April 11, 1944. P. E. FLOWERS 2,346,213

SHEET METAL STRETCHING PRESS

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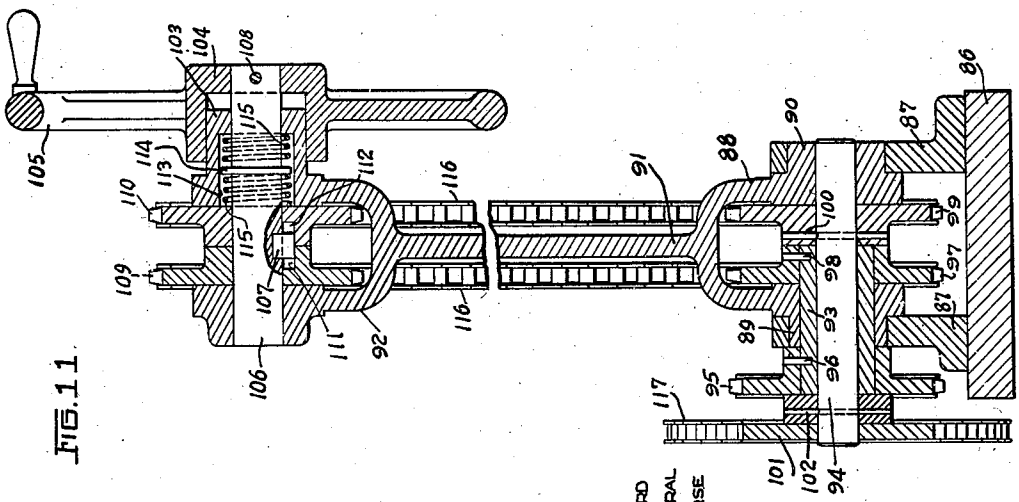


FIG. 11

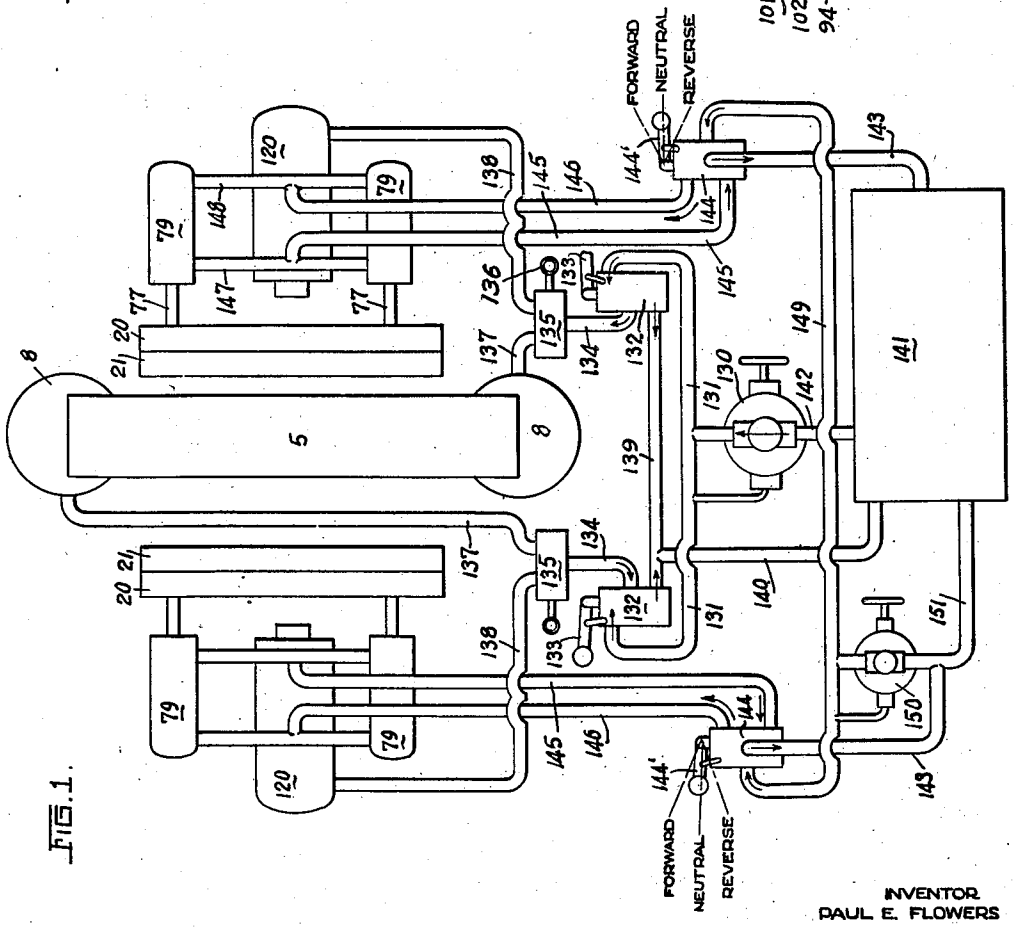


FIG. 1.

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SHEET METAL STRETCHING PRESS

Filed Feb. 20, 1941 6 Sheets-Sheet 2

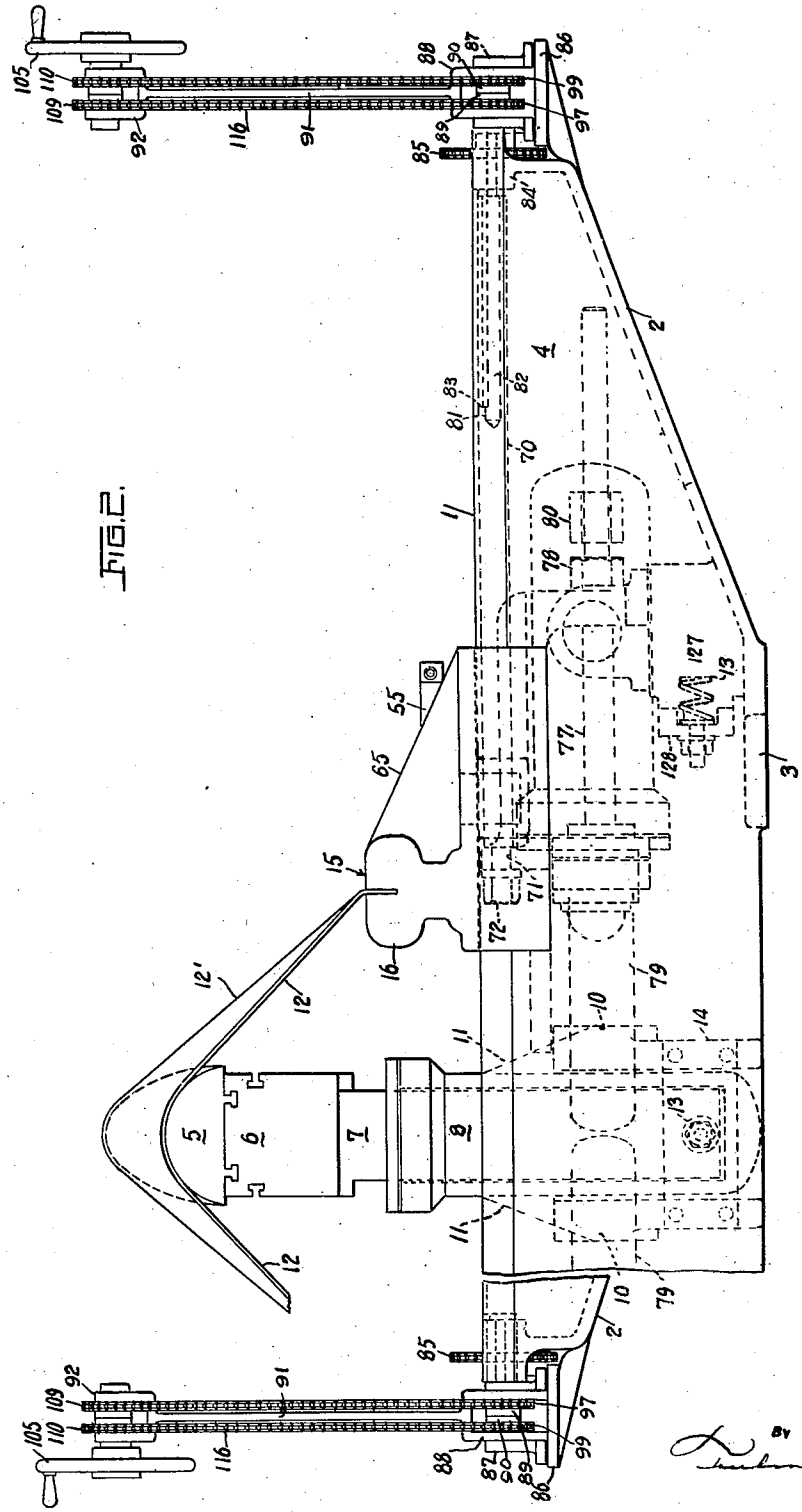


FIG. 2.

