

PATENT SPECIFICATION (11)

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(54) IMPROVEMENTS IN OR RELATING TO PUNCH PRESSES

(71) We, U.S. AMADA LIMITED, a company organised under the laws of the State of Washington, one of the United States of America, of 615 8th Avenue South, Seattle, Washington, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a punch press and, more particularly, to a punch press in which the workpiece is movable along both X and Y axial directions.

Numerically controlled punch presses of the type in which the workpiece is moved in the X and Y axial directions have heretofore employed conventional C-shaped frame configurations. This standard C-shaped frame configuration press has several distinct disadvantages. One is that under punching load the C-frame structure is subjected to deflection between the upper and lower arms of the C-frame. This deflection takes a pivotal motion at approximately the centre position of the back upright of the C-frame. Secondly the deep-throat C-frame used for large workpieces is further subjected to a side-to-side movement, causing change in alignment of the upper and lower pressarms. Both of these conditions result in poor hole quality and short punch and die life.

In the past it has been the general practice to use massive proportions for these C-frame structures to overcome the above disadvantages or at least minimize them within some usable limits. The massive proportions, of course, increase substantially the cost of the press and where deep throats are needed to increase the capacity of the machine the massive proportions take up a substantial amount of the press user's floorspace. Another disadvantage with prior art machines has been that their massive size has required the workpiece supporting tables be separate from the punch press frame. As a result installation of the press and table at the user's plant has required elaborate and ex-

pansive bed preparation and highly skilled installers to ensure that the press and table are accurately aligned relative to one another.

According to the present invention there is provided a punch press having a base, an upper frame which is connected to the base, the base and the upper frame defining a workpiece receiving area therebetween, means for supporting a workpiece in the workpiece receiving area, means for moving the workpiece in mutually perpendicular directions to position the workpiece in the workpiece receiving area, a ram, a downwardly movable striker beneath the ram, means for holding a punching tool beneath the striker, and means supporting the ram and striker centrally on the upper frame so that forces on the striker resulting from engagement of the punching tool with the workpiece cause upward deflection of the upper frame substantially equally on opposite sides of the ram to maintain alignment of the tool, with respect to the striker, and to symmetrically distribute the load along the upper frame.

Preferably, the upper frame and the base are elongate, the ends of the upper frame being connected to the base by means of corner posts.

Advantageously, the positioning means includes workpiece engaging means movable adjacent the surface of a workpiece support table forming part of the workpiece support means which further comprises a plurality of members movable from a first position in which the members are disposed below the workpiece engaging means, to a second position in which the members project above the surface of the table, and *vice versa*. Conveniently, cams are provided for moving the members, the cams comprising cam shafts extending in an X axial direction below, and parallel to, respective rows of the members, each cam shaft having a flat which, on rotation of the cam shafts engages the members of a respective row thereby lowering the members to the first position and means for

sequentially rotating the cam shafts to bring the flats thereof into contact with respective rows of the members as the workpiece engaging means moves in a Y axial direction.

5 Preferably, the workpiece support means comprises a central table which is fixed on the base, and lateral side tables which are supported by the base for movement relative thereto. The means for sequentially
10 rotating the cam shafts may comprise a cam surface movable with the side tables.

For a better understanding of the present invention, and to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:—

Figure 1 shows a perspective view of a turret punch press in accordance with the present invention,

20 Figure 2 shows a perspective view of part of the punch press of Figure 1, and

Figure 3 shows a side view, partly in cross-section, of part of the apparatus of Figure 1.

25 Referring now to the drawings, the turret punch press comprises two sets of legs 12 joined by plates 14 which rest on the floor or other support surface commonly employed at the user's site. The legs are
30 joined to a support frame 16 comprised of a lower frame 18 and an upper frame 20. The upper frame 20 is supported by the lower frame by four corner posts 22. Bolts 24 are passed through the upper and lower
35 frames and the corner posts and are provided with nuts 26 to draw the frames tightly together. As thus far described the press frame can be visualized as two C-frames facing one another with their arms joined
40 together at the centre. The upper frame 20 is thus in the form of a bridge spanning the four corner posts and spaced from the lower frame to define a work area WA.

