

PATENT SPECIFICATION

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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 punch presses and is particularly concerned with turret punch presses.

Known turret punch presses comprise two co-axially aligned circular discs, each having its own independent axle and bearing housing on which it rotates. The discs are positioned apart from each other to allow the work-piece which is to be punched to pass between. The upper disc is the punch carrier and the lower disc is a die carrier.

At the time of punching the related punches and dies are precisely aligned by means of shot-pins which extend into bushings in the circular discs. The bushings are so placed as to correspond to each radial station of the turrets. Therefore, to drive the turrets around to the selected position, the shot-pins must first be withdrawn, and the turrets can then be rotated by a motor and transmission arrangement. The two common methods heretofore used to obtain this motion are: (1) an electrical motor with a clutch arrangement and (2) an hydraulic motor with related control valves and pump drive system.

To achieve the necessary high speed turret index dictated by modern NC controls, it is necessary to rotate the turrets at a very high speed, which puts a heavy burden on the deceleration factors prior to the turrets reaching the final position.

According to a first aspect of the present invention there is provided a mechanism for indexing turrets of a punch press, which

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mechanism comprises fluid operable means for rotating turrets of a turret punch press to move a station of the turrets to a selected position, means for sensing the approach of the station to the selected position and for sensing the presence of the station at the selected position, the fluid operable means being responsive to the sensing means in that it decelerates the turrets when the sensing means senses the approach of the station to the selected position and stops rotation of the turrets when the sensing means senses the presence of the station at the selected position.

According to a second aspect of the present invention there is provided a punch press comprising a punch striker, a pair of turrets having circumferentially spaced stations positionable below the striker, and a turret indexing mechanism in accordance with the preceding paragraph.

According to a third aspect of the present invention there is provided a punch press having a pair of turrets provided with circumferentially spaced stations positionable beneath a punch striker, a turret indexing mechanism comprising drive means for rotating the turrets simultaneously to position a selected station beneath the punch striker, the drive means including a pair of fluid accumulators each having a reservoir of hydraulic fluid and an upper end portion for receiving pressurized air, control means coupled to the upper end portion of each accumulator for selectively pressurizing or exhausting the air on the hydraulic fluid, an hydraulic actuator having a drive member for rotating the turrets, means coupling the hydraulic fluid in the accumulators with the hydraulic actuator for moving the drive member selectively in opposite directions, flow control means in the coupling means operable to restrict the flow of fluid therein, means for sensing the close approach of a station on the turrets to a punching position

tion and operable thereupon to energize the flow control means for decelerating the drive member and for sensing the presence of a station on the turret at the punch location and operable thereupon to energize the flow control means to stop the drive member, thus stopping the station beneath the striker.

Thus the invention provides a mechanism for rapidly indexing punching turrets.

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 punch press in accordance with the present invention.

Figure 2 shows a schematic illustration of a turret indexing mechanism forming part of the press of Figure 1, and

Figure 3 shows a modified form of indexing mechanism.

Referring now to the drawings, Figure 1 illustrates a C-frame punch press 10 having a work-piece holder 12 and work-piece positioning means 14. The punch press is provided with a pair of turrets 16 which rotatably position a variety of tools beneath the striker on the punch press.

The turrets include an upper disc 20 and a lower disc 21 each respectively mounted by its own axle and bearings 23 and 24. The upper disc 20 contains a plurality of circumferentially spaced punches 33 whereas the lower disc includes a plurality of circumferentially spaced dies 28 alignable beneath the punches 33. The discs are locked and accurately positioned in place by shot-pins 30 which extend into bushings 32 corresponding to the various stations on the turrets.

The indexing mechanism of this invention includes a solenoid actuated spring-centred four-way rotation valve 38 movable into the lefthand and righthand position respectively, by solenoids 39 and 40. Air at readily available shop pressures is introduced through an intake line 42 and is exhausted through an exhaust line 44. The valve is coupled to a pair of accumulators 46 and 48 each containing a quantity of hydraulic fluid F. Fluid accumulator 46 has a lower passageway 50 connected to a bypass leg 52 in which is positioned a manually-controlled conventional flow control valve 54. A solenoid controlled deceleration valve 56 is positioned in the lower passageway in parallel with the bypass leg. The lower passageway communicates with one end of an hydraulic cylinder 58.

The other accumulator 48 is provided with a lower passageway 60 having a bypass leg 62 in which is positioned a manual flow control valve 64. A solenoid controlled

deceleration valve 66 is provided in the lower passageway in parallel with the flow control valve 64. The lower passageway 60 communicates with the other end of the cylinder 58.

A piston 70 is slidably received in the cylinder 58 and is secured to a piston rod 72 which in turn is secured to a plate 74. In the preferred form of the invention, as illustrated in Figure 2, the plate 74 is rigidly secured to a rack and pinion drive 76 coupled to the axles 23 and 24 of the turrets. Thus reciprocation of the piston 70 will simultaneously rotate the two turrets. The stroke of the piston will be equivalent to 360° of rotation of the turrets.

