Jan. 25, 1966 J. PUCCI ETAL 3,230,812

PUNCH PRESS ACTUATED BY AN EXPANSIBLE COLLAPSIBLE HOSE

Filed Jan. 4, 1963 4 Sheets-Sheet 1

FIG. 1

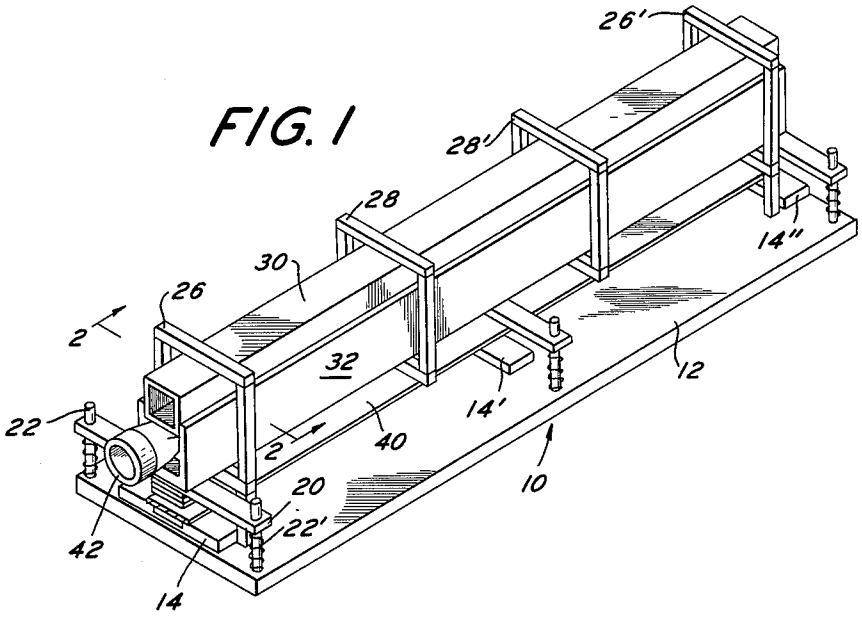

FIG. 2

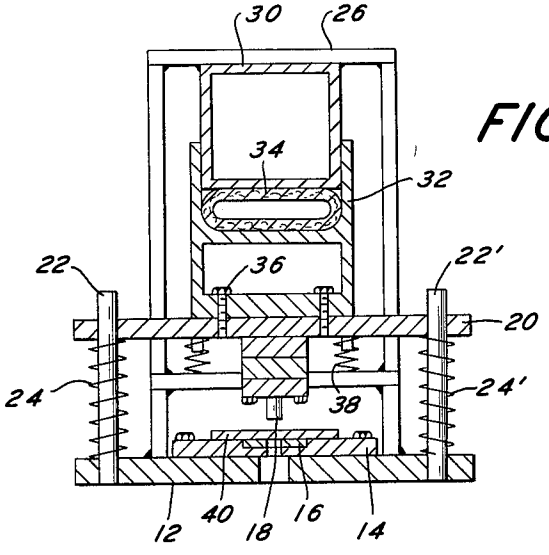

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FIG. 3

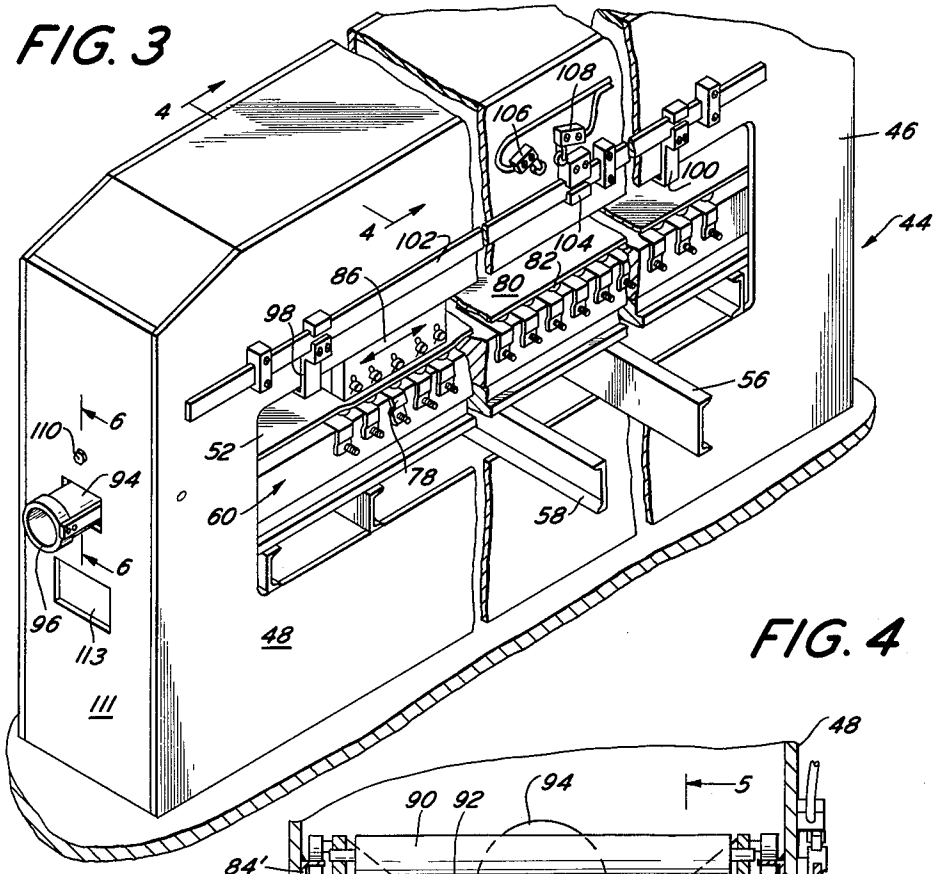