45 Mounted in the work area WA is a tool holding turret mechanism 28 comprising an upper turret 30 and a lower turret 32. As is conventional the upper turret holds a plurality of circumferentially spaced punches and the lower turret 32 holds corresponding dies.
50 The turrets are rotated to position a tool at the desired punching location by a sprocket and chain rotary drive 36.

The upper frame includes a flywheel 38 driven by belts 40 from a motor 42. A shaft
55 44 is fixed to the flywheel and extends across the midsection of the upper frame to a similar flywheel on the opposite side of the frame. Mounted on the shaft 44 is a conventional ram and striker 46. The striker is driven by the ram against the selected tool and at the precise moment as dictated by a
60 programmed numerical control. Since the striker is movable only in the vertical plane and is positioned exactly at the midsection of the frame the reaction load on the striker

will be distributed over the upper frame so that the frame is deflected along its entire length. As a result the striker will remain vertically aligned with the tool regardless of
70 the amount of deflection.

The workpiece is supported in the work area WA by a fixed central table 50 having a plurality of workpiece supporting posts 52. As can be readily seen this central table
75 may be of substantial width along the Y axial direction resulting in a large capacity but without making the upper and lower frames of massive dimensions to withstand the load.

80 Joined to the lower frame 18 are side tables 54 which are movable along the Y axial direction relative to the fixed central table 50. The side tables are supported solely by the lower frame so that alignment tolerances between the tables and the tool
85 in the turrets may be obtained accurately during the manufacturing of the press and need not be adjusted during or after installation at the user's site.

90 The side tables 54 are guided for movement in the Y axial direction on the lower frame 18 by guidebars 56 that are slidably received in a carriage way 58. The side tables are supported in the vertical plane by
95 inner and outer swinging support members 62 and 64 respectively. Inner support member 62 swings about a pivot 66 secured to the lower frame 18. The pivot 66 is similar to a door hinge and allows free horizontal swinging movement but prevents vertical
100 movement. The outer support member is coupled to the inner support member by a second hinge or pivot 68 which also precludes movement in the vertical direction but
105 allows the outer member to swing relative to the inner member. The outer support member 64 is provided at its outer end with a sleeve 70 which rotatably receives a support post 72. The post 72 is secured to a
110 plate 74 on its upper end which is secured to the underside of the side table. During reciprocating motion of the side table along the lower frame 18 the weight is transferred to the swinging support member with the
115 plate 74 moving in a purely linear direction.

Coupled to the side tables 54 for movement therewith is a workpiece positioning
120 mechanism 76. The positioning mechanism includes an elongated guideway 78 in which is mounted a slidable carriage 80. The carriage 80 is slid relative to the side tables in the X axial direction by a bi-directional motor and screw mechanism 81. Coupled to the
125 slidable carriage 80 are workpiece clamps 82. The guideway 78, carriage 80 and clamps 82 are of conventional construction the details of which will be apparent to one skilled in the art. The numerically controlled programmer, in a manner well known, will

position the carriage 80 relative to the tables in the X axial direction.

The carriage 80 and guideway 78 along with the side tables 54 are moved together in the Y axial direction by a bi-directional motor and screw mechanism 84. As is readily apparent movement in the Y axial direction is guided by the guide bars 56 and carriage way 58.

As is best shown in Figure 3 movement of the clamps 82 toward the turrets 28 will bring them past the rows of workpiece support posts 52 so that movement in the X axial direction would then result in interference between the clamps and posts. It thus becomes necessary to lower the posts on the central table out of the path of the clamps 82. For this purpose the carriage way 58 is provided with an upper cam edge 86 which engages a cam follower 87 on each of a plurality of elongated cam shafts 88 which extend across the underside of the central table 50 in the X axial direction. The cam shafts 88 are provided with flats 89 aligned below each of the workpiece support posts 52. As is readily apparent rotation of a cam shaft will cause simultaneously lowering of a row of workpiece support posts onto the flats. Rotation of the cam shafts to move the posts off the flats will raise the posts. Springs 90 normally bias each cam shaft in a counterclockwise direction to raise the posts. Thus movement of the carriage way 58 will automatically lower the posts out of the path of the clamps 82.