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Filed Feb. 20, 1941 6 Sheets-Sheet 3

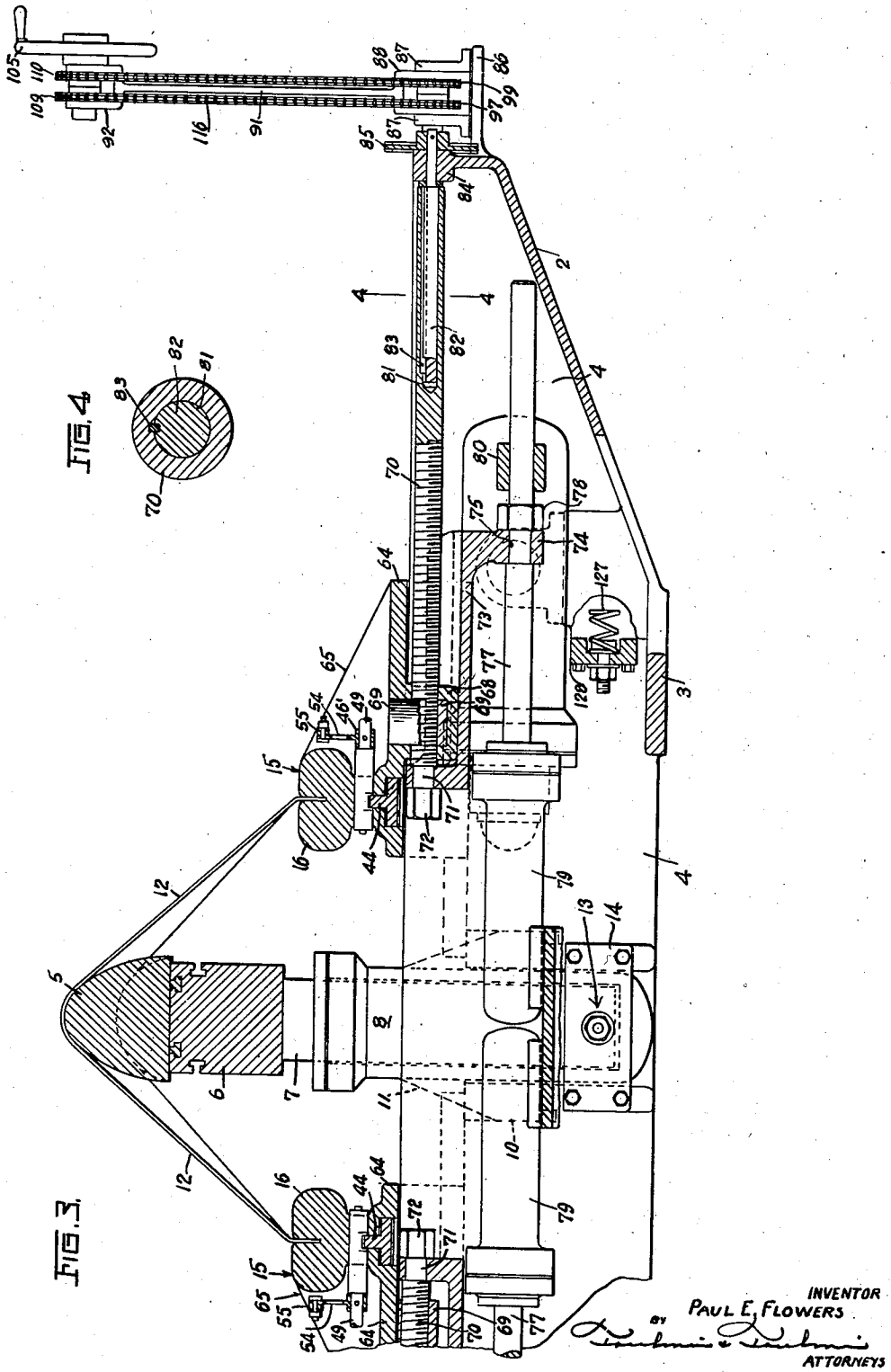


FIG. 3.

FIG. 4.

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SHEET METAL STRETCHING PRESS

Filed Feb. 20, 1941 6 Sheets-Sheet 4

FIG. 5.

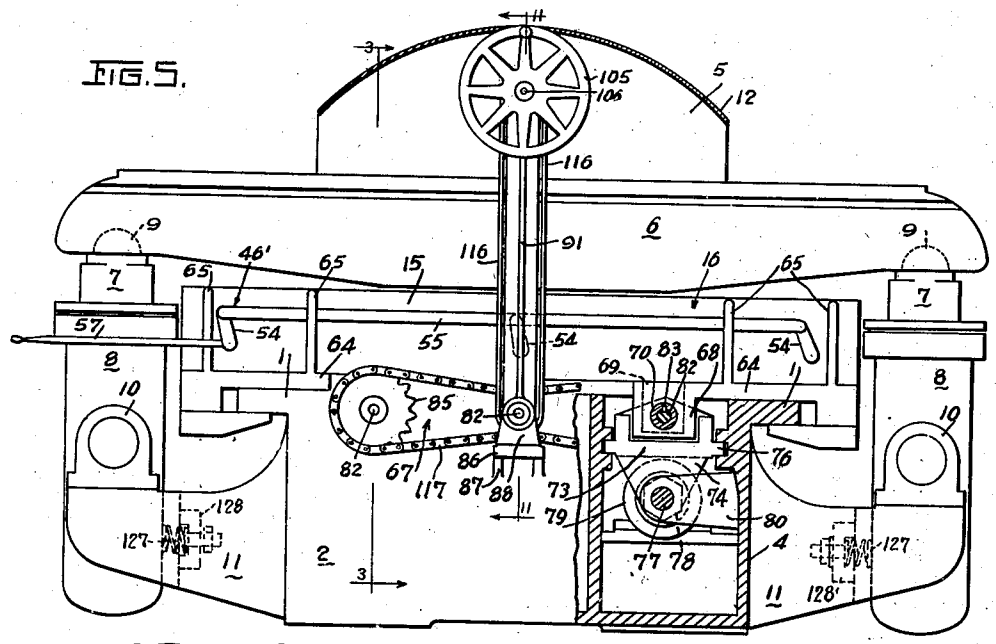
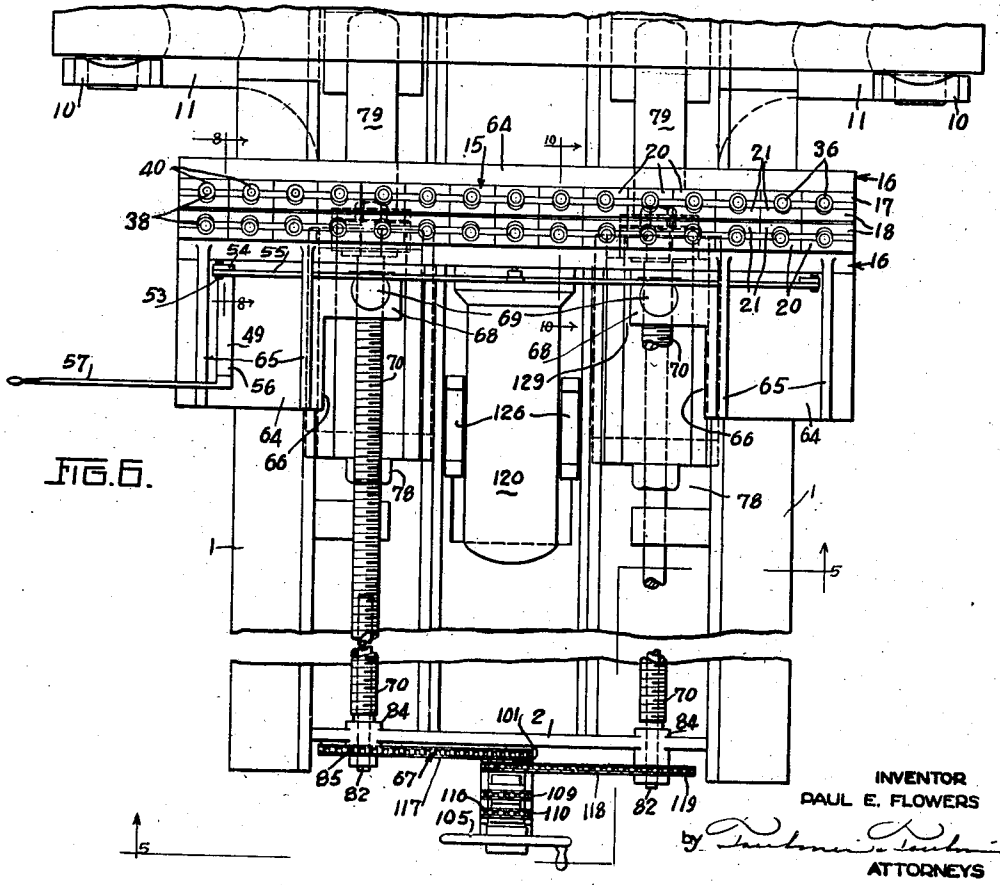


FIG. 6.



