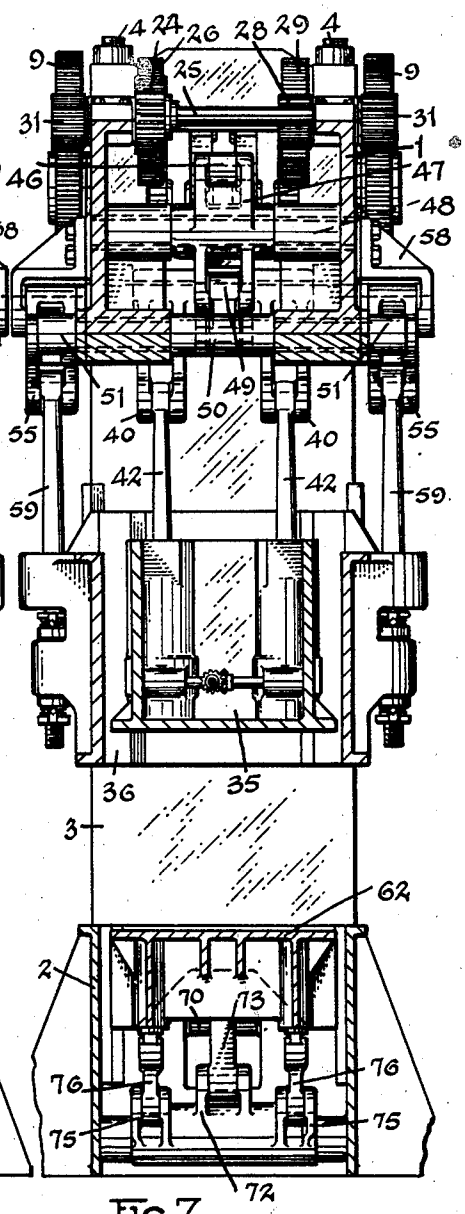


Fig 7

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Jan. 1, 1935. F. J. RODE 1,986,410