FIG. 4

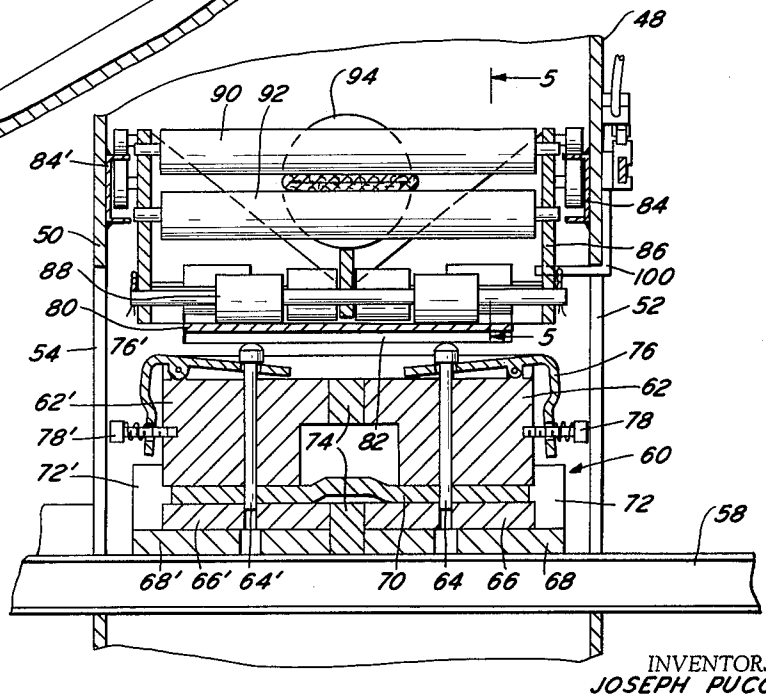

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FIG. 5

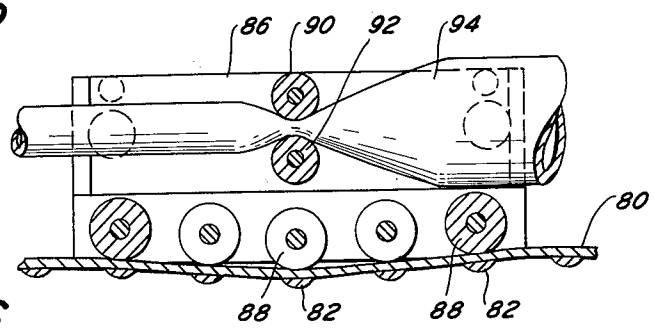


FIG. 6

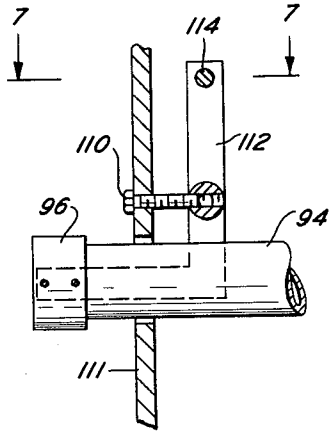


FIG. 7

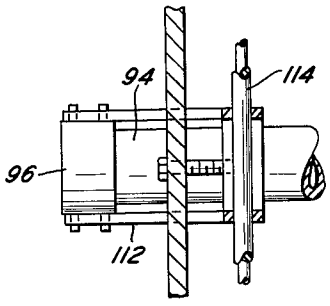
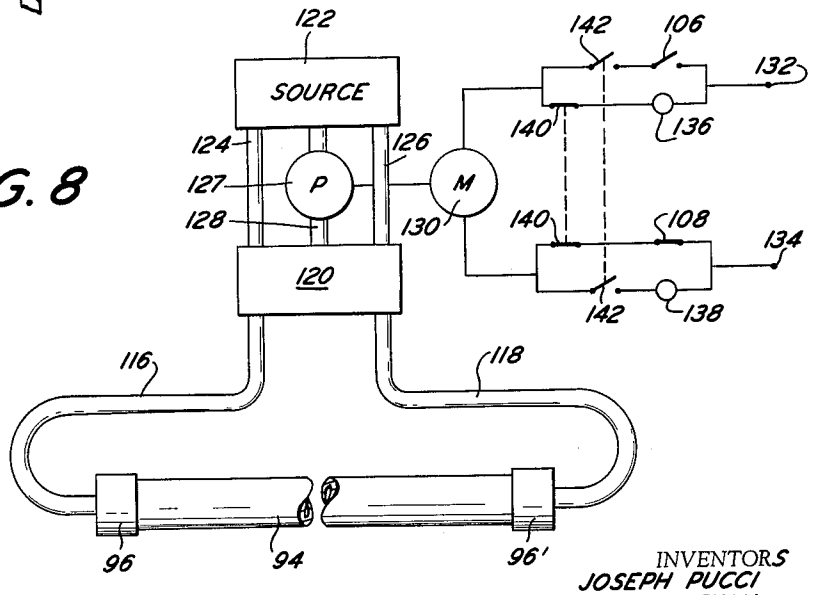