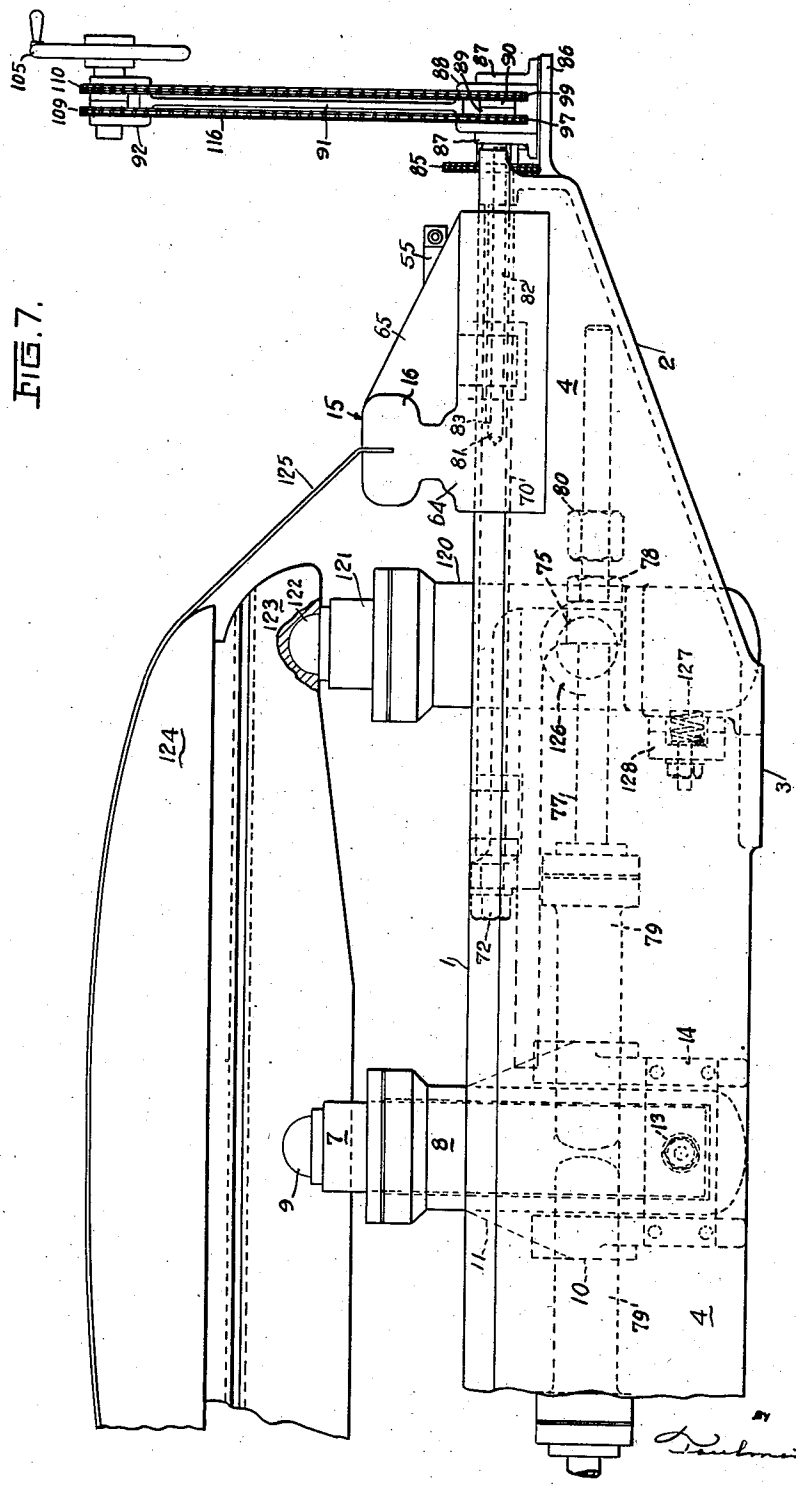
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SHEET METAL STRETCHING PRESS

Filed Feb. 20, 1941 6 Sheets-Sheet 5

FIG. 7.



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April 11, 1944. P. E. FLOWERS 2,346,213

SHEET METAL STRETCHING PRESS

Filed Feb. 20, 1941 6 Sheets-Sheet 6

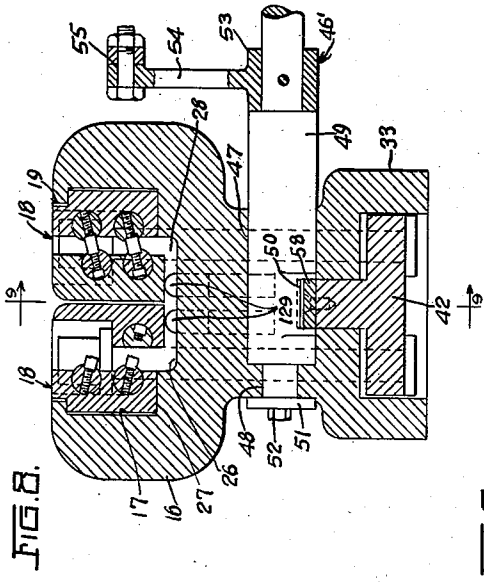


FIG. 8.

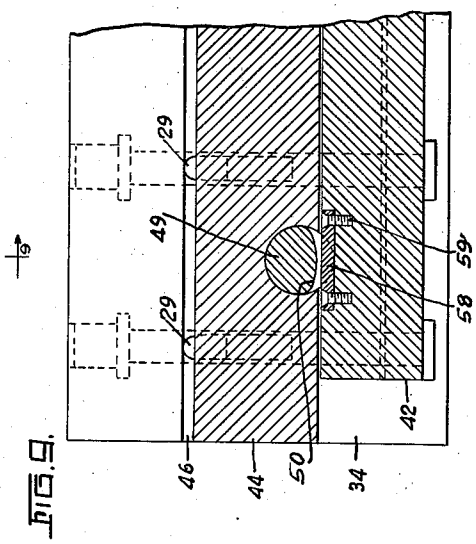


FIG. 9.

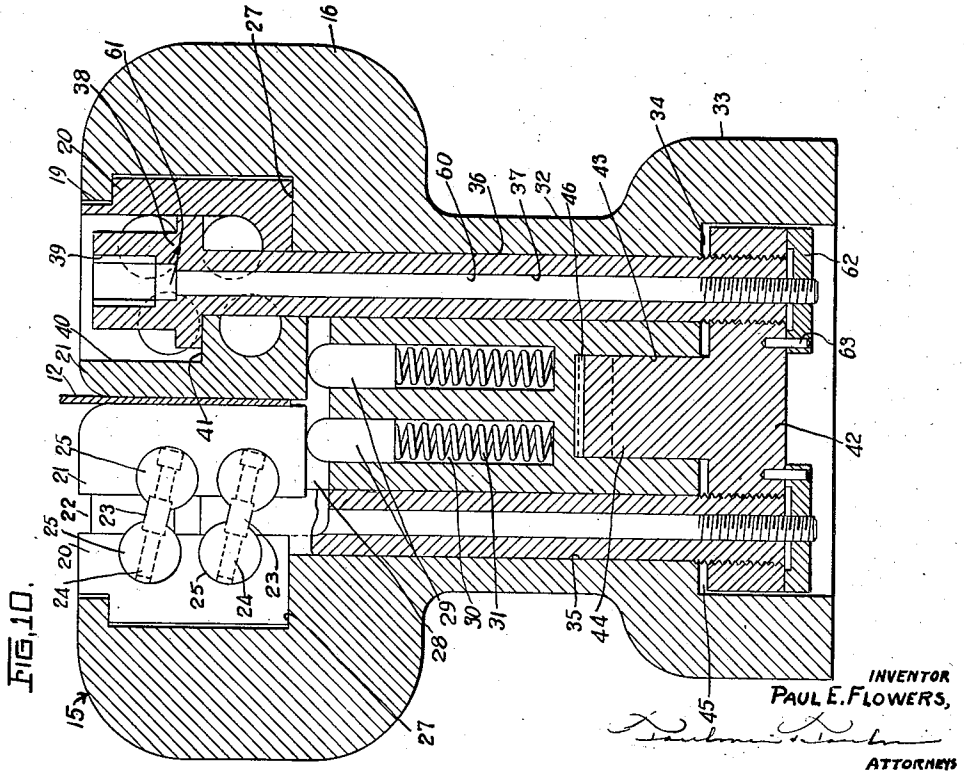


FIG. 10.

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Patented Apr. 11, 1944

2,346,213

UNITED STATES PATENT OFFICE

2,346,213

SHEET METAL STRETCHING PRESS

Paul E. Flowers, Mount Gilead, Ohio, assignor to The Hydraulic Development Corp. Inc., Wilmington, Del., a corporation of Delaware

Application February 20, 1941, Serial No. 379,875

19 Claims. (Cl. 153—48)

This invention relates to presses of the type that employ mechanism for clamping the workpiece to the press. Certain types of sheet metal articles are economically fabricated by means of a stretching press in which a plain sheet of metal is bent at the proper places, and stretched in other places until the desired configuration of the article is obtained.

