SUPPORTING STRUCTURE FOR PUNCH PRESSES AND THE LIKE

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This invention relates to a supporting structure for punch presses or the like and more particularly to a punch press frame made of structural or rolled steel elements welded together and in which novel provision is made for supporting the main crank shaft and for cushioning the movement of the main reciprocating cross head to reduce vibration and undue wear as well as the danger of breakage of the parts. The invention, particularly as embodied in the welded structural steel frame construction is, however, applicable to machines other than punch presses.

The principal object of this invention is to provide a frame for punch presses or the like in which the machine frame is fabricated from rolled or structural steel members, the structural steel members being welded together to form the load carrying frame. By employing welded structural or rolled steel members in place of the usual heavy castings, the machine frame is very much lighter and possesses far more strength and rigidity for its weight, the machine frame is more easily assembled and erected, changes in design can be made and carried out with little additional cost, as compared with the changes in the large patterns required with the usual cast iron or steel frames, and the use of standard rolled shapes also permits the production of the frame at lower cost.

Another aim is to so construct the frame of welded structural or rolled steel members that the welding and fabrication can be accomplished in the most efficient manner and provide the maximum strength and rigidity and also provide the necessary guideways, half bearing supports and other necessary parts of a machine frame.

A still further object is to construct such a frame which is composed of sections, the several sections being removable, held together by tie bolts or other fastening devices so that the machine can be readily dismantled for shipment or for making major repairs upon it.

Another object is to provide means for holding the sections properly positioned with respect to one another, and also to provide means for supporting the lower half bearing in position while the machine is being assembled, the latter being removable, if desired, when the machine is completely set up.

Another object is to place the absorbing springs which cushion the downward movement of the reciprocating die holder or cross head at the sides of the punch press and between columns forming part of each standard of the frame, thereby eliminating the large overhead springs generally employed for this purpose. This placement of the springs not only renders the machine more compact but enhances the appearance of the same as well as cutting down its height and reducing the danger of interference with parts conveyed over the press by a crane or the like.

Another object is to provide a spring absorber so placed at the sides of the machine frame which can be easily repaired or springs replaced should this become necessary.

In the accompanying drawings:

Figure 1 is a front elevation of a punch press embodying my invention.

Figure 2 is an end view thereof.

Figure 3 is a vertical longitudinal section taken on line 3—3, Fig. 2.

Figure 4 is a horizontal section taken on line 4—4, Fig. 2.

Figure 5 is a top plan view of the punch press.

Figure 6 is a front elevation, partly in section, of the cross head or cross beam section of the punch press frame which carries the upper half bearings for the main shaft.

Figure 7 is an end view thereof, partly in section.

Figure 8 is a horizontal section taken on line 8—8, Fig. 6.

Figure 9 is a front elevation of the pair of standards or legs which support the working parts of the machine and also carry the lower half bearings for the main crank shaft.

Figure 10 is a side view of one of the standards or legs shown in Fig. 9.

Figure 11 is a top plan view of standards or legs taken on line 11—11, Fig. 10.

Figure 12 is a horizontal section taken on line 12—12, Fig. 10.

Figure 13 is a side elevation of the fabricated base or pedestal on which the standards or legs of the machine frame are mounted.

Figure 14 is a front elevation thereof.

Figure 15 is a top plan view of the base.

Figure 16 is a horizontal section through the base taken on line 16—16, Fig. 13.

Figures 17 and 18 are vertical sections taken on the correspondingly numbered lines of Fig. 16.

Fig. 19 is a perspective view of one of the lower half bearings, shown in Figs. 9 and 11.

Similar reference numerals refer to like parts in each view.