FIG. 8



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PUNCH PRESS ACTUATED BY AN EXPANSIBLE COLLAPSIBLE HOSE

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FIG. 9

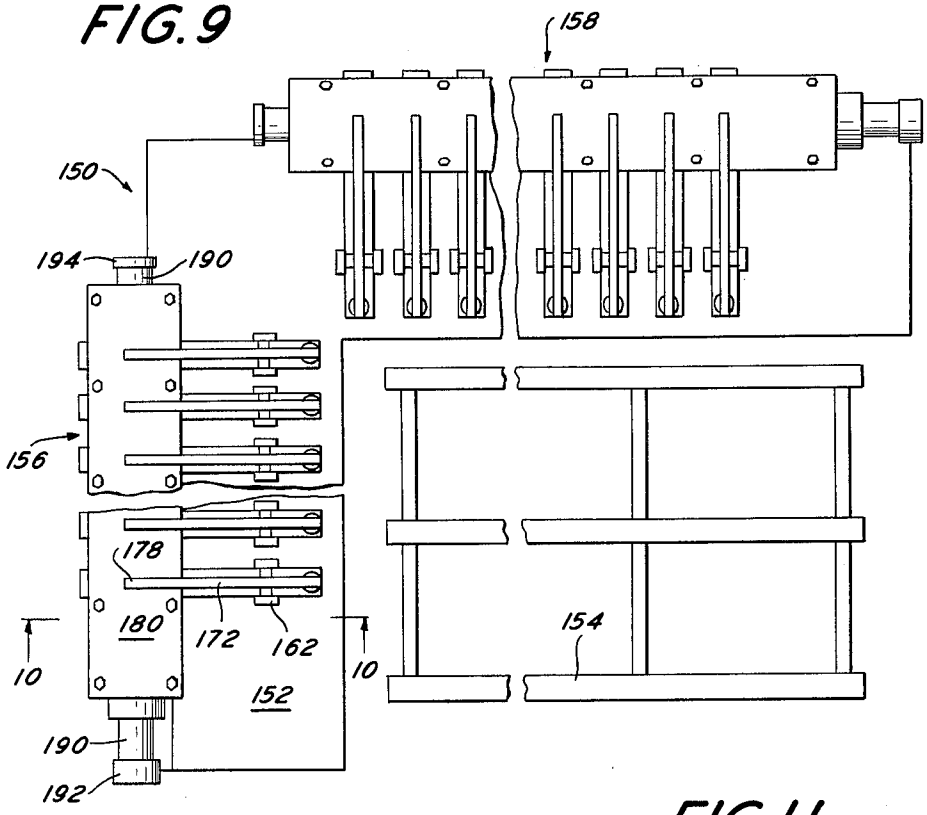


FIG. 10

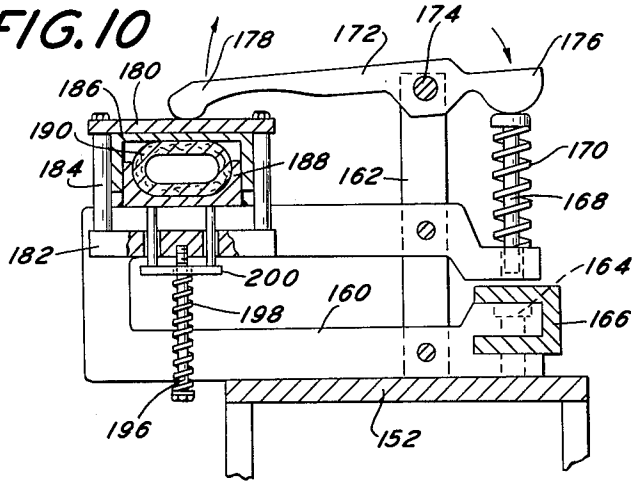
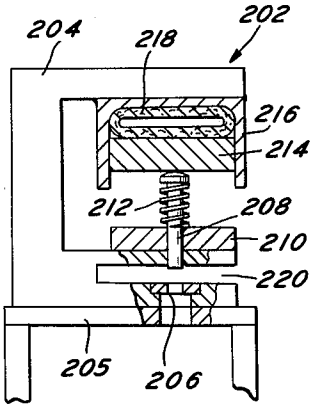


FIG. 11



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3,230,812

PUNCH PRESS ACTUATED BY AN EXPANSIBLE COLLAPSIBLE HOSE

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Filed Jan. 4, 1963, Ser. No. 249,438
4 Claims. (Cl. 83—588)

This invention relates to a punch press, and more particularly, to a punch press wherein one or more holes are sequentially punched in a work piece in a rapid manner in response to the expansion and contraction of a collapsible member.

For many years the punch presses have been of conventional construction. The present invention is directed to a punch press which differs from those proposed heretofore by making the die punch response to the expansion and contraction of a collapsible hose or the like. When the hose or the like is collapsed, the die punch is spaced from a die so that a work piece may be disposed therebetween. When the hose or the like is expanded, the die punch is caused to move towards the die thereby punching a hole through the work piece.

The structural interrelationship of a die punch and expansible collapsible hose or the like lends itself to various types of punching operations. In accordance with one embodiment of the present invention, the punch press is particularly useful in punching a plurality of longitudinally spaced holes in an elongated member which is substantially longer than its width. In another embodiment of the present invention, the punch press is particularly adapted for punching a plurality of spaced holes along the periphery of a sheet of material. In another embodiment of the present invention, the punch press is particularly adapted for punching a plurality of closely spaced holes in an elongated member or through a central portion of a sheet of metal or the like.