It is necessary to secure opposite edges of the metal sheet to the press, and during the forming operation the operator causes a platen to move upwardly by fluid pressure against the under surface of the metal sheet or strip. The shape of the article is controlled in part by the amount of pressure exerted at the platen and also in part by the amount of slippage permitted at the jaws. After the distance between the jaws and the amount of slippage at the jaws have been determined, assuming that the metal sheet has been placed in position, the operator by controlling the fluid pressure applied to the moving platen can determine the shape into which the metal sheet is formed. It is therefore necessary that the operator have a full view of the metal strip during the stretching operation, and no obstructions to this view should be permitted.

In the prior art form of press it is usual to provide the same amount of slippage or full clamping effects over the entire length of one or both jaws therefore over the entire width of the metal strip. Under these conditions the number of shapes which can be formed in a press of this character is limited. When articles of intricate design are to be fashioned it may be necessary to provide full clamping effects at one or more points along the edge of the strip, and different amounts of slippage at other points. On occasion, other special clamping and slipping effects must be provided in order to procure the desired stretched shape which may be a complicated design. For example, it may be necessary to move both halves of the jaws bodily either toward or away from the central stretching axis of the press, or in the case of a long jaw, to move only one end of the jaw with respect to the press or to move both ends of the jaw in opposite directions. In fact, the shapes into which a metal strip can be bent and stretched are almost without number when the press is operated by a skilled workman and the jaws are given universal movement as a body, and in addition can be adjusted as between jaw halves to allow any amount of slippage or full clamping effects at any point or points throughout the line of jaws.

Among the objects of the present invention is to provide a stretching press in which adjustment can be made of the jaws as a complete body with respect to the other jaw body and with respect to the press.

Another object is to provide mechanism by which the clamping device halves can be adjusted with respect to one another so as to obtain any desired clamping or slipping effect at any point throughout the length of each jaw.

These two objects are carried out, in brief, by subdividing each clamping assembly into a number of individually adjustable clamping blocks mounted on a support which can be swung in the horizontal plane, and also moved in relation to the vertical axis of the press.

In order to provide for full gripping effect on the strip, i. e., without any slippage whatsoever, it has been customary to employ a two-part clamping device in which the gripping surfaces of the device are provided with a knife edge or its equivalent. This edge exerts a compressional force of an intense character over a line contact across the metal strip. The strains caused by these gripping forces may be so high, in the case of powerful presses, as to tear the metal. The same condition arises even when the jaws are corrugated or grooved in a criss-cross or diagonal manner, because the clamping forces are concentrated at one or more limited areas of the metal. Consequently another object of the present invention is to provide an improved stretching press clamping device in which the tearing effect on the metal is reduced to a minimum, even when the stretching forces and the necessary gripping effects to counteract these forces are considerable.

This object is carried out, in brief, by providing the clamping blocks, referred to hereinbefore, with perfectly smooth gripping surfaces, these surfaces being arranged parallel to one another and to the metal strip. In order to obtain flat contact with the strip over the entire gripping surface of each block, a toggle mechanism is provided that permits the blocks to move with respect to one another and with respect to the metal strip, these movements being constrained to parallel paths. Thus a line or a point contact with the strip anywhere throughout the clamping device is avoided. The blocks are initially held lightly in contact with the strip, and the operation of the toggle mechanism is such that a pull on the metal strip will cause the clamping blocks to move toward one another in parallel paths, thus to exert a clamping effect on the strip in proportion to the pull on the strip by the moving platen.

Still another object is to provide a conveniently operated structure, simple in design, for simultaneously opening the clamping blocks in order either to insert a metal strip or to remove the stretched piece of metal. This object is attained by mounting the blocks on a common support. This support is actuated by a suitably positioned lever in such a direction that the blocks are caused to move about their toggle connection and thus to recede from one another and to leave a space between the jaw surfaces so as to permit the strip to be removed from the clamping device without effort. It is therefore apparent that the clamping blocks are individually adjustable with respect to one another, as pointed out in the earlier stated objects, and are adjustable as a unit in order to insert or remove a metal strip from the clamping device.

A still further object is to provide a stretching press in which the mechanism employed for making a preliminary adjustment of the position of the jaws can be temporarily removed from the press, so as not to interfere with the operator's view of the metal strip during the stretching operation. In carrying out this object I employ a hand wheel device which operates from sprockets and chains in such a way as to provide a universal horizontal movement of each line of clamping assemblies, and after the positions of these assemblies have been set the hand wheels are effectively removed from the press by being swung out of position.

Another object is to provide a stretching press employing two sets of clamping devices which can be moved hydraulically either toward or away from the metal strip, and at any rate of speed. For this purpose I employ hydraulically operated cylinders and pistons at each end of the clamping assembly, the pressure fluid in these cylinders being controlled by a suitably positioned valve.

In the case of relatively large stretching presses it is usual to provide hydraulically operated rams at each end of the platen rather than a single ram at the middle of the platen. However, when the end rams are employed there is a tendency for the rams to move at unequal speed, even though the same pressure fluid is admitted to the cylinders. Again, in the case of an article having a complicated shape, it may be desirable to move one end of the platen at a faster rate than the other end, in which case different fluid pressures are applied to the end rams of the platen. When one ram moves at a faster speed than the other ram, as an upwardly pushing movement against the under side of the platen, the faster moving ram is subjected to certain stresses brought about solely by reason of this difference in movement.

Another object of the invention is to equalize these stresses regardless of the difference in rate of speed at which the rams are either accidentally or deliberately operated. This object is attained, in brief, by arranging the rams in such a way as to permit them to swing in the horizontal direction so as to assume positions in which the resultant stresses are reduced to a minimum.

In the fabrication of certain articles it may be necessary to position the metal strip along the longitudinal axis of the press instead of being transverse of the press, which would be the normal position. Under these conditions the platen would be moved in any suitable manner 90 degrees so as to lie along the length of the press, and in accordance with another feature of my invention two additional hydraulically operated rams are provided to accommodate a different position of the strip. When these rams are not in use their cylinders can be swung out of position so as not to interfere with the operation of the machine on a strip laid transverse of the press.

The invention will be better understood when reference is made to the following specification and the accompanying drawings.

In the drawings:

Figure 1 is a layout of the hydraulic system showing the pumps, platen, jaws and cylinders in diagrammatic form.

Figure 2 is a side elevation of the improved press with a portion to the left of the platen broken away. It will be noted that the platen extends transversely of the press.

Figure 3 is a sectional view taken along the line 3—3 in Figure 5.

Figure 4 is a small sectional view taken along the line 4—4 in Figure 3.

Figure 5 is a partial elevational and sectional view which would be seen along the line 5—5 in Figure 6.

Figure 6 is a plan view of the press with a portion broken away.

Figure 7 is a side elevational view of a modified form of the press, in which the platen is positioned lengthwise of the press instead of transversely thereof.

Figure 8 is a sectional view of the clamping jaws taken along the line 8—8 in Figure 6.

Figure 9 is a section taken between the jaws along the line 9—9 in Figure 8.

Figure 10 is an enlarged sectional view of the jaws taken along the line 10—10 in Figure 6. Figure 10 shows the left-hand pair of jaws in elevation more fully to illustrate the toggle connection between the jaws.

Figure 11 is a sectional view taken along the line 11—11 in Figure 5.

Referring more particularly to Figure 2, the frame of the machine is constituted of long flat metal plates, indicated at 1, which are supported at each end on an inclined webbed member 2 provided at the bottom with feet 3. The framework is closed at each side of the plates by means of a metal wall 4. The die or punch of the press is shown at 5, this die being bolted or otherwise removably secured to a platen 6 carried at each end on rams 7, which are adapted to reciprocate in a pair of cylinders 8. The rams 7 preferably terminate at the top in a hemispherical bearing cap 9 which fits within a suitably shaped opening in the platen.

The cylinders 8 are hung on the trunnioned bearings 10 which are carried at the ends of the webs 11, extending outwardly from the walls 4 of the frame. Thus the cylinders 8 are adapted to be rotated in the vertical plane at the trunnions. The metal strip which is undergoing the stretching operation is indicated at 12 and extends over the upper surface of the die 5, the latter being suitably rounded, as indicated, in order to avoid cutting the metal. It is apparent that when hydraulic pressure is applied to the cylinders 8, in a manner to be described hereinafter, and assuming that one of the rams 7 moves upwardly at a faster rate than the other ram, the cylinder which shows the greater ram movement will tend to rotate at the pivot 10 and move

to a position such as to cause the load to be divided equally with the other ram. In order to maintain the cylinders in a normally vertical position, there may be interposed between each cylinder and the walls of the frame a compression spring, broadly indicated at 13, which is carried on a plate 14 bolted to the frame. Thus any movement of either cylinder from its normal vertical position would cause a compression of one of the springs, depending on which side of the vertical position the cylinder is moved.