The frame embodying my invention is shown as a punch press frame and consists of a base A composed of structural or rolled steel parts welded together, a pair of similarly constructed legs B and C rising from the opposite ends of the base and an upper cross head or beam...
D which carries the lower and upper half bearings for the main crank shaft 20. The movable parts carried by this frame can be any usual construction and as shown in the punch press illustrated include a crank 21 formed centrally in the main shaft 20 and carrying a pitman or connecting rod 22. This connecting rod is connected to a reciprocating cross head 23 by a universal joint 24, this cross head being guided for vertically reciprocable movement in the machine frame as hereinafter described. The movable cross head 23 is adapted to carry the male die (not shown) which coats with a female die (not shown) carried on the table formed by the base or pedestal A.

The main shaft 20 is turned to reciprocate the movable cross head 23 and its male die by means of a train of gears including a large gear wheel 25 fast to the main drive shaft 20 at one side of the machine frame and a pinion 26 which meshes with a pinion 28 fixed to a counter shaft 27. This counter shaft 27 is carried by a bearing 29 secured to the standard C hereinafter described, and at the opposite side of this bearing 29 the counter shaft 27 is by a universal joint 24 connected to a large gear wheel 20 which meshes with a pinion 30 carried by a power shaft 31. This power shaft 31 is journaled at one end in a bearing 32 which is secured to the counter head D of the machine frame as hereinafter described, and at its opposite end is journaled in a bearing 33 at the end of an arm 34 which is secured to the side of the standard B as hereinafter described. The power pulley 35 is loosely mounted on the power shaft 31 and transmits power through a disk clutch 36, this clutch being operatively connected to a hand lever 37 which is operatively connected with the disk clutch 36 by a rock arm 38 and shipper rod 39. The pulley 35 can be driven by the usual belt (not shown).

It is apparent that upon closing the clutch 36 through the manipulation of the hand lever 37 the driving pulley will rotate the power shaft 31, pinion 30, gear 29, counter shaft 27, pinion 28, large gear 25 and main crank shaft 20. This rotation of the main crank shaft 20 reciprocates the pitman 22, universal connection 24 and movable cross head to move the dies (not shown) toward and from another and form or punch the metal blank placed therebetween.

The base or pedestal A of the machine frame, as best shown in Figs. 15-18, is constructed of structural steel parts, welded together, as follows.

The base or pedestal section A is generally of H-shaped form having a central cross part 40 and four horizontally projecting legs 41 at its corners. The bottom of this base is composed of a machined base or bottom plate 42 which is of rectangular form in plan and is comparatively thick. Spaced above this bottom plate 42 is an upper horizontal plate 43 which forms the table on which the female or stationary die is placed, this plate having for this purpose a central rectangular opening 44. The upper plate 43 is comparatively thick and is formed to provide four extensions 45 at its corners which form part of the feet 41 of the completed base.

The plates 42 and 43 are connected together by a number of risers each of which is made of rolled plate or bar stock and is welded at its edges to the corresponding or opposing faces of the two plates 42 and 43. A pair of these risers 46 are arranged at opposite outer sides of the base A, the upper side or edge of each of these risers 46 being welded to the under side of the upper plate 43, as indicated at 47, and extending in the direction of the extension 45 of this upper plate, and the lower edge of this riser being cut out to receive the lower rectangular base plate 42 and being welded to its upper face as indicated at 48. The risers 46 are extended beyond the front and rear edges of the base plate 42 and are beveled as indicated at 49 and to the lower edges of these beveled extensions of the risers 46, foot plates 50 are welded.

Spaced inwardly from the outer risers 46 is a pair of parallel inner risers 51, these inner risers being of rectangular form and which are arranged in the tube formed by the risers 46 and 51 and the plates 42 and 43. These strengthening pieces are each welded at one end to the outer riser 46 as indicated at 52 and at its opposite end to the inner riser 51 as indicated at 53, each of these inner risers 51 is provided with a pair of holes 54 which locate the riser at its upper edge and are spaced apart for a purpose which will presently appear.