The punch press of the present invention is lighter in weight than those proposed heretofore, can obtain substantially the same amount of pressure as those proposed heretofore, is cheaper than those proposed heretofore, and is easier to maintain. The expansible collapsible hose in the punch press of the present invention is substantially the only member subject to wear and replacement. Since the hose or the like is replaceable at a cost of approximately $1.00 per linear foot, it will be seen that maintenance and repair of the punch press of the present invention do not involve a substantial investment.

It is an object of the present invention to provide a novel punch press.

It is another object of the present invention to provide a novel punch press wherein one or more holes may be sequentially and rapidly punched in a work piece in response to the expansion and contraction of a hose or the like.

It is another object of the present invention to provide a punch press adapted to provide a plurality of spaced aligned holes along a marginal edge of a work piece.

It is another object of the present invention to provide a punch press which is more versatile than those proposed heretofore.

It is another object of the present invention to provide a punch press which is simple, inexpensive, and easy to maintain.

It is still another object of the present invention to provide a punch press wherein a plurality of holes are sequentially punched in a work piece.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood, however, that this invention

is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a perspective view of one embodiment of the present invention.

FIGURE 2 is a sectional view taken along lines 2—2 in FIGURE 1.

FIGURE 3 is a partial perspective view of another embodiment of the present invention.

FIGURE 4 is a sectional view taken along the lines 4—4 in FIGURE 3.

FIGURE 5 is a sectional view taken along the lines 5—5 in FIGURE 4.

FIGURE 6 is a sectional view taken along the lines 6—6 in FIGURE 3.

FIGURE 7 is a sectional view taken along the lines 7—7 in FIGURE 6.

FIGURE 8 is a schematic circuitry diagram.

FIGURE 9 is a partial top plan view of another embodiment of the present invention.

FIGURE 10 is a sectional view taken along the lines 10—10 in FIGURE 9.