Construction of the clamping devices

The strip 12, after passing over the platen 5, is gripped at each end or side by a clamping assembly, generally designated 15. This assembly is shown in section in Figures 8, 9 and 10 and in plan in Figure 6. Each assembly takes the form of a rail-like member, indicated at 16, which preferably extends along the entire width of the machine so that the assembly can accommodate the maximum width of strip. The rail member 16 is provided with a large rectangular opening 17 at the top, extending along the entire length of the rail member and is adapted to receive a plurality of clamping units. The latter are generally designated 18 and comprise supporting and clamping blocks constituted of tough metal such as nickel steel. As shown in Figure 6, the length of the rail member 16 is divided into a large number of these units 18, contained within each opening 17. The innermost surfaces of the supporting and clamping blocks are perfectly smooth, preferably ground, and when placed in position these surfaces are exactly parallel to one another and parallel to the strip contained between the surfaces. The blocks are held within the opening 17 at their outer upper edges by means of an overhanging ledge 19 (Figures 8 and 10), which fits into a corresponding groove in the blocks.

Each clamping unit is subdivided into two blocks, the outer one 20 of which is called the supporting block and the inner one 21 is termed the clamping block. These blocks are spaced apart, as indicated at 22, by means of a pair of toggle levers 23. Each lever is constituted of a threaded rod 24 having a collar at the middle, the rod being received by cylindrically shaped metal elements 25. These elements fit snugly within cylindrical openings which extend longitudinally of the blocks 20, 21. The rods 24 are affixed to the cylindrical elements 25 in such a manner as to cause the blocks 20 to be spaced from the opposite adjacent blocks 21, as illustrated. The cylinders 25 and their openings preferably extend the entire width of each block.

Due to the toggle arrangement provided by the cylindrical members 25 and their interconnecting rods 24, each clamping block 21 is adapted to move upwardly, but in moving upwardly the blocks 21 are constrained to move inwardly, i. e., away from the supporting blocks 20, due to the swivel action of the rod 24-cylinder 25 arrangement. In setting up and adjusting the blocks there is a space left between the inner surfaces of the inner pair of blocks 21 just enough snugly to receive the end of the metal strip 12 which is to be stretched. During the stretching operation the platen tends to pull the strip 12 out from between each adjacent pair of clamping units, and inasmuch as the clamping blocks 21 actually contact both sides of the strip, this movement of the strip will cause the blocks 21 to move upwardly and inwardly to increase their clamping effects on the strip.

The rectangular opening 17 is provided with a countersunk rectangular groove 26 which leaves a ledge, indicated at 27, on which the two outermost sets of blocks 20 rest but provides a space indicated at 28 directly below the inner sets of blocks 21. The latter are maintained in their vertical position by resting on the upper ends of the round-headed pins 29, which are received in the vertical openings 30 drilled in the rail member 16. There is a compression spring 31 positioned between the lower surface of each pin 29 and the bottom of the opening 30. The tension of the springs 31 is such as to force the blocks 21 upwardly to such a distance as to cause the inner faces of the blocks firmly to contact the sides of the strip 12.

The rail member 16 preferably tapers down to a smaller cross section, as indicated at 32, at the middle, and then flares outwardly at the bottom, as indicated at 33, to accommodate a relatively large recessed opening 34. There are two rows of openings 35 extending between the rectangular opening at the top of the rail member to the recessed opening 34 at the bottom of the rail member. These openings are positioned in line with the spaces 22 between the blocks 20, 21 on opposite sides of the strip 12. The openings 35 are positioned along the length of the rail member, one opening to each pair of blocks 20, 21, and if the blocks are relatively long, then two or more openings per pair of blocks may be provided and symmetrically positioned with respect to each pair of blocks. These openings are adapted to receive bolts 36 of annular cross section, having bores 37 extending along the length of each bolt. Figure 6 shows only one bolt per pair of blocks, but it will be understood that as many bolts as may be necessary can be employed. Each bolt 36 terminates at its upper end in a flanged head, indicated at 38, the upper portion of which is provided with a hexagonal opening 39 which is adapted to receive a socket wrench (not shown).

The opposite adjacent inner surfaces of each pair of blocks 20, 21 are provided with a round opening indicated at 40, which is adapted to receive the flanged head 38. This opening terminates at the bottom of the blocks 21 in a ledge 41, on which the flanged head 38 of the bolt 36 rests. However, the opening 40 extends for a greater depth into the block 20 so that no ledge is formed at this point, and the bolt 36 rests solely on the ledges formed in the blocks 21. The purpose of this will be explained presently. The bolts 36 are threaded at their lower ends into a T-shaped bar 42, the horizontal portion of which is carried within the opening 34. The rail member 16 is provided with a longitudinally extending slot, indicated at 43, which receives the upwardly extending portion 44 of the bar 42. The bolts 36 are threaded into the bar 42 in such a manner as to leave a space 45 between the upper surface of the horizontal portion of the bar and the lower surface of the opening 34. A space 46 is also left between the upper surface of the metal portion 44 and the lower surface of the slot 43. A mechanism which will now be described is provided for moving the bar 42 in a vertical direction in order to move the inner blocks 21 in a corresponding direction. This mechanism is generally indicated by the reference numeral 46', and is shown in detail in Figures 5, 6, 8 and 9.

The rail member 16 is provided at a number of positions along its length (three as illustrated) with transversely extending openings 47 having a necked portion 48 and adapted to receive a shaft 49. The shaft is round for the greater portion of its length, but at a position directly above the metal portion 44 is turned down, as indicated at 50, to conform to a cam shape. Consequently the shaft at this position has a portion which corresponds to the true diameter of the shaft, and another portion which is arcuate in shape formed by a radius greater than the radius of the shaft. The latter is provided with a turned-down portion at one end which fits the smaller diameter part of the opening 47 and carries a washer 51 secured to the shaft by a nut 52. Thus the shaft is prevented from moving in the longitudinal direction. At the opposite end the shaft is pinned to a hub 53 of a lever 54 which carries a connecting rod 55 secured to the levers 54 of the other two devices, as can be plainly seen in Figure 5.

One of the shafts 49, the left-hand one as shown in Figure 6, may be extended beyond the hub 53, as indicated at 56, and secured to a hand-operated lever 57. By moving the lever 57 in a vertical direction the shafts 49 of the three devices are caused to rotate (due to the interconnecting bar 55), thus causing the cam surfaces 50 of the shafts to move either toward or away from the upper surface of the metal portion 44 (Figures 9 and 10), depending on the direction in which the lever 57 is moved. Directly below each cam surface 50 there is a wearing plate 58 of hardened metal secured by the screws 59 to a slot formed in the metal portion 44. Thus by rotating the lever 57 the T-shaped bar 42 can be moved upwardly or downwardly within the rail member 16, and if moved downwardly will cause the lower surface of the flanged portion 38 of the bolts 36 to exert a downward pressure on the ledges 41 of the inner blocks 21, causing these blocks to move downwardly against the action of the springs 31.

Due to the toggle arrangement 24, 25, this downward movement of the inner blocks 21 causes these blocks to move away from one another, thus decreasing the pressure exerted against the strip 12. If the lever 57 is rotated through a sufficient angle, the inner blocks 21 will have moved outwardly to such an extent as to break all contact with the strip 12. Thus the latter can be readily removed from the jaws. It will be understood that there are as many of the clamp loosening devices 46' at one side of the rail member 16 as may be necessary, depending on the length of the rail member, and it is further apparent that the rotation of the shafts 49 by the lever 57 causes the same outward movement of all of the individual blocks 21 on both sides of the strip 12, because the downward movement of the bar 42 exerts the same effect on all of the individual bolts 36 which rest on the ledges 41 of the individual blocks 21.

During the operation of the stretching press it may be desirable to permit a certain amount of slippage at a particular point along the width of the metal strip, but to fully clamp other portions of the strip. In order to accommodate these different clamping and slipping effects it may be necessary to effect different adjustments at the bolts 36. It has been pointed out that as the bolts are tightened into the bar 42, the inner blocks tend to move away from one another, thus to permit any desired amount of slippage, and by tightening some of the bolts and loosening other bolts any opposite pair of jaws can be given a full clamping effect on the strip 12 or would permit any degree of slippage. It will be noted in this respect that each block 21 is provided with its own adjusting bolt 36 so that the adjustment of the latter affects only its individual block, thus providing a nicety of adjustment at each point along the width of the strip. In order to lock the bolts 36 in position after the individual adjustments have been made, a locking rod 60 which extends through the central bore 37 of each bolt may be provided. This rod is provided at its upper end with a screw driver head 61, to which access can be had through the hexagonal opening 39. The lower end of the rod is threaded into a bar 62 which spans the lower end surface of the bolt 36, and is pinned as indicated at 63 to the bar 42. Thus by turning the rod 60 at the head 61 a locking action is effected which prevents any movement of the bolt 36.