The corresponding risers 46 and 51 at each side of the base are connected together by two longitudinal pieces of structural steel 55 which are arranged in the tube formed by the risers 46 and 51 and the plates 42 and 43. These strengthening pieces are each welded at one end to the outer riser 46 as indicated at 56 and at its opposite end to the inner riser 51 as indicated at 57; at its outer edge to the under face of the table plate 43 as indicated at 58; and at its lower edge to the upper face of the base plate 42 as indicated at 59. These strengthening pieces 55 are arranged in pairs and in the center of the space delimited by each pair of the strengthening pieces 55 and the risers 46 and 51, the upper plate is provided with a hole 60 and the base plate 42 and foot plate 50 with a hole 61 which holes are adapted to receive the main tie bolts of the machine frame as hereinafter described. The feet 41 of this base are completed by plates or pieces 62, each of which is welded at its lower edge to the upper side of the corresponding foot plate 50 as indicated at 63; at its upper edge to the under side of the corresponding extension 45 of the table plate 43 as indicated at 64; and at its inner end to the adjacent end of the inner riser 51 and the outer face of the adjacent strengthening piece 55 as indicated at 65.

The base A is further strengthened by a pair of cross bars 66 which are arranged between the base plate 42, table plate 43 and risers 51. Each of these cross bars 66 is provided at its opposite ends with extensions 67 which fit into the recesses 54 formed in the risers 51 and each of these cross bars is welded to the risers 51 as indicated at 68; to the upper plate 43 at 69 and to the base plate 42 as indicated at 70. The upper plate 43 is also provided at its opposite sides with a keyway 71 which is employed in securing the correct alignment of the several sections when the machine frame is set up. The upper plate 43 is also provided at its opposite ends with a plurality of bolt holes 72 by means of which the two side standards or supports B and C are removably bolted to the base A in assembly of the machine frame.

It is apparent that a base constructed as described, entirely of structural or rolled steel members welded together provides an inexpensive base having as great or more strength and rigidity than a cast steel base and a great deal less weight. A base so constructed also lends itself to changes in design since all that is necessary is to cut the structural steel parts to conform to...
the new design instead of requiring the making of a new pattern as would be required if the base fixed guides.

The side standards B and C are substantially identical in construction and hence a description of one will be deemed to apply to both. Each of these standards is composed of rolled or structural steel parts welded together and is constructed as follows:

The standards B and C each, as best shown in Figs. 9 and 10, rise from a foot plate 75 which is provided on its under side with a pair of oppositely located guide bars 71 in the base A and is also provided with bolt holes 77 which register with the bolt holes 72 in the base A. A pair of keys 78 are set in the keyways 71 and 72 when the machine frame is being set up to properly position the standards B and C on the base A and bolts 79 are passed through the corresponding bolt holes 72 and 77 to secure the standards B and C to the base A.

Welded at their lower ends to each of the plates 78 as indicated at 80 are a pair of spaced tubular columns 81 and 82. Each of these columns includes an inner channel bar 83, an outer opposing channel bar 84 and an outer plate 85 which is welded to the outer flanges of the channel bars 83 and 84 as indicated at 86. The inner sides of both of the columns 81 and 82 are en- closed along a line 109, the upper flanges of the channel bars 84 and 83 of both columns as indicated at 88 and bridges the space between the two columns. The upper end of each of the columns 81 and 82 is capped by a cap plate 89 each of which is welded to the respective column, as indicated at 90 and provided with a central hole 91 which is arranged over a similar hole 92 in the foot plate 75. The holes 91 and 92 register with the holes 60 and 61 in the upper and base plates of the base A to receive a tie bolt as hereinafter described. Each cap plate 89 is also provided with two keyways 93 and 94 which are arranged perpendicular to one another and receive keys 95 which line up the cross head D with reference to the standards B and C.