FIGURE 11 is a sectional view similar to FIGURE 10, but illustrating another embodiment of the present invention.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 a punch press designated generally as 10.

The punch press 10 is illustrated as being mounted on a support 12. A plurality of spaced die plates 14, 14' and 14'' are mounted on the support 12 and define the general distance between the spaced holes to be punched in a work piece. Each of the die plates contains a die 16 below a die punch 18. The die punch 18 is mounted for reciprocation toward and away from the die 16.

Each die punch 18 is secured to the underside of a die holder 20 having a guide hole at opposite ends. Posts 22 and 22' extend through one of the holes in the die holder 20. Springs 24 and 24' bias the die holder 20 away from the support 12. The punch press 10 includes a pair of end yokes 26 and 26' and intermediate yokes 28 and 28'. The end yokes 26 and 26' are supported from the support 12. The intermediate yokes 28 and 28' surround the tubular member 30 and U-shaped member 32. Each of the yokes is fixedly secured to the member 30.

Members 32 and 30 are disposed in telescopic relation and define an expansible chamber therebetween. An expansible collapsible hose 34 is disposed within said chamber. Member 32 is fixedly secured to die holder 20 by bolts 36 and the like. The underbrace of the yokes 28 and 28' extends below the member 32 and springs 38 therebetween disposed bias the member 32 toward the member 30.

In operation of the die press 10, a workpiece such as an elongated sheet of metal 40 is inserted endwise and supported on die plates 14, 14' and 14''. A conduit coupled to a source of fluid under pressure such as hydraulic oil is coupled to terminal 42 on hose 34. The hydraulic oil entering hose 34 expands the same thereby causing member 32, die holder 20 and die punch 18 above each die plate to reciprocate towards its respective die plate thereby punching a hole in the member 40.

Expansion of the hose 34 will be gradual, starting at one end of the hose and continuing along its entire length to the remaining end. In other words, the long confined length of hose 34 enables a full expansion at one end while the remote end remains flat. Thus, one end of member 32 and corresponding die holder 20 and die punch 18 will reciprocate towards its respective die plate before a remote end of the member 32 and its corresponding die holder and die punch. Spacing the die

punches in place along the length of the hose member 34 and members 30, 32 thus provides a sequential operation. If desired, the time lag of the sequential operation can be accentuated by mounting each die punch 18 progressively closer than another to the die holder 20. If the distance between the yokes 26 and 26' is approximately ten feet, the time lag between the reciprocation of the first and last die punch will be approximately two seconds. When the pressure of the hydraulic oil is decreased by operating a valve so that the hose 34 is now in communication with a supply chamber, the bias of springs 24, 24' and 38 causes the hose 34 to be collapsed thereby raising the die punches 18. Thereafter, the metal member 40 may be removed and a new metal member inserted in the punch press 10 so that the operation may be repeated.

If the hose 34 is a two inch diameter hose, it will be slightly more than three inches across when collapsed. If the hose 34 is approximately 8½ feet long, and the pressure of the hydraulic oil is 300 pounds per square inch, the punch press 10 will develop a pressure of 45 tons. Hence, it will be seen that the punch press 10 is light in weight, simple, easy to maintain, and can develop pressures comparable to those associated with the punch presses proposed heretofore.

In FIGURES 3–8, there is disclosed another embodiment of the present invention designated generally as 44.

The punch press 44 comprises a generally rectangular housing 46 having side walls 48 and 50. Large elongated openings 52 and 54 are provided in the walls 48 and 50, respectively. Elongated support beams such as beams 56 and 58 extend transversely through the openings 52 and 54 and extend therebeyond. The beams 56 and 58 are adapted to assist in supporting elongated sheet-like materials adapted to have a series of holes punched therein at any point between the side edges of the sheet-like materials. The length of the openings 52 and 54 determines the maximum transverse dimension of the sheet-like material which will be fed therethrough.

Between the side walls 48 and 50 and supported by the beams 56 and 58, there is illustrated in FIGURE 4 a die means designated generally as 60. The die means 60 includes spaced guide blocks 62 and 62'. Block 62 has a plurality of aligned guide holes, with a die punch 64 extending through each hole. Block 62' has a plurality of aligned holes therethrough, with a die punch 64' in each hole. Below the blocks 62 and 62', there is provided a pair of spaced base plates 68 and 68'. Base plate 68 supports a die plate 66 and base plate 68' supports a die plate 66'. A workpiece 70 such as a metal member is adapted to overlie the die plates 66 and 66'.