WHAT WE CLAIM IS:—

1. A punch press having a base, an upper frame which is connected to the base, the base and the upper frame defining a workpiece receiving area therebetween, means for supporting a workpiece in the workpiece receiving area, means for moving the workpiece in mutually perpendicular directions to position the workpiece in the workpiece receiving area, a ram, a downwardly movable striker beneath the ram, means for holding a punching tool beneath the striker, and means supporting the ram and striker centrally on the upper frame so that forces on the striker resulting from engagement of the punching tool with the workpiece cause upward deflection of the upper frame substantially equally on opposite sides of the ram to maintain alignment of the tool, with respect to the striker, and to symmetrically distribute the load along the upper frame.

2. A punch press according to Claim 1, wherein the upper frame and the base are elongate, the ends of the upper frame being

connected to the base by means of corner posts.

3. A punch press according to Claim 1 or 2, wherein the positioning means includes workpiece engaging means movable adjacent the surface of a workpiece support table forming part of the workpiece support means which further comprises a plurality of members movable from a first position in which the members are disposed below the workpiece engaging means, to a second position in which the members project above the surface of the table, and *vice versa*.

4. A punch press according to Claim 3, wherein cams are provided for moving the members, the cams comprising cam shafts extending in an X axial direction below, and parallel to, respective rows of the members, each cam shaft having a flat which, on rotation of the cam shaft, engages the members of a respective row thereby lowering the members to the first position, and means for sequentially rotating the cam shafts to bring the flats thereof into contact with respective rows of the members as the workpiece engaging means moves in a Y axial direction.

5. A punch press according to any one of the preceding claims wherein the workpiece support means comprises a central table which is fixed on the base, and lateral side tables which are supported by the base for movement relative thereto.

6. A punch press according to Claim 5 when appended to Claim 4, wherein the means for sequentially rotating the cam shafts comprises a cam surface movable with the side tables.

7. A punch press according to Claim 5 or 6 including side table supporting means comprising a pair of hinged inner and outer support members, the inner support member being hinged to the base for pivotal movement only in the horizontal plane, the outer support member being hinged to the inner support member also for movement only in the horizontal plane, and means rotatably mounting the side table to the outer member whereby the support members are free to swing while the side tables are reciprocated in a linear direction.

8. A punch press according to Claim 5, 6 or 7, wherein the workpiece positioning means comprises first means for moving the workpiece over the central table and the side tables in an X axial direction and second means for moving the workpiece and the side tables in the Y axial direction, and wherein the base is the sole support for the central table and the side tables.

9. A punch press according to any one of the preceding claims, wherein the means

position the carriage 80 relative to the tables in the X axial direction.

The carriage 80 and guideway 78 along with the side tables 54 are moved together in the Y axial direction by a bi-directional motor and screw mechanism 84. As is readily apparent movement in the Y axial direction is guided by the guide bars 56 and carriage way 58.

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7. A punch press according to Claim 5 or 6 including side table supporting means comprising a pair of hinged inner and outer support members, the inner support member being hinged to the base for pivotal movement only in the horizontal plane, the outer support member being hinged to the inner support member also for movement only in the horizontal plane, and means rotatably mounting the side table to the outer member whereby the support members are free to swing while the side tables are reciprocated in a linear direction.

8. A punch press according to Claim 5, 6 or 7, wherein the workpiece positioning means comprises first means for moving the workpiece over the central table and the side tables in an X axial direction and second means for moving the workpiece and the side tables in the Y axial direction, and wherein the base is the sole support for the central table and the side tables.

9. A punch press according to any one of the preceding claims, wherein the means



for holding a punching tool comprises a pair of turrets, means being provided for rotating the turrets to position a tool beneath the striker.

- 5 10. A punch press substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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