SHEET METAL PRESS

Filed Sept. 24, 1934 5 Sheets-Sheet 5

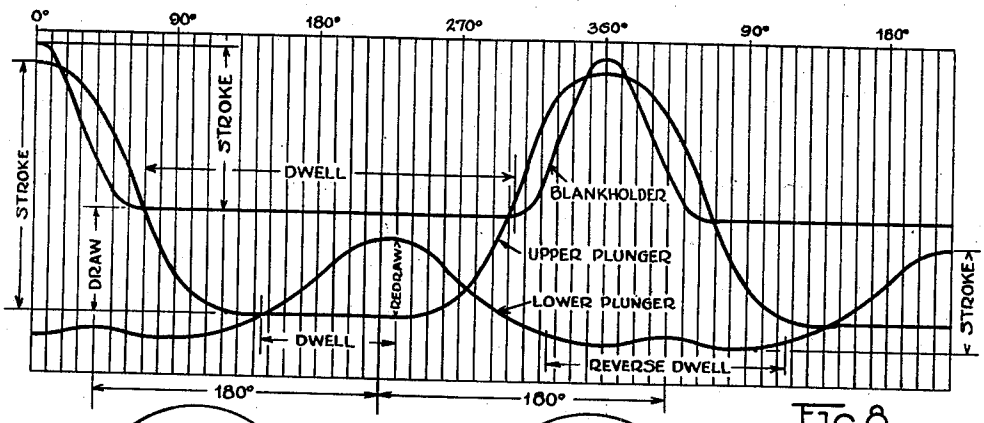


Fig 8

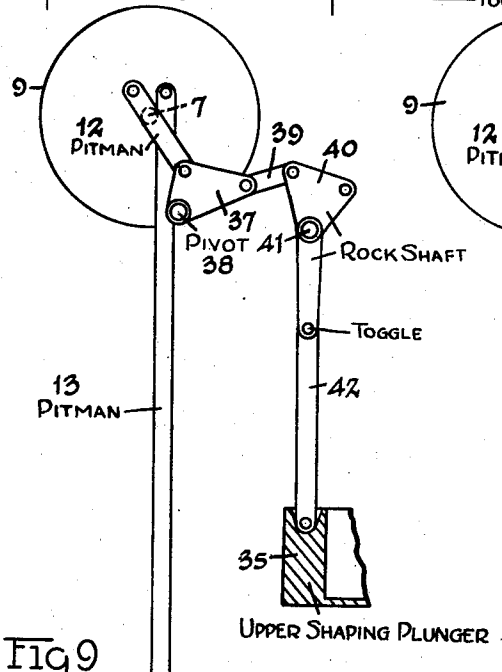


Fig 9

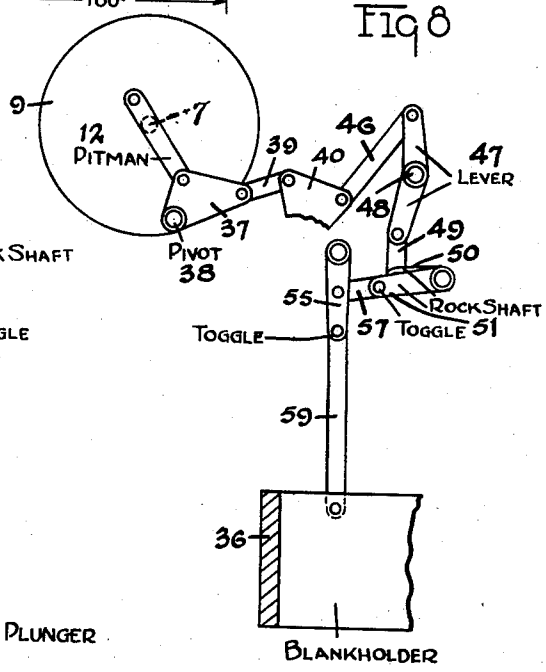


Fig 10

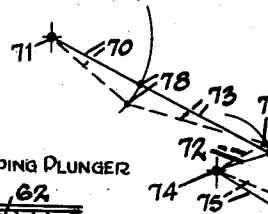
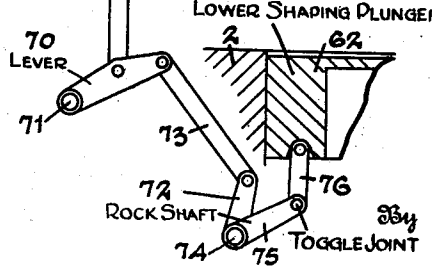


Fig 11



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Patented Jan. 1, 1935 1,986,410

UNITED STATES PATENT OFFICE

1,986,410

SHEET METAL PRESS

Fredrich J. Rode, Toledo, Ohio

Application September 24, 1934, Serial No. 745,204

36 Claims. (Cl. 113—38)

My invention relates to a sheet metal press wherein die carrying plungers or slides engage sheet metal to shape it into desired forms. The invention has for its object to locate the driving parts and the intermediate actuating parts in such a relation to each other as to produce power transmission to each plunger through common or closely positioned parallel planes, thereby greatly reducing the friction loss in the operation of the press. The invention eliminates transmission of the actuating forces through contacting plane surfaces, such as is produced by location of axes of interconnected shafts at right angles to each other or in inclined relation to each other or by the use of slides located intermediate machine driving members and the plungers or die slides. The invention when embodied in the preferred form eliminates all lateral friction, as distinct from pivot friction, except that existing between the plungers and the guideways. Thus, the invention provides means wherein the plunger actuating forces are transmitted from the driving shafts at a minimum friction loss though modified by the connections to produce sequential plunger engagement with the work and withdrawal from the work in the reverse order or as may be desired, according to the manner in which the work is to be manipulated.

Presses of the type with which this invention is concerned are large machines and necessitate transmission of a large power through a number of movable elements. The invention provides a structure wherein all the actuating elements pivot about axes; and in a more effective embodiment of the invention they pivot about axes located parallel to each other; and in a still more effective embodiment the axes extend in a direction across the shorter horizontal dimension of the machine, which enables the use of short torsional power transmission members, closely disposed bearings, and the location of shaft actuated and actuating elements in close proximity to the shaft bearings. This practically eliminates all shaft flexure and vibration. It also enables, in the main, closely aligned connections from the machine drive shaft to the four corners or parts of the plungers that are in pairs disposed diametrically opposite with respect to the vertical central axis of the machine. It also insures uniform sheet metal forming engagement and pressure throughout the area of each of the dies; moreover, it enables symmetrical arrangement of the parts of the machine and produces the same active and reactive forces in the four vertically extending quarters of the machine, which include all of the moving elements and parts of the frame of the machine.