A slide switch 80 is rigidly secured to the rack of the top turret for linear movement along a slide bar 82. The slide switch is provided with a central stop contactor 84 and two spaced deceleration contactors 85 and 86. The slidebar is provided with a plurality of spaced position command contacts 88 each corresponding to a station on the turrets and each electrically coupled to either a NC control 90 or a manual control 91. Engagement of the energized position command contact by one of the contactors will complete a circuit for operating the various deceleration valves and the rotation valve 38.

In operation the leading deceleration contactor 85 or 86, depending upon the direction of movement of the piston 70, will first engage the energized position command contact 88. At this point an electrical signal is transmitted to a deceleration valve closing the valve to force the fluid in the lower passageway through the related flow control valve to reduce the rate of movement of the piston 70. The central stop contactor then engages the energized position command contact at the decelerated rate and signals the rotation control valve to return to its centre exhaust position so that the piston is stopped. The shot-pins 30 may then be driven into the bushings 32 to align and position the turrets at the proper station.

As a typical example assume that the position command contact 88 furthest to the left in Figure 2 is energized. The numerical control will also energize the solenoid 40 directing air through line 42 to the accumulator 48. Hydraulic fluid F will be forced through the unrestricted lower passageway 60 to the righthand side of the cylinder 58 driving the piston and thus the racks of the rack and pinion drive 76 also to the left. When the contactor 86 makes contact with the energized contact 88 a signal will be sent to close the deceleration valve 66 forcing the fluid through the bypass leg 62 and flow control valve 64. Since the rate of flow is reduced the piston will decelerate but will continue moving to the

left. Next the central stop contactor 84 will engage the energized contact signalling the rotation valve to return to its centre position so that all motion stops. Then the shot-pin may be inserted in the bushings as earlier described.

Figure 3 illustrates a modified form of drive for rotating the turrets 20a and 21a with similar parts denoted by references with 'a' added. In this form of the indexing mechanism rotary actuator 58a is connected to the lower passageways 50a and 60a. The rotary actuator is of the type suitable for two way rotation. The rotary shaft 72a of the rotary actuator is coupled to a belt and sprocket drive 76a which is coupled to the axles 23a of the turrets. A slideswitch 80a engages a slidebar 82a in the manner described with reference to Figure 2.

WHAT WE CLAIM IS:—

1. A mechanism for indexing turrets of a punch press, which mechanism comprises fluid operable means for rotating turrets of a turret punch press to move a station of the turrets to a selected position, means for sensing the approach of the station to the selected position and for sensing the presence of the station at the selected position, the fluid operable means being responsive to the sensing means in that it decelerates the turrets when the sensing means senses the approach of the station to the selected position and stops rotation of the turrets when the sensing means senses the presence of the station at the selected position.

2. A punch press comprising a punch striker, a pair of turrets having circumferentially spaced stations positionable below the punch striker, and a turret indexing mechanism including fluid operable means for simultaneously rotating the turrets to move a station of the turrets to a selected position, means for sensing the approach of the station to the selected position and for sensing the presence of the station at the selected position, the fluid operable means being responsive to the sensing means in that it decelerates the turrets when the sensing means senses the approach of the station to the selected position and stops rotation of the turrets when the sensing means senses the presence of the station at the selected position.

3. A punch press having a pair of turrets provided with circumferentially spaced stations positionable beneath a punch striker, a turret indexing mechanism comprising drive means for rotating the turrets simultaneously to position a selected station beneath the punch striker, the drive means including a pair of fluid accumulators each having a reservoir of hydraulic fluid and an upper end portion for receiving pressurized air, control means coupled to the upper end

portion of each accumulator for selectively pressurizing or exhausting the air on the hydraulic fluid, an hydraulic actuator having a drive member for rotating the turrets, means coupling the hydraulic fluid in the accumulators with the hydraulic actuator for moving the drive member selectively in opposite directions, flow control means in the coupling means operable to restrict the flow of fluid therein, means for sensing the close approach of a station on the turrets to a punching position and operable thereupon to energize the flow control means for decelerating the drive member and for sensing the presence of a station on the turret at the punch location and operable thereupon to energize the flow control means to stop the drive member, thus stopping the station beneath the striker.

4. A punch press according to claim 3, wherein the coupling means includes a lower fluid passageway connected to each accumulator and having a bypass leg, a deceleration control valve in the passageway and a variable restriction valve in the bypasses in parallel with the deceleration valve, the sensing means being operable to energize the deceleration valve for forcing the flow through the flow restriction valve in the bypass leg when the sensing means senses the close approach of a station to the punch location.