The side edges of the workpiece 70 are guided by side guides 72 and 72'. The die means 60 extends for substantially the full length of the punch press 10. The die means 60 is adapted to accommodate varying widths of workpieces. This is accomplished by utilizing spacer blocks 74 between the guide blocks 62 and 62' and between the die plates 68 and 68'.

Each of the die punches 64 and 64' is provided with an enlarged head at one end. The die punches extend through generally L-shaped lever arms 76 and 76', respectively. A headed stud 78 extends through a hole in one end of lever arm 76 and is adjustably connected to guide block 62. A spring surrounding stud 78 biases the punch 64 upwardly in FIGURE 4 so that the workpiece 70 may be inserted between the guide blocks and the die plates. Similar structure illustrated with primed numerals is provided for the die punch 64'.

It will be noted that the workpiece 70 may be nonplanar, as illustrated in FIGURE 4. The die punches 64 and 64' may be closely adjacent one another. For example, in an operative embodiment of the punch press 44, 100 die punches 64 and 64' are provided over a die having a length of approximately ten feet. It will be

appreciated that the illustration in FIGURE 4 provides two rows of aligned holes in the workpiece 70. If only one row of holes is desired, the die punches 64' may be removed. A means is provided to sequentially reciprocate the die punches in a direction towards the die plates. In an operative embodiment of the punch press 44, two rows of holes may be punched in a workpiece 70 having a length of approximately ten feet in a period of approximately two seconds.

The means for causing sequential reciprocation of the die punches includes an elongated pressure sheet 80 having semicylindrical pressure rods 82 fixedly secured to its under surface at spaced points therealong corresponding to the spacing between the adjacent sets of punches 64 and 64'. The sheet 80 is flexible and is supported only at its ends adjacent the end walls of the punch press housing 46. As shown more clearly in FIGURE 4, track members 84 and 84' are supported on the inner surface of the side walls 48 and 50. A trolley 86 is adapted to reciprocate along the track formed by the members 84 and 84'. The trolley 86 is provided with a plurality of parallel rotatable rollers 88 in rolling engagement with the sheet 80. As shown more clearly in FIGURE 5, the innermost roller 88 is rotatable about an axis which is lower than the axis of rotation of the rollers on either side thereof. The spacing of the axis of rotation of the rollers 88 assures that the trolley 86 may reciprocate in either direction, as illustrated by the double headed arrow in FIGURE 3, and gradually flexes the sheet 80.

A pair of rollers 90 and 92 are rotatably supported above the center roller 88 on the trolley 86. The distance between the peripheral surfaces of the rollers 90 and 92 corresponds with the thickness of an expansible collapsible hose 94 in the collapsed condition of the hose 94 as illustrated in FIGURE 4. The ends of the trolley 86 are open or otherwise cut-out so as to accommodate the hose 94 in its expanded condition while the hose is collapsed in that portion between the rollers 90 and 92.

The hose 94 is provided with terminals 96 and 96' at its opposite ends. The hose 94 is slightly longer than the distance between the end walls on the housing 46. As shown more clearly in FIGURE 3, adjustable limit stops 98 and 100 are provided on a reciprocally supported bar 102. A switch actuator 104 is adjustably connected to the bar 102 adjacent a central portion thereof. Limit switch switches 106 and 108 are supported by the wall 48 adjacent a central portion of the opening 52.

As shown more clearly in FIGURES 6 and 7, a tension nut 110 is threadedly engaged with end walls 111 of housing 46 and is threadedly connected to a crossbar interconnecting L-shaped lever arms 112. Lever arms 112 are rotatably supported at their upper end by pin 114. The other end of lever arms 112 is connected to terminal 96. By rotating tension nut 110, the tension in hose 94 may be adjusted so as to prevent the hose 94 from swaying within the housing 46.

As shown more clearly in FIGURE 8, the terminals 96 and 96' on hose 94 are connected to a supply and exhaust valve 120 by conduits 116 and 118. Valve 120 is connected to a source of hydraulic oil 122 by conduits 124, 126 and 128. A pump 127 is disposed within conduit 128 and coupled to a motor 130. Motor 130 is coupled across electrical terminals 132 and 134. One coil 136 of a solenoid actuator for valve 120 is disposed between terminal 132 and motor 130. The other coil 138 of the solenoid actuator for valve 120 is disposed between terminal 134 and motor 130. A switch 140 for causing the trolley 86 to reciprocate to the right in FIGURE 5 and a switch 142 for causing the trolley 86 to reciprocate to the left in FIGURE 5 are coupled across the terminals 132 and 134 in parallel with the motor 130. The switches 106 and 108 are in series with the switches 142 and 140, respectively.