Presses having plungers that perform their effective functions by movement in opposite directions toward the work, require a relatively large vertical dimension, comparable to their horizontal dimensions. The invention provides means for greatly shortening the return movement of one of the sheet metal shaping plungers from the point of initial engagement with the metal although the plunger is caused to produce the required extended metal shaping stroke. This enables a corresponding reduction in the vertical dimension of the machine which gives it many advantageous features as to reduction of frame vibration, compactness of arrangement of parts, et cetera.

The invention consists in other features which will appear from the following description and upon examination of the drawings. Presses containing the invention may partake of different forms and may be varied in their details and still embody the invention. To illustrate a practical application of the invention, I have selected a sheet metal press as an example of the various structures and the details of such structures that contain the invention and shall describe the selected press hereinafter, it being understood that certain features of my invention may be used to advantage without a corresponding use of other features of the invention and without departing from the spirit of the invention as presented in the claims. The particular structure selected is shown in the accompanying drawings.

Fig. 1 illustrates a front view of the press selected as illustrative of structures containing my invention. Fig. 2 illustrates a top view of the press. Figs. 3 and 4 illustrate vertical longitudinal sections of the upper and lower parts of the press. In Fig. 1 the plungers are shown in their die-separated positions, while in Figs. 3 and 4 they are shown at their extreme metal engaging positions. Fig. 5 illustrates a view of a section taken on the plane of the line 5—5 indicated in Fig. 4. Fig. 6 illustrates an end view of the press. Fig. 7 illustrates a vertical transverse section of the press. Fig. 8 illustrates diagrammatically the movements of the plungers or the die slides relative to the degrees of movement of the machine drive shafts. Fig. 9 illustrates diagrammatically the connections between each machine drive shaft and the upper

and lower metal shaping plungers. Fig. 10 illustrates diagrammatically the connections between the blank-holding plunger and each machine drive shaft. Fig. 11 illustrates diagrammatically extreme positions of intermediate parts of the connections between the lower metal shaping plunger and the drive shaft whereby an extended dwell is produced in the lower metal shaping plunger subsequent to its sheet metal manipulating stroke.

The frame of the press illustrated in the accompanying drawings has a greater horizontal longitudinal dimension than the horizontal transverse dimension and comprises a crown 1, a base 2, and uprights 3 located intermediate the ends of the crown and the base. These parts are tied together by means of the tie rods 4 that extend through the uprights 3 to draw the parts of the frame tightly together. The crown is provided with suitable bearings for supporting the machine drive shafts and the counter shafts that transmit the power to the machine drive shafts. The crown also pivotally supports the elements through which the power is transmitted from the machine drive shafts to the upper plungers.

The base is provided with suitable bearings for pivotally supporting the elements that are operatively connected to the machine drive shafts and to the lower sheet metal shaping plunger. The base is also provided with guideways that guide the lower sheet metal shaping plunger. The upper surface or edge part of the base forms a bed on which may be supported metal shaping parts or dies that coact with dies and other parts connected to the plungers for engaging and shaping sheet metal as may be desired. The uprights 3 are provided with suitable guideways for guiding the blank-holding plunger, and the blank-holding plunger is provided with means for guiding the upper sheet metal shaping plunger in its movements relative to the blank-holding plunger and the frame.

The plungers may be provided with suitable adjusting means for adjusting the plungers relative to their actuating elements to maintain them in desired sheet metal engaging relation. The plungers may also be connected with pneumatic or hydraulic loading means for taking up any play between points of connections that may develop as the machine is used and maintain the connected, relatively moving parts in close contact in the manner well known in the art.

The crown 1 is provided with protruding end parts 6 that overhang the uprights 3 of the frame and project from the crown outwardly beyond the tie rods 4. A pair of machine drive shafts 7 that drive the moving elements of the machine are each rotatably supported on a protruding end part 6 at points outside the tie rods 4. The machine drive shafts 7 extend transversely with respect to the frame and in parallel relation to each other. They extend from "front to back" with reference to the manipulation of the blanks in inserting and in removing them. The machine drive shafts are rotatably supported in the bearings 8 located near their ends and supported on the sides of the end parts 6. The ends of the machine drive shafts 7 are provided with gear wheels 9 and are driven thereby. The shafts 7 are referred to as "machine drive shafts", since they drive all the movable parts that produce the desired plunger movements. They are driven by a main drive shaft operating through suitable speed reducing gears. Each machine drive shaft 7 is provided with eccentrics 10 and 11 to which the pitmen 12 and 13 are connected.