The movable cross head 23 is guided by a pair of closed guide bars 96 welded at the rear of the standards B and C and by a pair of adjustable guides 97 at the front ends of the standards. As best shown in Fig. 4, each of the fixed guide bars 96 is welded to the inner side of the inner plate 97 of each standard and is suitably reinforced by triangular pieces 98 and each of the movable guide bars 97 has an inclined or wedge face which engages the movable cross head 23 so that upon moving the guide bars 97 inwardly both the front and rear and the lateral clearance of the cross head 23 is reduced. For adjusting the guide bars 97, each is provided with a laterally extending flange 99 having holes which receive adjusting screws 100, these screws being received in threaded holes provided in a bar 101 which is welded to the front sides of each of the standards B and C.

The standard C also has welded to its rear side a box 102 which can be constructed of welded plates or made in any other suitable manner and the box is screwed or bolted to the bracket which carries the bearing 28 for the counter shaft 27. A plate 104 is also welded to the outer side of the standard B and to this plate is screwed or bolted the arm 34 which carries the bearing 33 for one end of the power shaft 31.

To the outer face of each of the inner plates or webs 87 connecting the columns 81 and 82 of each section B and C is secured a guide bar 105 and cooperating with each guide bar 105 is an angle bar 106 which is welded to the opposing sides of the columns 81 and 82 of each section. These bars 105 and 106 of each section B and C form guideways for the ends of a bracket 107 secured to each side of the movable cross head 23. These brackets 107 can be secured in any suitable manner to the cross head 23 as by screws 108.

The weight of the movable cross head 23 is yieldingly supported in the downward movement by two groups of springs which cushion the downward or operating movement of the cross head and insure smooth action and accurate work and eliminates vibration and undue wear of the machine. Two of such groups of springs are provided, one being arranged at each side of the press between the columns 81 and 82 of each standard B and C. By this means the usual heavy overhead springs are eliminated, thereby decreasing the height of the punch press as a whole and the two groups of springs are also arranged in the most convenient place for repairs and replacements.

Each of these groups of springs, as best shown in Figs. 2–4, includes a pair of primary helical compression springs 109, each of which surrounds one of the rods 110, the upper end of each of these rods 110 being screwed into or otherwise rigidly connected with the corresponding bracket 107 of the cross head 23 and the lower end sliding through openings provided in a bar 111 and a channel bar 112 which channel bar 110 is welded at its ends to the opposing sides of the columns 81 and 82 and is also secured and is also secured. The primary compression springs are relatively light and are interpolated between the bracket 107 and the bar 110 and this bar 110 is connected by a pair of vertical tie or tension rods 114 with a second bar 115. This last bar 115 is slidingly supported on heavy rods 116 which are anchored at their lower ends in the supporting channel bar 112 and the downward movement of the bar 115 is resisted by a pair of comparatively heavy compression springs 117 each of which surrounds one of the rods 116 and is interpolated between the sliding bar 115 and a nut and washer 118 at the lower end of each of the rods 116.

When the cross head 23 is forced downwardly by the crank of the main crank shaft, the bracket 107 is likewise moved downwardly and the pair of relatively light central compression 130 springs are compressed between the bracket 107 and the bar 111, the rods 119 sliding in the bar 111 and the supporting channel 112. At the same time, the spring pressure upon the bar 111 is transmitted through the rods 114 to the bar 115 which is drawn downwardly, slides upon the rods 116 and compresses the springs 117. It is therefore apparent that the downward pressure of the cross head 23 is simultaneously resisted by all four of the springs 109 and 117, the lighter central pair 109, of course, compressing to a greater degree than the outer pair 117, although all of the springs are compressed and released simultaneously.