The operation of the press 44 is as follows:

It will be assumed that it is desired to provide two rows of aligned holes in a work piece 70. The dies and punches will be arranged as illustrated in FIGURE 4. The punches will be in a raised position as a result of the bias of the springs on the various lever arms 76 and 76'. The work piece 70 will be inserted and disposed in the position illustrated in FIGURE 4. The trolley 86 will be at one end of the housing 46 and the hose 94 will extend between the rollers 90 and 92 on the trolley 86. Let it be assumed that the trolley is at the left-hand end of the housing 46 adjacent the end wall 111.

With the trolley 86 so disposed, conduit 118 will be in communication with source 122 by way of conduit 126. Switch 106 will be closed as a result of contact with actuator 104.

When switch 140 is closed, coil 136 causes the spool within valve 120 to reciprocate to a position placing conduit 128 in communication with conduit 116, thereby introducing hydraulic oil into the hose 94. As the portion of the hose 94 adjacent the collapsed portion between the rollers 90 and 92 expands, it pushes the trolley 86 along its track. As the trolley 86 reciprocates along its track, it flexes the sheet 80 downwardly. As the central roller 88 passes over the sets of die punches 64 and 64', the pressure rods 82 cam the die punches downwardly to punch holes in the work piece 70.

As the trolley 86 continues to reciprocate, and as it approaches the end of its travel, it contacts limit stop 100 thereby reciprocating bar 102. Reciprocation of bar 102 results in actuator 104 contacting limit switch 108 as illustrated in FIGURE 3. Such contact opens switch 108. Switch 106 will have closed immediately after losing contact with actuator 104. Limit stop 100 will flip an actuator opening switch 140 and closing switch 142.

At this point, the motor 130 will stop. Since switch 108 has opened, the trolley will not reverse itself until switch 142 is actuated. When switch 142 is actuated to a closed disposition, switch 140 is actuated to an open position. When current in coil 136 was interrupted, the spool in valve 120 was actuated to a disposition wherein conduit 116 was placed in communication with source 122 by way of conduit 124. Up to this point, conduit 118 was in communication with source 122 through conduit 126.

When the work piece 70 has been removed through the aperture 113 in end wall 111 or through a slot in the guides 72 and 72', a new work piece may be inserted and switch 142 actuated to a closed disposition to cause the trolley 86 to reciprocate from right to left in FIGURES 3 and 5. The manner in which trolley 86 causes reciprocation of the die punches 64 and 64' is the same as described above. Likewise, the manner in which reciprocation of the trolley 86 is halted is the reverse of the description set forth above. The reciprocation of the trolley 86 when punching holes in a work piece having a length of approximately ten feet occurs in a period of approximately two seconds. Hence, it will be seen that work pieces may have holes punched therein at spaced points therealong in a rapid manner.

In FIGURE 9, there is disclosed another embodiment of the present invention designated generally as 150. The punch press 150 is particularly adapted for punching holes along one or two edges of sheet material or through one leg of a U-shaped work piece. The punch press 150 includes two banks of punches 156 and 158 and a horizontal frame support 154 for supporting the portion of sheet material which is not being punched. The banks 156 and 158 are mounted on a horizontal support 152.

Each of the banks 156 and 158 is identical. Each bank is composed of a plurality of dies and mating die punches which are sequentially actuated in response to the expension and contraction of a hose. Hence, only one die and punch and its actuator will be described in detail.

As shown more clearly in FIGURE 10, there is disclosed a U-shaped frame member 160. One arm of the frame member 160 terminates in a bifurcated arm supporting a die 164 and having a slot therebelow. A U-shaped work piece may be supported in a manner so that a hole will be punched through one arm thereof while the other arm is disposed within the slot below the die 164. The two arms of the frame member 160 maintain a fixed distance apart from one another and are rigidly interconnected by a brace 162.

A die punch 168 is reciprocally mounted above the die 164 and is adapted to extend through a die hole in the other arm of the frame member 160. A spring 170 surrounds the die punch 168 and biases the same upwardly away from the die 164. An actuator 172 for the die punch 168 is pivotably supported at a point intermediate its ends by a pin 174 on the brace 162. The actuator 172 is a lever arm having one end 176 in abutting contact with a head on the die punch 168. The distance between pin 174 and end 178 of arm 172 is approximately three times the distance from pin 174 to the contact point on end 176. Hence, a mechanical advantage of 3 is obtained. A greater or lesser mechanical advantage may be obtained as desired.

The end 178 is in contact with the upper surface on a plate 180. The plate 180 is interconnected with the plate 182 disposed therebelow by a plurality of connector rods 184. As a result thereof, the plates 180 and 182 move as a unit.