5. A punch press according to Claim 3 or 4 wherein the hydraulic actuator is a linear cylinder and the drive member includes a piston and piston rod within the cylinder.

6. A punch press according to Claim 3 or 4 wherein the hydraulic actuator includes a rotary actuator, the drive member including a rotary output shaft of the rotary actuator.

7. A punch press according to Claim 3, 4, 5 or 6, wherein the sensing means includes a switch coupled to the drive member and having a central stop contactor flanked by two deceleration contactors, a slider bar having a plurality of spaced contacts corresponding to the various stations of the turrets when positioned beneath the punch striker, the leading deceleration contactor, dependent upon the direction of travel of the drive member, first contacting an energized contact to signal the approach of the station beneath the punch striker, and the central stop contactor being operable to engage the energized contact for deenergizing the control means to exhaust the air in both accumulators to stop the drive means.

8. A punch press substantially as hereinbefore described with reference to, and as shown in, Figures 1 and 2 of the accompanying drawings.

9. A punch press substantially as hereinbefore described with reference to, and as

left. Next the central stop contactor 84 will engage the energized contact signalling the rotation valve to return to its centre position so that all motion stops. Then the shot-pin may be inserted in the bushings as earlier described.

Figure 3 illustrates a modified form of drive for rotating the turrets 20a and 21a with similar parts denoted by references with 'a' added. In this form of the indexing mechanism rotary actuator 58a is connected to the lower passageways 50a and 60a. The rotary actuator is of the type suitable for two way rotation. The rotary shaft 72a of the rotary actuator is coupled to a belt and sprocket drive 76a which is coupled to the axles 23a of the turrets. A slideswitch 80a engages a slidebar 82a in the manner described with reference to Figure 2.

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2. A punch press comprising a punch striker, a pair of turrets having circumferentially spaced stations positionable below the punch striker, and a turret indexing mechanism including fluid operable means for simultaneously rotating the turrets to move a station of the turrets to a selected position, means for sensing the approach of the station to the selected position and for sensing the presence of the station at the selected position, the fluid operable means being responsive to the sensing means in that it decelerates the turrets when the sensing means senses the approach of the station to the selected position and stops rotation of the turrets when the sensing means senses the presence of the station at the selected position.

3. A punch press having a pair of turrets provided with circumferentially spaced stations positionable beneath a punch striker, a turret indexing mechanism comprising drive means for rotating the turrets simultaneously to position a selected station beneath the punch striker, the drive means including a pair of fluid accumulators each having a reservoir of hydraulic fluid and an upper end portion for receiving pressurized air, control means coupled to the upper end

portion of each accumulator for selectively pressurizing or exhausting the air on the hydraulic fluid, an hydraulic actuator having a drive member for rotating the turrets, means coupling the hydraulic fluid in the accumulators with the hydraulic actuator for moving the drive member selectively in opposite directions, flow control means in the coupling means operable to restrict the flow of fluid therein, means for sensing the close approach of a station on the turrets to a punching position and operable thereupon to energize the flow control means for decelerating the drive member and for sensing the presence of a station on the turret at the punch location and operable thereupon to energize the flow control means to stop the drive member, thus stopping the station beneath the striker.

4. A punch press according to claim 3, wherein the coupling means includes a lower fluid passageway connected to each accumulator and having a bypass leg, a deceleration control valve in the passageway and a variable restriction valve in the bypasses in parallel with the deceleration valve, the sensing means being operable to energize the deceleration valve for forcing the flow through the flow restriction valve in the bypass leg when the sensing means senses the close approach of a station to the punch location.

5. A punch press according to Claim 3 or 4 wherein the hydraulic actuator is a linear cylinder and the drive member includes a piston and piston rod within the cylinder.

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7. A punch press according to Claim 3, 4, 5 or 6, wherein the sensing means includes a switch coupled to the drive member and having a central stop contactor flanked by two deceleration contactors, a slider bar having a plurality of spaced contacts corresponding to the various stations of the turrets when positioned beneath the punch striker, the leading deceleration contactor, dependent upon the direction of travel of the drive member, first contacting an energized contact to signal the approach of the station beneath the punch striker, and the central stop contactor being operable to engage the energized contact for deenergizing the control means to exhaust the air in both accumulators to stop the drive means.

8. A punch press substantially as hereinbefore described with reference to, and as shown in, Figures 1 and 2 of the accompanying drawings.

9. A punch press substantially as hereinbefore described with reference to, and as



shown in, Figure 3 of the accompanying drawings.

10. A mechanism for indexing turrets of a punch press, substantially as hereinbefore
5 described with reference to, and as shown in, Figure 2 of the accompanying drawings.

11. A mechanism for indexing turrets of a punch press, substantially as hereinbefore described with reference to, and as shown
10 in, Figure 3 of the accompanying drawings.

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