Mechanism for moving the clamping assembly as a unit toward and away from the platen

It is necessary to move the clamping unit assembly 15 (Figure 2) on each side of the platen 5 in a horizontal direction in order to accommodate different lengths of the strip 12 and in order to control the stretching operation, because as the platen 6 moves upwardly, carrying with it the strip, the clamping units must move inwardly with a corresponding or predetermined rate of travel. Each clamping assembly is carried on a flat plate 64 which rests on the plate 1 of the press, and which is reenforced by a number of diagonally extending ribs 65, connecting the plate 64 with the outer surfaces of the rail member 16. The plate 1 has a large rectangular shaped opening 66 extending inwardly from each end of the plate. As will be explained in connection with other operating mechanism, the width of this opening is sufficient to clear a sprocket mechanism which is generally designated 67. Secured to the bottom surface of the plate 64 there is a pair of spaced downwardly extending box-shaped members 68 (Figures 3 and 5). A nut 69 is contained within each box member, and there is a rod 70 which passes through openings in the sides of the box and is threaded in the nut. The latter preferably has a cylindrical shape for purposes which will appear hereinafter, the axis of the cylinder being vertical (as seen in Figure 3) so that the rod 70 extends through the diameter of the cylinder. The purpose of this rod will be explained hereinafter. The rod 70 has a shouldered portion indicated at 71 where it passes through the inner wall of the box 68, and is secured to the box by a nut 72.

There is a web of metal 73 secured to the under side of the box-shaped member 68 and is therefore secured to the plate 64, this web being provided with a right-angle extension, indicated at 74 and which has a bore 75. The web 73 is provided with outwardly extending ledges 76 at each side (Figure 5), these ledges being adapted to ride in grooves formed at opposite sides of a box-shaped member 4 forming part of the frame. A ram 77 passes through the bore 75 and is secured to the web 73 by a nut 78. This ram is received in a hydraulically operated cylinder 79 at one end, and at the other end is supported by a bracket lug 80 which is secured to the frame. It will be understood that there are two sets of cylinders 79 for each jaw unit 15 and consequently two box-shaped members 4, and two sets of

the apparatus contained in the box-shaped members. These cylinders are obviously positioned in a horizontal plane, and are preferably arranged at the same height so that one of the pairs of cylinders for one jaw body is placed end to end with the corresponding cylinder of the other jaw body 15. When fluid pressure is applied to the pistons contained in the cylinders 79, the clamping unit assemblies 15 will be given a movement either inwardly toward the platen or outwardly away from the platen, depending on which side of the piston receives the pressure fluid.

Mechanism for canting the clamping assemblies

It has been pointed out that in order to stretch strips of metal into certain shapes, the assemblies 15 may have to be canted in the horizontal plane, i. e., move the corresponding ends of the clamping units either toward or away from one another so that these units will not extend in parallel directions but instead be positioned at an acute or obtuse angle with respect to one another. In order to obtain this adjustment there are two rods 70 provided for each assembly 15, these rods being threaded in the nuts 69 which form part of the moving carriage on which the clamping units 15 are mounted. The rod 70 at the opposite end is provided with an axially extending bore 81 which receives a case hardened shaft 82. The latter is keyed to the rod 70, as indicated at 83 (Figure 4), and is journalled at the outer end in a bearing 84 which is supported on a vertical extension of the frame member 2. The shaft 82 extends beyond the bearing 84 and carries a sprocket wheel 85.

At the center of the machine the frame 2 is provided with a horizontal platform 86, on which is mounted a pair of spaced uprights 87. The latter are provided with round openings in which is swivelly mounted a U-shaped member 88 having hubs 89 and 90 which are adapted to rock within the openings in the uprights 87. The U-shaped member merges at the top into a flat bar portion 91, which in turn spreads out into a U-shaped member 92 (Figure 11). The hub 89 is bored to receive a sleeve 93, the latter having an opening which contains a shaft 94. The sleeve is adapted to rotate on the shaft and carries at its left-hand end a sprocket 95 secured thereto by a pin 96. At its opposite end the sleeve 93 carries a sprocket 97 which is secured thereto by the pin 98. A sprocket 99 is fixedly mounted on the shaft 94 by means of a pin 100, and at its left-hand end the shaft carries a sprocket 101 to which it is secured by means of a pin 102.

Referring now to the upper end of the bar 91, the U-shaped element 92 is provided with a hub member 103 which is adapted to rotate within a cap element 104 forming the central hub of the hand wheel 105. The U-shaped element 92, together with its hub member 103, serves as a bearing for a shaft 106. The latter is provided at a position in line with the bar 91 with a key 107, and at its right-hand end is pinned, as indicated at 108, to the cap-shaped member 104 of the hand wheel. Thus by turning the wheel 105, the shaft 106 can be rotated. Within the legs of the U-shaped member 92 there is positioned a pair of sprockets 109, 110, the inner faces of which abut one another and the outer faces are held in position by the legs of the member 92. These sprockets are mounted on the shaft 106 and are provided with registering keyways 111, 112 at the position of the key 107, the length of each keyway 111, 112 being equal to that of the key 107 so that the total length of the keyways 111, 112 is approximately twice that of the key as indicated.

The hub member 103 is provided with a countersunk opening 113, and about midway the length of the opening there is provided a shoulder 114 on the shaft 106. Compression springs 115 are positioned in the compartments thus formed on opposite sides of the shoulder, the springs being retained in place by the right-hand surface of the sprocket 110 and the flat surface of the opening 113. A sprocket chain 116 is connected between the sprocket wheels 109 and 97, and a similar chain is connected between the sprocket wheels 110 and 99. A chain 117 is connected between the sprocket wheel 101 and the sprocket wheel 85 (Figure 5), and a chain 118 is connected between the sprocket wheel 95 and a sprocket wheel 119 which is carried on the end of the other rod 70, as can best be seen in Figure 6.

Assuming that the hand wheel 105 has been neither moved inwardly or outwardly but is in the position shown in Figure 11, so that the key 107 contacts both keyways 111, 112 in the sprocket wheels 109, 110, any movement of the wheel in either direction will rotate both sprockets 109, 110, causing a similar rotation of the sprockets 97 and 99. Rotation of sprocket 97 will rotate the sprocket 95, and the rotation of sprocket 99 will cause rotation of the sprocket 101. The sprocket 101 will rotate the sprocket 85 and the sprocket 95 will rotate the sprocket 119 (Figure 6), thus rotating both of the rods 70 at the same rate of speed and in the same direction. As these rods rotate the threaded portion which passes through the nuts 69 will cause the carriage on which the assembly 15 is mounted to move either to the right or left, depending on the direction in which the hand wheel 105 is turned.

Let us now assume that the hand wheel is pressed to the left against the left-hand spring 115, and causing the key 107 entirely to leave the keyway 112 and completely to engage the keyway 111. If the wheel 105 is turned under these conditions only the sprocket 109 will be rotated and the sprocket 97 so that the sprocket 119 will be turned. The opposite sprocket 85 will remain stationary. A rotation of the right-hand rod 70, as seen in Figure 6, will cause the carriage to swing around the circular nut 69 of the other rod as a pivot so that the carriage and the clamping assembly mounted thereon will now be canted with respect to the opposite carriage and its assembly. The clamping assemblies may be caused to extend at an acute or an obtuse angle with respect to one another, depending on the direction in which the wheel 105 is turned.

On the other hand, if the hand wheel 105 were to be pulled outwardly, i. e., to the right as seen in Figure 11, so as to compress the other spring 115, the key 107 will entirely leave the keyway 111 and will completely engage the keyway 112. Thus any rotation of the wheel will turn the sprocket 110, and through the sprockets 101 and 85 will cause the left-hand rod 70, as seen in Figure 6, to rotate. Under these circumstances the carriage on which the clamping assembly is mounted will now pivot about the cylindrical nut 69 of the opposite rod 70, and in a direction depending on the direction of rotation of the wheel

105. Thus the left-hand end of the assembly is moved in a horizontal direction with respect to the right-hand end in order again to provide a cant between the line of clamping units.

As shown in Figure 2, there is a hand wheel 105 and its associated apparatus at each side of the machine in order to cant either one or both of the jaw assemblies 15 in any horizontal direction, or to move either or both of the assemblies along parallel paths either toward or away from the platen 6. The operation performed by the hand wheels is usually of a preliminary nature and represents an adjustment which is determined by the size and shape of the strip to be stretched, also by the configuration into which the strip is to be stretched. In order to remove the slightest possibility of the adjusting mechanism obstructing the view of the operator during the stretching process, the bar and its hand wheel and sprocket mechanism can be swung at the hubs 89, 90 from its vertical to its horizontal position or beyond, and if necessary a well or other depression may be provided in the floor to receive the hand wheel and its associated apparatus. There is ordinarily no need to reinstate the bar 91 in its vertical position until either changes in the size of the strip or in the shape of the piece to be formed shall be required.