The upper cross beam or head D is composed entirely of structural steel parts welded together and is preferably constructed as follows:

The head section D includes front and rear plates 125 and 126 which are welded at their ends to vertical end plates 127 and 128 in any...
suitable manner. Extending fore and aft and spaced inwardly from each of the end walls 127 and 128 is also arranged a comparatively thin wall 129 and a comparatively thick wall 130, these walls 129 and 130 being welded at their vertical edges to the adjacent inner faces of the front and rear walls 125 and 126. In each of the spaces between the side walls 127 and 128 and the adjacent inner wall 129 is arranged a pair of vertical channel bars 131, these bars being equally spaced from the front and rear walls 125 and 126 and being welded to the opposing faces of the side walls and the adjacent inner wall 129. These angle bars 131 extend the full height of the walls of the section and the spaces between the lower ends of each of these angle bars 131 and the adjacent wall 129, front or rear wall 125 and 126 and side wall 127 or 128 is enclosed by a rectangular plate 132, these plates 132 being welded in place. These plates 132 each has a pair of keyways 124 which align with the key- ways 93 and 94 of the standards B and C and receive the upper parts of the keys 85 which serve to link or slide with reference to the standards. In a similar manner four cap plates 133 are welded to the top of the section D at the corners thereof, these cap plates extending inwardly to the inner walls 130 and overhanging the channel bars 131. Each of the plates 133 is provided with a hole 134 and each of the plates 133 is provided with a similar hole 135, these holes registering with the holes 91 and 92 in the sections B and C and the holes 60 and 61 of the section A. The overhanging parts of each of the plates 133 are also each provided with a plurality of holes 136, three being shown for a purpose which will presently appear.

A narrow bar 137 is also welded at each end of the head section D, these bars being arranged centrally on top and between the pairs of plates 133 at each end. Each of these bars 137 is welded to the upper edges of the walls 129 and 130 and the adjacent end wall 127 or 128 and each is provided with a pair of holes 138.

The front and rear walls 125 and 126 can be strengthened or stiffened in any suitable man- ner. For example, an angle 139 can be welded to the inside of each of these walls near the upper edge and horizontal channel bars 140 can be welded at their edges to the outside thereof.

Any suitable means can also be provided for supporting the power or drive shaft bearing 32 from this section. For example a box 141 composed of welded steel plates can be welded to the rear side of the rear wall 126 and the bearing 32 detachably secured to this box by screws 142 or the like.

The bearings for the main crank shaft 20 are composed of two half bearings each of which is hung from the upper or cross head section D. The lower half bearing 150 is provided with outwardly extending flanges 151 at its ends and is supported by a cradle which, as best shown in Fig. 19, consists of a horizontal plate 152, three blocks 153 which rise from the plate 152 and are provided with rounded recesses which receive the bearing 150 and spacers 154 between the ends of the blocks 153. Three holes 155 and 156 are provided at opposite sides of the bearing and ex- tends through the bearing and the plate 153 of its supporting cradle, these holes being adapted to receive bolts 157 which carry the bearing, these bolts passing through the holes 156 in the cap plates 133 of the supporting structure. To hold the lower half bearings 150 against axial dis-
As a whole this invention provides a punch press having a frame which can be fabricated at low cost and possesses more strength and rigidity than a cast steel frame and by reason of its construction from standard structural steel elements welded together can be easily varied as to design and size without materially increased cost. The manner of mounting the main crank shaft also greatly facilitates the assembling of the same and at the same time provides strong and easily adjusted bearings for this shaft. The placement of the springs which take the thrust and their arrangement also eliminates the usual overhead springs and provides a spring structure for taking the thrust of the cross head which is reliable in operation, can be easily repaired and will stand up under constant service without getting out of order.

While the invention has been described with reference to a punch press, it is apparent that it can also be used in connection with other similar machines and the invention is therefore to be construed as embracing the full range of equivalents comprehended in the following claims.

I claim as my invention:

1. A frame for punch presses or the like, composed of structural steel members welded together, said frame including a base composed of an upper rolled metal plate, a rolled metal base plate and risers welded at their upper and lower edges and said base and upper base plates and a pair of rolled metal standard members removably secured to and rising from said base, said standards being adapted to support the moving parts of the punch press.