The machine drive shafts 7 are driven by a suitable motor 18 that is connected by means of a belt 19 to a wheel 20. The wheel 20 is connected through a clutch 21 with a main drive shaft 22. The main drive shaft 22 has a pinion 23 that meshes with an idler 24 located on the shaft 25. The idler 24 and the pinion 23 mesh with gear wheels 26 located on counter shafts 27. The shafts 27 are provided with the pinions 28 that mesh with gear wheels 29 keyed to the shafts 30. The ends of the shafts 30 are provided with the pinions 31 that mesh with the gear wheels 9 located on the ends of each machine drive shaft 7. All the shafts 22, 25, 27, and 30 extend across the crown and have bearings at their ends which are supported on upper edge parts of the opposite sides of the crown. The four pinions 31 of the shafts 30 are located outside the sides of the crown in meshing relation with the four gear wheels 9 on the ends of the shafts 7. The gear wheels and pinions of the other shafts are located within the crown, and the corresponding shafts 7, 30, and 27 are equally spaced from the central vertical transverse plane of the machine. Also, the idler 24 produces opposite rotation of the corresponding counter shafts 30 and 27 and the machine drive shafts 7, and the centers of the eccentrics 10 and 11 are correspondingly located with reference to the axes of the machine drive shafts 7 to produce like movement of their pitmen and parts connected therewith and also to produce equally distributed reactive pressures in the frame of the machine.

The eccentrics 10 lead the eccentrics 11 with reference to the center lines of the pitmen by about 35 degrees, as measured in the rotation of the machine drive shafts 7, to produce the desired timed movements of the lower plunger with respect to the other plungers.

The gear wheels 9 are located in close proximity to the bearings 8 and on outer sides of the sides of the crown, and the four eccentrics 10 are located in close proximity to the bearings 8 and on the inner sides of the side parts of the crown, while the two eccentrics 11 are located centrally on the machine drive shafts 7.

The eccentrics 10 operate to reciprocate the pitmen 12 that are connected through power transmitting elements to each of the upper plungers, that is, to the sheet metal shaping plunger 35, which through its die engages and shapes the metal, and the sheet metal holding plunger 36, which through a suitable clamping die or ridge engages the sheet metal and holds it against the bed or against the edge of a lower die supported on the bed as the sheet metal is shaped by the upper and lower sheet metal shaping plungers. The power transmitting elements between the drive shafts and the plungers are pin interconnected and rock relative to each other and by the relative to and fro or reciprocatory movements of a varying number of the rocker members there is produced relative advancement and retardation in the movement of the plungers as measured in the degrees of rotation of the drive shafts.

The pitmen 12 are connected to rock shafts 37 that are supported in the bearings 38 located on the crown. Each rock shaft 37 is connected by a link 39 to a rock shaft 40 that is oscillatably supported on the bearing bar 41 fixedly se-

cured in the sides of the crown by suitable locking pins. The links 39 are pivotally connected to the rock shafts 37 to produce toggle connections as between the rock shafts 37 and 40. Since the links approach alignment with the axes of the rock shafts 37 as the centers of the eccentrics approach alignment with the axes of rotation of the machine drive shafts 7 and the points of connection of the pitmen with the rock shafts 37, the rock shafts 37 and links 39 cooperate to produce a dwell in the movement of the rock shafts 40. The arms of the rock shafts 40 are connected to the corners of the plunger 35 by means of the links 42 that form toggles. The links 42 are adapted to be brought into alignment with the axes of the rock shafts 40 during the time that the links 39 are brought into alignment with the centers of oscillation of the rock shafts 37 and also as the centers of the eccentrics 10 approach alignment with the axes of the shafts 7 and the centers of connection of the pitmen with the rock shafts 37. The plunger 35 is thus forced down and held during part rotation of the shafts 7 and is raised shortly after the eccentrics move from alignment with the axes of the shafts and the points of connection of the pitmen with rock shafts 37.

The interconnecting elements between the shafts 7 and the sheet metal shaping plunger 35 thus have corresponding parts located in parallel longitudinal vertical planes and are correspondingly located with reference to the vertical transverse and longitudinal central planes of the machine. Also, the axes of rotation and oscillation of the elements that cooperate to produce the required movements of the metal shaping plunger 35 are all located parallel to the central transverse vertical plane of the machine.