Auxiliary main cylinder apparatus

In certain lengths or widths of strip material, or in the case of certain shapes into which the strip is to be formed, it may be necessary to arrange the platen lengthwise of the machine. It will be noted that in Figures 2, 3 and 5 the platen has been shown transverse of the machine. As shown in Figure 7, an extra pair of main cylinders 120 (of which only one cylinder is shown in this figure) may be provided, this line of cylinders being displaced from the other line of main cylinders ninety degrees. As in the case of the other main cylinders 8, rams 121 may be provided which terminate in hemispherical heads 122. These heads fit in spherical openings formed at the ends of the platen 123. It will be noted that the upper surface of the platen contacts the strip 125 throughout a much greater distance than the platen 6 in the case of the transversely positioned main cylinders. Thus the punch 124 produces an object of considerably different shape from that formed by the punch 5. Another point of difference between the two types of punches is that in the case of the punch 5 contact with the strip 12 is made at the start of the pressing operation only at the uppermost surface of the punch, allowing a complete stretching movement of the metal strip between this surface and each clamping unit until the platen has reached its uppermost position, at which time full contact over the entire surface of the punch is made. The feature of preventing full contact between the punch and the strip during the initial stretching operation is enhanced by the fact that the assemblies 15 are spread wide apart at the start of the stretching operation, thus causing the strip to leave the punch at a tangent. Obviously, the closer to a straight line that both sides of the strip leave the punch 5, the less will be the friction at the slippage surface on the punch.

As in the case of the main cylinders 8, the auxiliary main cylinders 120 are carried on trunnions 126 which are secured to the frame in any suitable manner, permitting the cylinders and the contained ram to swing in the vertical direction. Thus any stresses set up in the cylinders or in the rams during the stretching operation, caused by unequal pressure in the cylinders or by the difference in travel of the respective rams, are equalized. The cylinders are maintained in a normal vertical position by means of springs 127, which are maintained at the proper height by means of countersunk plates 128 secured to the frame, and which receive the springs. A similar arrangement is employed in connection with the transversely positioned main cylinders.

One point of difference between the two sets of main cylinders is that the cylinders 8 are positioned so close to the ends of the carriage on which the clamping assembly is mounted as to prevent rotation on the trunnions 10 except for the amount of rotation necessary to relieve the cylinders of unequal stress. On the other hand, the auxiliary cylinders 120 are positioned relatively far removed from the carriage so that when these cylinders are not in operation they may be rotated the full ninety degrees to get them out of the way, and prevent any obstruction to the operator's view. In order to assure full clearance for the vertical movement of the auxiliary cylinders, the plate 64 on which the clamping assembly is mounted may be provided with a cutaway portion, as indicated at 129. In Figure 6 the hydraulic system by which the auxiliary cylinders 120 are selectively operated will now be explained.

Hydraulic circuit

The hydraulic system is shown in Figure 1. The fluid pressure for actuating the cylinders 8 and the auxiliary cylinders 120 is obtained from the main pump 130. The high pressure side of the pump is taken through a conduit 131, into a valve 132 which is controlled by a hand-operated lever 133. A conduit 134 is taken from the valve 132, into a valve 135 which is controllable by a hand-operated lever 136. From the valve 135 a conduit 137 passes into one of the cylinders 8, another conduit 138 passing from the valve 135 to the auxiliary cylinder 120. A conduit 139 is taken from the valve 132, through a conduit 140 to the tank 141. The low pressure side of the pump 130 is connected to the tank through the conduit 142. A similar set of hydraulic connections and valves is provided for the other of the main cylinders 8 and for the other of the auxiliary cylinders 120, and will be given similar reference numerals. A conduit 143 is taken from the tank 141 to a four-way valve 144 of suitable and well known type, and controlled by a lever 144', which has forward, neutral and reverse positions. Two conduits 145, 146 extend from this valve and connect respectively with conduits 147, 148 which lead to the opposite sides of the pistons contained in the cylinders 79. The valve 144 is provided with high pressure fluid through a conduit 149 by the pump 150, the low pressure side of which is connected by a conduit 151 to the tank 141. The hydraulic system for one pair of cylinders 79 is the same as for the other pair so that both systems will be designated by the same reference characters.

Assuming that the pumps 130 and 150 are actuated, for example, by means of an electric motor, and the valves 132 have been adjusted to admit pressure fluid to the cylinders 8, thus causing the platen 5 to rise. As the platen continues to ascend it may be necessary to move the clamping assemblies 15 inwardly in order to allow a predetermined amount of upward movement of the

metal strip 12. The operator would then move the valve 144 by the lever 144' into the forward position, which would cause pressure fluid to be admitted to the conduits 146 and therefore to the outside surfaces of the pistons contained within each pair of cylinders 79. The movement of the lever 144' would also cause any pressure fluid contained between the inner surfaces of the pistons and the cylinders 79 to be exhausted through the conduits 145, 143 to the tank. Thus the rams 77 and the jaw assembly 20, 21 are moved inwardly at a rate depending on the rate at which pressure fluid is admitted to the opposite sides of the pistons. A skilled workman can, after little experience, determine how fast to admit pressure fluid to the conduits 146 in order to regulate the inward movements of the clamping assemblies. At the same time the operator will control the levers 133 to regulate the rate of admission of pressure fluid to the main cylinders 8.

If during the stretching operation it is desired to maintain the clamping assemblies rigid at a particular position, i. e., so that they no longer move inwardly, the operator will move the lever 144' of the valve 144 to its neutral position, which in the case of a four-way valve prevents the admission of high pressure fluid to the conduits 146 and also prevents the exhausting of fluid through the conduits 145. Thus the pistons in the cylinders 79 are maintained rigid in their last position.

After the stretching operation the strip in its formed shape is removed from the clamping units 20, 21 by rotating the levers 57 (Figure 6), which as pointed out hereinbefore, serves to move the blocks 21 outwardly away from the strip. The clamping assembly 20, 21 can then be returned to its initial position, ready for the insertion of a fresh metal strip, by moving the lever 144' to its reverse position, at which time high pressure fluid is admitted to the conduits 145, causing the pistons within the cylinders 79 to be moved outwardly and carrying the assemblies with them. In case it is desired to stretch the metal strip by turning the platen 6 ninety degrees from the position shown in Figure 1, and thus to actuate the cylinders 120, the latter are rotated from their normal horizontal position to a vertical position in any suitable manner, and when placed in position under the platen the valves 135 are moved to cause high pressure fluid to enter the conduits 138. Control of this pressure fluid can be maintained at the valve 132 in the same manner as the control of the pressure fluid admitted to the main cylinders 8.

From the foregoing it is evident that there is disclosed a stretching press having the greatest universality of use in that provision is made for permitting any amount of slippage or full clamping effects at the clamping assemblies by individually adjusting the blocks 21 at the bolts 36. The refinement to which the slippage effects can be carried is determined solely by the number of individually adjustable blocks into which each assembly is divided. As another preliminary adjustment, there is also a means provided for canting one or both lines of clamping units in any horizontal plane to accommodate the complex shape into which the metal strip may be stretched. The clamping units as a whole may also be moved parallel to one another.

The hydraulic circuit shown in Figure 1 is so arranged that the operator may not only control the admission of pressure fluid to the main stretching cylinders but also control the rate at which the clamping assemblies are caused to move toward or away from the platen, or if desired maintained in a rigid position with respect to the platen. There is also provided a convenient means for releasing the strip from the blocks by simply moving a pair of levers 57. It will be noted that pressure fluid is admitted separately to the cylinders 8, this fluid being under the control of the individual valves 132. Consequently, one end of the punch or die 5 may, if desired, be moved at a faster rate than the other end in case it is necessary to form articles of complicated shape. The fact that the opposite ends of the platen 6 may be raised at different speeds is illustrated in Figure 2 by showing the front edge of the strip 12 in a lower position than the rear edge 12'. Under these circumstances the slippage at that portion of the jaws 15 directly opposite the faster moving ram may be permitted, this slippage being brought about by individual adjustments of each set of blocks 20, 21 at the adjusting bolt 36. Auxiliary stretching cylinders 120 are provided to extend the usefulness of the press in accommodating those formed articles which may be pressed to shape only by arranging the platen at ninety degrees from its usual position. Unequal stresses throughout the stretching cylinders are also relieved by the provision of mounting these cylinders on trunnions. Finally, all of the apparatus which serves to preliminarily adjust the jaws may be swung away from the press so as to give the operator a clear view of the work during the stretching operation.

It will be understood that I desire to comprehend within this invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a stretching press, a pair of spaced clamping devices for gripping a metal strip to be stretched, a platen positioned between said devices, and means for moving the devices toward and away from the platen as the stretching operation proceeds, and means comprising a pair of actuating members pivotally secured at spaced points to each clamping device, and a single means for driving said actuating members including means for driving them at will in the same or in opposite directions.

2. In a stretching press, a plurality of spaced clamping devices for gripping a metal strip to be pressed, a stretching platen positioned between said devices, at least one of said devices being adapted to be moved in a plane at right angles to the direction of movement of the stretching platen, and means comprising a pair of actuating members pivotally secured at spaced points to each clamping device, and a single means for driving said actuating members including means for driving them at will in the same or in opposite directions.