A U-shaped channel member 186 is secured to the under side of plate 180. A U-shaped plate 188 is fixedly secured to the upper surface of the upper arm on frame member 160. The channel members 186 and 188 are in telescoping relation with each other and define a variable capacity chamber within which is disposed a hose 190. The hose 190 is provided with terminals 192 and 194 at its ends.

A rod 196 is adjustably connected to the plate 182 and depends therefrom. A spring 198 surrounds the rod 196. One end of the spring is in abutting contact with an adjustable nut on the end of rod 196. The other end of spring 198 is in abutting contact with a plate 200 which is rigidly connected to channel member 188. Rod 196 extends through a hole in plate 200.

When a hydraulic oil or the like is introduced into hose 190 under pressure, the hose gradually expands along its length thereby raising the plate 180 upwardly at spaced points progressively along the length of plate 180. As plate 180 is raised, actuator lever arm 172 reciprocates thereby forcing the die punch 168 towards die 164. At this point, it will be noted that springs 198 and 170 have been compressed. After a hole has been punched in the work piece 166, the pressure of the hydraulic oil in hose 190 will be relieved. Thereafter, springs 170 and 198 expand to cause the hose 190 to collapse. The hose 190 is illustrated as being in a partially collapsed position.

In FIGURE 11, there is disclosed another embodiment of the present invention designated generally as 202. The punch press 202 comprises a plurality of U-shaped frame members 204. A plurality of such frame members may be provided adjacent one another in the same manner as the plurality of frame members 160 in FIGURE 9. One arm of the frame member 204 is bifurcated with the lowermost bifurcation supporting a die 206. The frame member 204 is supported on a support member 205.

A punch 208 is mounted for reciprocation towards and away from the die 206. The die punch 208 is guided by a guide plate 210 resting on the other of the bifurcations. The bifurcations on the said one arm of the frame member 204 are spaced from one another thereby defining a slot 220 within which a work piece may be placed during the punching operation.

The punch 208 is biased away from the die 206 by means of a spring 212. The spring 212 biases the head of the punch 208 in contact with a plate 214. Plate 214

is reciprocally disposed within U-shaped channel member 216.

A hose 218 is disposed between the base of channel member 216 and plate 214. Channel member 216 is fixedly secured to the other arm of the U-shaped frame member 204 and above the die 206. When pressure is introduced into hose 218, it expands thereby causing the plate 214 to move downwardly. As plate 214 moves downwardly, punch 218 is driven through the work piece which is disposed in slot 220. When the pressure on the oil in hose 218 is relieved, spring 212 expands thereby returning the parts to the position illustrated in FIGURE 11.

It will be appreciated by those skilled in the art that other mechanical linkages may be substituted for those illustrated between the die punches and the expansible collapsible hose. As pertains to the punch press 44, other means may be utilized to reciprocate the trolley 86. Hereinafter, the trolley 86 may be referred to as a carriage.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

It is claimed:

1. A punch press comprising a plurality of die punches biased to an inoperative position, said die punches disposed in a position so that a plurality of holes may be punched in a work piece at spaced points along the work piece, a support for a work piece juxtaposed to said punches, means for guiding said punches for movement towards and away from said support, an expandable, collapsible member structurally interrelated with said die punches for moving said die punches towards said support to punch holes in the work piece when said member is expanded, means for selectively expanding and contracting said member and a reciprocal member responsive to expansion and contraction of said collapsible, expandable member for moving the die punches sequentially, said reciprocal member being a trolley, and said expansible member having a collapsed portion structurally interrelated with said trolley.

2. A punch press comprising a plurality of die punches, a work piece support, means guiding said punches for movement towards and away from said support, means biasing said punches to an inoperative position, and a selectively operable reciprocating means for sequentially camming said punches towards said support, said last-mentioned means including a reciprocally supported trolley and an expansible hose structurally interrelated with said trolley for moving said trolley in response to the introduction of a fluid into said hose.

3. A punch press in accordance with claim 2 including means for tensioning said hose.

4. A punch press comprising a plurality of die punches, a support for a work piece juxtaposed to said punches, means for guiding said punches for movement toward and away from said support, spring means biasing said punches away from said support, a track means extending juxtaposed to said punches, a carriage reciprocally supported by said track means, an expansible collapsible hose, a portion of said hose extending through said carriage, the portion of said hose extending through said carriage being collapsed, said carriage being positioned and arranged to sequentially move said punches towards said support to cause the punches to engage a work piece, and means for selectively expanding said hose to effect reciprocation of said carriage.

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WILLIAM W. DYER, JR., *Primary Examiner.*

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