The blank-holding plunger 36 is connected by a plurality of toggles to the rock shafts 40 that operate the sheet metal shaping plunger 35. The additional toggles produce a more extended dwell in the blank-holding plunger 36 than the dwell that is produced by the toggle joints that interconnect the machine drive shafts with the sheet metal shaping plunger 35. Thus, since the pitmen 12 operate both the plungers 35 and 36, the plunger 36 reaches its point of dwell in its work stroke well in advance of the initial engagement of the work by the plunger 35, and upon return movement of the pitmen 12, the plunger 35 begins its recession in advance of the return movement of the blank-holding plunger 36.

The rock shafts 40 are connected by means of the links 46 to levers 47. The levers 47 are rotatably supported on suitable bearing bars 48 secured in the sides of the crown and are connected by the links 49 to rock shafts 50. The links 49 approach alignment with the levers 47 during the approach of the pitmen 12 to positions of alignment of their centers with the axes of rotation of the machine drive shafts 7. The rock shafts 50 extend through the sides of the crown and have arms 51 located on the outside of the crown. The arms 51 are connected to levers 55 by means of links 57. The levers 55 are rotatably supported on short bearing bars fixedly secured in the brackets 58 and to the crown. The links 57, with respect to the arms 51 of the rock shafts 50, are such as to produce a toggle connection between the rock shafts 50 and the levers 55. The ends of the levers 55 are connected to the blank-holding plunger 36 by means of the links 59. The levers 55 and the links 59 form toggle links and thus cooperate to produce the extended dwell of the plunger 36.

The interconnecting elements between the machine drive shafts 7 and the blank-holding plunger 36 thus having corresponding parts located in parallel longitudinal vertical planes equidistant from the central vertical longitudinal plane and from the central vertical transverse plane of the machine, and the shafts and axes of rotation of the parts extend across the crown.

By reason of the connection of the blank-holding plunger 36 with the machine drive shafts 7 through a greater number of similar toggles and toggle links than that used in the connection of the metal shaping plunger 35 with the drive shafts 7, the dwell produced in the blank-holding plunger 36 is greater than the dwell produced in the metal shaping plunger 35. The relation of the dwells is illustrated in Fig. 8 wherein the line marked "Blank-holder" indicates the relative length of the dwell in the working stroke of the plunger 36, and the line marked "Upper plunger" indicates the relative length of the dwell in the working stroke of the plunger 35.

Dies are secured to the bed and the plungers and constitute the metal shaping parts of the metal shaping plungers. Thus, the blank-holding plunger 36 has a clamping member 65 that coacts with a clamping part of the die 66 located on the bed, and the upper sheet metal shaping plunger 35 operates through its die 67 to engage the metal and, in coaction with the die 66, to partially shape the metal. The lower sheet metal shaping plunger 62 then engages the metal by means of the die 68 and in conjunction with the die 67 produces the desired configuration. The correlation of the dies may be varied as desired.

The lower sheet metal shaping plunger 62 is slidably supported in the base 2 and is operated by the reciprocatory movements of the pitmen 13 that are connected to the machine drive shaft 7 by the eccentrics 11. The base 2 has end projecting parts 69 in which the levers 70 are rotatably supported on fixed bearing bars 71. The ends of the levers 70 are connected to rock shafts 72 by means of the links 73. The rock shafts 72 are rotatably supported on the bearing rods 74 fixedly connected in the base. In the downward movement of the pitmen 13, the connecting centers of the links 73 and the levers 70 pass through the lines connecting the centers of oscillation of the levers 70 and the rock shafts 72 and thus produce a delayed toggle movement of the rock shafts. Each rock shaft is provided with a pair of arms 75 located at its ends. The arms 75 are connected by means of the links 76 to the lower sheet metal shaping plunger 62 and produce limited toggle joint movements of the links and corresponding movements in the plunger during the working stroke.

The movement of the lower sheet metal shaping plunger subsequent to the completion of its working stroke is diagrammatically shown in Fig. 11. The points of connection 78 of the links 73 to the levers 70 and the points of connection 79 of the links 73 to the rock shafts 72 are such as to cause the points 78 to pass across the lines that connect the axes of rotation of the levers 70 to the points 79. The arms 75 and the links 76 thus cause the lower sheet metal shaping plunger 62 to produce a slight reverse movement and an extended dwell dur-

ing its non-working stroke. The extent of the reverse movement of the plunger in the ratio of the dimensions of the drawings of the application to the size of the press is indicated in Fig. 11 by the difference in the location of the centers 80 at which the links 76 are connected to the plungers 62. The extent of the dwell period of the lower shaping plunger and the shortening of its receding movement from the initial metal engaging point is indicated in the line marked "Lower Plunger" in Fig. 8. The dwell in the movement of the lower plunger occurs at a point very close to the point of engagement of the die part of the lower plunger with the sheet metal as indicated by the relation of dwell-indicated part of the line of the "Lower Plunger" to the dwell-indicated part of the line of the "Upper Plunger." The return part of the stroke below that point at which the lower plunger engages the metal is less than fifty per cent of the part of the stroke in which the metal is shaped by the lower plunger. This enables reduction in the height of the press and produces the many advantageous features that flow from material dimensional reduction of presses of the type to which this invention relates.