3. In a stretching press, a plurality of spaced clamping assemblies for gripping a metal strip to be stretched, a stretching platen positioned between the assemblies, at least one of said assemblies being swivelly mounted on the press and at least one of said assemblies being adapted to be moved toward and away from the platen, and means external of the press for giving the assemblies any desired angle with respect to one another and for moving the assemblies toward and away from one another, and means compris-

ing a pair of actuating members pivotally secured at spaced points to each clamping device, and a single means for driving said actuating members including means for driving them at will in the same or in opposite directions, or selectively to drive either actuating member in one or the other direction while the other actuating member remains stationary.

4. In a stretching press, a pair of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the devices and adapted to move in a vertical direction, both of said devices being mounted for movement in a horizontal direction about pivots intermediate the ends of said devices whereby said devices can be given any desired cant with respect to one another and with respect to the platen, and means including a hand wheel for manually moving said devices about their pivots so as to control the distances between corresponding points on the devices throughout their lengths, said last named means further including means comprising a pair of actuating members pivotally secured at spaced points to each clamping device, said hand wheel being connected to said last named means whereby said devices may be moved at will by means of said hand wheel in the same, or in opposite directions.

5. In a stretching press, a plurality of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the devices, at least one of said devices being swivelly mounted on the press and at least one of said devices being adapted to be moved toward and away from the platen, means external of the press for giving the devices any desired angle with respect to one another and for moving the devices toward and away from one another, a rod for actuating the swivel of the swivelly mounted device, and a hand wheel on a vertical support for operating said rod, said hand wheel being adapted to be swung out of the vertical to an approximate horizontal position in order to remove the hand wheel and its support from the operator's view.

6. In a stretching press, a pair of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the devices, said devices being mounted on pivot rods which extend in a direction parallel to the axis of the platen, said pivot rods being adapted to be moved toward and away from one another, whereby the devices may take positions which represent the composite movement of the rotation of the devices about their pivot rods and the movement of the pivot rods with respect to one another, and means comprising a pair of actuating members pivotally secured at spaced points to each clamping device, and a single means for driving said actuating members including means for driving them at will in the same or in opposite directions, or selectively to drive either actuating member in one or the other direction while the other actuating member remains stationary.

7. In a stretching press, a plurality of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the devices, at least one of said devices being swivelly mounted on the press for canting the device with respect to the platen, each portion of said device also being adapted to be moved throughout equal distances toward and away from the platen, and a common means for changing the angle that the device makes with the platen and for moving the devices with respect to the platen, said means including rods which are secured to opposite ends of the device, and means including a common actuator for moving the rods through unequal distances and in different directions in order to cant the device, said actuator also being adapted to move the rods through the same distances and in the same direction.

8. In a stretching press, a plurality of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the devices, at least one of said devices being swivelly mounted on the press for canting the jaw with respect to the platen, said device also being adapted to be moved throughout equal distances over its entire length toward and away from the platen, a common means for changing the angle that the device makes with the platen and for moving the device with respect to the platen, said means including rods which are secured to opposite ends of the jaw, and means for moving the rods through unequal distances and in different directions in order to cant the device, said last-mentioned means also including mechanism by which the rods are moved the same distances and in the same direction, the mechanism for canting the device and for moving the same bodily with respect to the platen being constituted of a sprocket chain transmission and a hand wheel for actuating the transmission, separate connections from said transmission to said rods to effect their movement in opposite directions, or in the same direction, at will, said hand wheel being mounted on a shaft and adapted to be moved in a direction along the shaft, the said common means further including means whereby when the hand wheel is moved to its innermost position one portion of the sprocket chain transmission is operated to move one of said rods, and further including means whereby when the wheel is at its other extreme position the other of said rods is moved to effect a different cant at the device, and further including means whereby when the hand wheel is in a position intermediate its two extreme positions both of said rods are moved equally in order to move the device throughout equal distances and over its length toward and away from the platen.

9. In a stretching press, a stretching platen, and means including rams positioned at opposite ends of the platen for moving the platen in a vertical direction during the stretching operation, said rams being contained in cylinders which are pivotally mounted on horizontal axes, said pivotal mountings being located in positions to provide for movement of said cylinders from their vertical stretching positions 90° to horizontal inoperative positions in order to prevent obstruction of the operator's view.

10. In a stretching press, the combination of a pair of longitudinally extending clamping devices, a platen positioned between said devices, hydraulic means for moving both ends of the devices with respect to the platen and through equal distances, and hand-operated means and connections from said means to said clamping devices constructed and arranged for controlling the movement of and aligning the clamping devices at an angle with respect to one another.

11. In a stretching press, the combination of a pair of longitudinally extending clamping devices, a platen positioned between the devices, separate hydraulically operated means for moving the devices independently of one another toward and away from the platen, a pair of rams

disposed at opposite ends of the platen, and hydraulic means for operating said rams independently of one another to cause them to move in directions at right angles to the directions of movement of said devices whereby the position of each device with respect to the platen and the position of each of said rams with respect to the devices can be independently controlled.

12. In combination, a clamping device comprising a rail member having a groove along the length of the rail and containing an inner and an outer set of blocks, each set comprising two rows of blocks, said inner rows of blocks being adapted to receive a strip of metal, the outer set of blocks being in contact at the side and bottom with said groove, yielding means for holding the inner row of blocks from the bottom of the groove, the inner and outer sets of blocks being secured together by toggle mechanism, and means including bolts passing between the inner and outer sets of blocks said bolts having projecting portions in engagement with said inner blocks and said bolts being secured to a rigid bar for causing the inner set of blocks to be simultaneously moved toward the bottom of the groove so as to cause separation of the blocks of the inner set from one another and thus to open the clamping device, said means comprising a rod one end of which is adapted to rotate in said rigid bar and the other end carrying a lever which is positioned external of the machine for rotating the rod, said rod being provided with a cam surface which bears against a wearing plate whereby upon rotation of the rod said cam surface moves said bar to thereby cause movement of the inner set of blocks with respect to each other and to open said clamping device.

13. In a stretching press, a plurality of spaced clamping devices for gripping a metal strip to be stretched, a stretching platen positioned between the clamping devices, at least one of said devices being swivelly mounted on the press and at least one of said devices being adapted to be moved toward and away from the platen, and means external of the press for giving the clamping devices any desired angle with respect to one another and for moving the devices toward and away from one another, said means comprising a pair of round-headed swivels positioned along one clamping device and rods threaded into said swivels, said rods extending to a position external of the press, separate sets of sprocket and chain connections and a single manually operable member therefor for operating said rods simultaneously, and means to render inoperative at will either of said sets of connections while the other set of connections remains in operation in order to cause the clamping devices to rotate around either of said swivels.

14. In combination, a clamping device comprising a rail member having a groove along the length of the rail and containing an inner and an outer set of blocks, each set comprising two rows of blocks said inner rows of blocks being adapted to receive a strip of metal, the outer set of blocks being in contact at the side and bottom with said groove, yielding means for holding the inner row of blocks from the bottom of the groove, the inner and outer sets of blocks being secured together by toggle mechanism, and means including bolts passing between the inner and outer sets of blocks and secured to a rigid bar for causing the inner set of blocks to be simultaneously moved toward the bottom of the groove so as to cause separation of the blocks of the inner set from one another and thus to open the clamping device, said last-mentioned means also including at least two rods, the corresponding ends of which are adapted to rotate in said bar and the other ends are extended to the exterior of said device, and common means for rotating said rods simultaneously, said rods having cam surfaces which are adapted to bear against wearing plates whereby upon rotation of the rods by the common means the cam surfaces cause the bar to be moved into a position such as to open the clamping device.

15. In a stretching press, a plurality of pairs of hydraulically operated rams, said pairs of rams being positioned in different vertical planes, and each pair being selectively adapted to engage a common stretching platen, all of said ram pairs being mounted on horizontal pivots and at least one of said ram pairs being adapted to be swung from the vertical to the horizontal position.

16. A metal stretching press which includes a clamping device for gripping a metal sheet, a press platen, a carriage and fluid operable motor means including a reciprocable member for varying the position of said clamping device relative to the press platen, said clamping device being pivotally connected to said carriage, said carriage being movable on the press and rigidly connected to said reciprocable member.

17. A metal stretching press with a press platen, a metal sheet clamping device movable relative to the press platen, a fluid operable motor, a carriage, said motor having a reciprocable member rigidly connected with the carriage, said carriage being movable on the press and carrying two spaced pivots associated with the clamping device, each of said pivots constituting a single point of rotation about which the opposite end of its respective clamping device is adapted to move.

18. A metal stretching press with a press platen, a metal sheet clamping device movable relative to the press platen, a fluid operable motor, a carriage, said motor having a reciprocable member rigidly connected with the carriage, said carriage being movable on the press and carrying two spaced pivots associated with the clamping device, each of said pivots constituting a single point of rotation about which the opposite end of its respective clamping device is adapted to move, each of said pivots being formed as a nut which is threadedly engaged by an adjusting screw.

19. A press according to claim 18 in which the adjusting screws are drivingly connected with a driving element common to said screws and operable selectively to actuate only one of said screws and both of said screws simultaneously.

PAUL E. FLOWERS.