2. A frame for punch presses or the like, composed of a base, a pair of standards composed of structural steel members welded together rising from said base, each of said standards being composed of a pair of rectangular columns each column being composed of three walls made of plates welded together and the fourth wall of each of said columns comprising a plate connecting each pair of columns and means for supporting the moving parts of the punch press from said standards.

3. A frame for punch presses or the like, comprising a base, standards rising from said base and a cross head connecting the upper ends of said standards, said cross head being composed of front, rear and side plates welded together, lower and upper plates welded to said front, rear and side plates, and internal and external structural steel strengthening members welded to said plates, and means for supporting the working parts of the punch press from the frame.

4. A frame for punch presses or the like composed of a base section, standards rising from said base section and a cross head connecting the upper ends of said standards, tie means for holding the several sections together and means for supporting the moving parts of the punch press from the frame, said standards being composed of a base plate and a top plate spaced above said base plate, side plates rising from said base plate and welded at their upper and lower edges to said top plate and base plate, risers parallel to said side plates and spaced inwardly therefrom and welded at their upper and lower edges to said top plate and base plate, cross risers between said inner risers and said top and base plates and welded at their edges to said inner risers, top and base plates and spacers between said top, side and base plates and said inner risers and welded at its edges thereto.

5. A frame for punch presses or the like composed of a base section, standards rising from said base section and a cross head connecting the upper ends of said standards, tie means for holding the several sections together and means for supporting the moving parts of the punch press from the frame, said standards being each composed of a base plate, a pair of columns welded at their lower edges to said base plate and a cap plate at the top of each column and welded thereto, said columns being composed of three walls and forming three walls and a third plate extending between said columns and welded thereto to form a fourth wall for each of said columns.

6. A frame for punch presses or the like composed of a base section, standards rising from said base section and a cross head connecting the upper ends of said standards, tie means for holding the several sections together and means for supporting the moving parts of the punch press from the frame, said cross head being composed of a plurality of base plates adapted to rest on said standards, front, rear and side plates rising from said base plates and welded to said base plate and one another, cap plates welded to said walls and internal and external structural steel strengthening members welded to said plates and to one another.

7. A frame for punch presses or the like composed of a base section, standards rising from said base section and a cross head connecting the upper ends of said standards, tie means for holding the several sections together and means for supporting the moving parts of the punch press from the frame, said cross head being composed of a plurality of base plates adapted to rest on said standards, outer, front, rear and side plates rising from said base plates and welded to said base plates and to one another, spaced internal vertical plates connected at their ends to the opposite outer plates and at their lower edges to said base plate, cap plates welded to said outer and internal plates, a plurality of strengthening members welded to said outer and internal plates and to said base and cap plates, and external strengthening members welded to the exterior of said outer plates.

8. A power press comprising a base, columns each made from sheet metal cut or formed to shape and welded together to form substantially a hollow rectangular member, internal reinforcing strut members welded in place within the columns and extending across the space from one side to the other, plates welded on one of the outside surfaces of each column to form a guideway and reinforcing member for a ram, and means for connecting the top of the columns.

9. A machine tool of the character described, comprising spaced frame elements formed from rolled stock, connecting means for said elements, a slide, means for actuating said slide, members welded to said elements to provide bearing means...
for said slide, and guide means on said slide adapted to engage said bearing members upon the inner sides thereof.

11. A frame for a machine tool of the type having a reciprocable slide, comprising spaced side elements formed from rolled stock, connecting means extending between said side elements, and means welded to said side elements to provide the frame with bearing portions for said slide.

12. A machine tool of the character described, comprising spaced frame elements formed from rolled stock, connecting means for said elements, a slide, means for actuating said slide including a plurality of shafts, and bearing means for supporting said shafts including sleeve members welded to said frame elements.

13. A frame for a machine tool of the type having a reciprocable slide, comprising spaced side elements formed from rolled stock, connecting means extending between said side elements, means welded to an intermediate portion of said side elements to provide the frame with bearing portions for said slide, and integral extensions at one end of said side elements forming supporting means for the slide actuating gearing.

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