I claim:

1. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported on the crown, and means for connecting each of the plungers with the machine drive shafts.

2. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, the crown having end parts projecting endwise beyond the bed, a plurality of plungers, a pair of machine drive shafts extending transversely and rotatably supported on the projecting end parts of the crown, means for continuously rotating the machine drive shafts in but one direction during all operations of the plungers, sheet metal shaping dies located on the plungers and means for connecting each plunger with each drive shaft.

3. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width, a bed, a blank holding plunger for holding sheet metal with reference to the bed, a pair of sheet metal engaging plungers, a pair of transversely extending drive shafts, and means for connecting the plungers with each drive shaft.

4. In a sheet metal press, a pair of machine drive shafts, means for continuously rotating the machine drive shafts in but one direction during all operations of the press, a pair of coacting sheet metal shaping dies, a pair of plungers for carrying the dies and movable in opposite directions to engage the sheet metal, and means for independently connecting each plunger with each machine drive shaft.

5. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, a sheet metal shaping plunger movable towards the sheet metal, a pair of machine drive shafts, means for connecting one of the plungers with each machine drive shaft, and means connecting the other plunger with each machine drive shaft for reciprocating and producing an extended dwell in the said other plunger following its withdrawal from the sheet metal.

6. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, a sheet metal shaping plunger movable downward toward the sheet metal, a pair of machine drive shafts, a pair of rock shafts connected to the sheet metal shaping plunger, each machine drive shaft operatively connected to one of said pair of rock shafts, a second pair of rock shafts operatively connected to the first pair of rock shafts and connected to the blank holding plunger.

7. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, a sheet metal shaping plunger movable downward toward the sheet metal, a pair of machine drive shafts, a pair of rock shafts located parallel to the machine drive shafts and to each other for operating each plunger, toggle links interconnecting the rock shafts and the plungers, and means for operatively connecting each of the machine drive shafts with one of each pair of rock shafts.

8. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, means for rotating the machine drive shafts, and a plurality of pin interconnected members reciprocated by the machine drive shafts, each end of each plunger connected by certain of the said pin interconnected members to each machine drive shaft for connecting each plunger with each shaft.

9. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal against the bed, an upper plunger movable downward towards the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, three pairs of rock shafts having arms at their ends, means for connecting each machine drive shaft with one of each pair of rock shafts, and links interconnecting the arms of the rock shafts and the plungers.

10. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal against the bed, an upper sheet metal shaping plunger movable downwards toward the sheet metal and a lower sheet metal shaping plunger movable upward toward the sheet metal, a pair of machine drive shafts, means including toggle joints for connecting each drive shaft with each plunger, the number of toggle joints in each connecting means of the plungers with each machine drive shaft being different to produce sequential plunger engagement with the sheet metal.

11. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, and means including a variable number of toggle joints for connecting the plungers with the machine drive shafts to produce sequential plunger engagement with the sheet metal, one of said machine drive shaft interconnecting means for producing an extended dwell in the movement

of its respective plunger following the withdrawal of its respective plunger from the sheet metal.

12. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal against the bed, an upper plunger movable downward towards the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, three rock shafts operated by each machine drive shaft and having end arms, and toggle links interconnecting the end arms of each rock shaft and a single plunger.

13. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, a plurality of pitmen connected to and reciprocated by the machine drive shafts, means for connecting each of the upper and the blank holding plungers to each of said pitmen and through the pitmen to both of the machine drive shafts, additional pitmen connected to the machine drive shafts and means for connecting the lower plunger to the additional pitmen and through the last named pitmen to both of the machine drive shafts.

14. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding the sheet metal relative to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported in the crown, and means including a variable number of toggle joints for connecting the plungers with the drive shafts to produce sequential plunger engagement with the sheet metal.

15. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported on the crown, means for connecting the plungers with the machine drive shafts, a lower plunger movable upward toward the sheet metal, and means connecting the lower plunger with the drive shafts for reciprocating the lower plunger and producing an extended dwell during the non-working stroke of the lower plunger.

16. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending drive shafts rotatably supported on the crown, and means including two toggle joints for connecting each of the drive shafts with each of the plungers, the points of connection of the toggle joints with each of the plungers being located equi-distant from the central transverse and vertical planes of the press.

17. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward towards the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported on the crown, gear wheels connected to the ends of the machine drive shafts, means for driving the gear wheels and the said machine drive shafts comprising a chain of gears including two pairs of transversely extending counter shafts rotatably supported on the crown, each of said counter shafts having gear wheels and pinions, each pair of corresponding shafts spaced equally from a central vertical transverse plane of the press and means for connecting each of the plungers at two points with each of the machine drive shafts.

18. In a sheet metal shaping press, a pair of parallel machine drive shafts, a pair of sheet metal shaping plungers, a pair of rock shafts for operating each plunger, each rock shaft having a pair of arms, and means for connecting the arms of the rock shafts of each pair with a plunger, and means for connecting each machine drive shaft with a rock shaft of each pair.

19. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal relative to the bed, a sheet metal shaping plunger movable toward the sheet metal, a pair of machine drive shafts extending transversely and rotatably supported on end parts of the crown, a pair of rock shafts for operating each plunger, each rock shaft having a pair of arms, means for connecting the arms of the rock shafts of each pair with a plunger, and means for operatively connecting the machine drive shafts with the rock shafts.

20. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal relative to the bed, an upper plunger movable downward towards the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported in the crown, three pairs of transversely located rock shafts operatively connected to the machine drive shafts, and links connected to end parts of the rock shafts and to the plungers.

21. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal against the bed, an upper sheet metal shaping plunger movable downward toward the sheet metal and a lower sheet metal shaping plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported in the crown, two pairs of rock shafts operatively connected to the machine drive shafts and to the sheet metal shaping plungers, a third pair of rock shafts connected to one of said pairs of rock shafts, and a fourth pair of rock shafts connected to said third pair of rock shafts and to the sheet metal holding plunger.

22. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding

sheet metal with reference to the bed, an upper plunger movable downward towards the sheet metal, a lower plunger movable upward towards the sheet metal, a pair of transversely extending machine drive shafts supported on the ends of the crown, gear wheels connected to the ends of each of the machine drive shafts, a pair of transversely extending counter shafts supported on the crown, pinions located on the counter shafts meshing with the said gear wheels, means including a main drive shaft for driving the said counter shafts, three pairs of rock shafts operated by the machine drive shafts and toggle links connected to the ends of the rock shafts and to the plungers.

23. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal relative to the bed, an upper plunger movable downward towards the sheet metal and a lower plunger movable upward toward the sheet metal, the crown having projecting end parts, a pair of parallel transversely extending machine drive shafts rotatably supported in the projecting end parts of the crown, three pairs of transversely extending rock shafts operatively connected to the machine drive shafts, and links connected to end parts of the rock shafts and to the plungers.

24. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a base and end strut members, the crown having end parts projecting beyond the strut members, a bed, a blank holding plunger for holding sheet metal relative to the bed, a sheet metal shaping plunger movable downward toward the sheet metal, a pair of machine drive shafts extending transversely and rotatably supported on the end parts of the crown, gear wheels connected to the ends of the machine drive shafts, means for driving the said gear wheels, a pair of rock shafts for operating each plunger, each rock shaft having a pair of arms, means for connecting the arms of the rock shaft of each pair with a plunger, and means for operatively connecting the machine drive shafts with the rock shafts.

25. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward towards the sheet metal, a lower plunger movable upward towards the sheet metal, a pair of transversely extending machine drive shafts supported on the ends of the crown, gear wheels connected to the ends of each of the machine drive shafts, a pair of transversely extending counter shafts supported on the crown, pinions located on the counter shafts meshing with the said gear wheels, means including a main drive shaft for driving the said counter shafts, and means including a variable number of toggle joints for connecting the plungers with the machine drive shafts to produce sequential plunger engagement with the sheet metal.

26. In a sheet metal press, a crown and a base, uprights located at the ends of the crown and the base and tie rods for connecting the crown and the base, the crown having end parts projecting beyond the tie rods, machine drive shafts extending across the ends of the crown and supported on the projecting end parts, means for continuously rotating the machine drive shafts in but one direction during all operations of the press, an upper plunger slidably movable between the uprights toward the base, a lower plunger slidably supported in the base sheet metal dies carried by the plungers, each plunger operatively connected to both of the machine drive shafts.

27. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, and means including two toggle joints for connecting each plunger with each machine drive shaft.

28. In a sheet metal shaping press, a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of machine drive shafts, means including a plurality of pitmen for connecting the upper and blank holding plungers with the machine drive shafts, additional pitmen, rock members connecting the lower plunger with the last named pitmen for producing an extended dwell subsequent to withdrawal of the lower plunger from the sheet metal.

29. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported on the crown, a plurality of pin interconnected members reciprocated by the rotation of the machine drive shafts each end of each plunger connected by certain of the said pin interconnected members to each machine drive shaft for operating each of the plungers by each of the drive shafts.

30. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width and having a crown and a bed, a blank holding plunger for holding sheet metal with reference to the bed, an upper plunger movable downward toward the sheet metal and a lower plunger movable upward toward the sheet metal, a pair of transversely extending machine drive shafts rotatably supported on the crown, means for producing advancement and retardation in the strokes of the plungers relative to each other and as measured in the degrees of rotation of the machine drive shafts, the said means interconnecting each of the plungers to both of the drive shafts for reciprocating each of the plungers by the rotation of both of the drive shafts.

31. In a sheet metal press, a frame having a greater horizontal longitudinal length than the horizontal transverse width, a bed, a blank holding plunger for holding sheet metal with reference to the bed, a pair of sheet metal engaging plungers, a pair of transversely extending drive shafts rotatably supported on the upper part of the frame, a plurality of pin interconnected members reciprocated by the rotation of the machine drive shafts, each end of each plunger connected by certain of the said pin intercon-

nected members to each machine drive shaft for operating each of the plungers by each of the drive shafts.

32. In a sheet metal press, a pair of machine drive shafts, means for rotating the machine drive shafts, a pair of co-acting plungers movable in opposite directions to operate on the sheet metal, a plurality of pin interconnected members reciprocated by the drive shafts for independently connecting each end of each plunger with each machine drive shaft.

33. In a sheet metal press, a bed, a pair of machine drive shafts, means for rotating the machine drive shafts, a metal holding plunger for holding sheet metal with reference to the bed, a metal shaping plunger movable towards the sheet metal, pitmen connected to and reciprocated by the machine drive shafts and rocker members connected to the pitmen and to the plungers for connecting the pitmen reciprocated by each drive shaft to each plunger.

34. In a sheet metal shaping press, a pair of machine drive shafts, means for rotating the machine drive shafts, sheet metal engaging plungers, pitmen connected to each of the machine drive shafts and rocker members connected to the pitmen operated by each machine drive shaft and to one of the plungers, additional pitmen connected to each of the drive shafts, rocker members connected to the additional pitmen and to the other of the plungers, the additional pitmen having their maximum pressure of movement by the operation of the drive shafts at points in the rotation of the drive shafts following the maximum pressure points of the first named pitmen.

35. In a sheet metal press, a crown and a base, uprights located at the ends of the crown and the base and tie rods for connecting the crown and the base, the crown having end parts projecting beyond the tie rods, machine drive shafts extending across the end parts of the crown and rotatably supported thereon, an upper plunger slidably movable between the uprights, a lower plunger slidably supported in the base, sheet metal dies carried by the plungers, pitmen connected to the machine drive shaft, and means for connecting the upper plunger to the said pitmen and through the pitmen to each of the machine drive shafts, additional pitmen connected to the machine drive shafts and means for connecting the lower plunger to the additional pitmen and through the additional pitmen to each of the machine drive shafts.

36. In a sheet metal press, a crown and a base, uprights located at the ends of the crown and the base and tie rods for connecting the crown and the base, the crown having end parts projecting beyond the tie rods, machine drive shafts extending across the end parts of the crown and rotatably supported thereon, an upper plunger slidably movable between the uprights, a lower plunger slidably supported in the base, sheet metal dies carried by the plungers, means for connecting the upper plunger to both drive shafts and for reciprocating the plunger by rotation of the drive shaft, pitmen connected to the drive shafts, a pair of rock shafts connected to the pitmen and having end arms, four links connected to the end arms of the rock shafts and to the lower plunger for connecting the lower plunger through the links, the rock shafts and the pitmen to both of the machine drive shafts.

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