

June 16, 1942.

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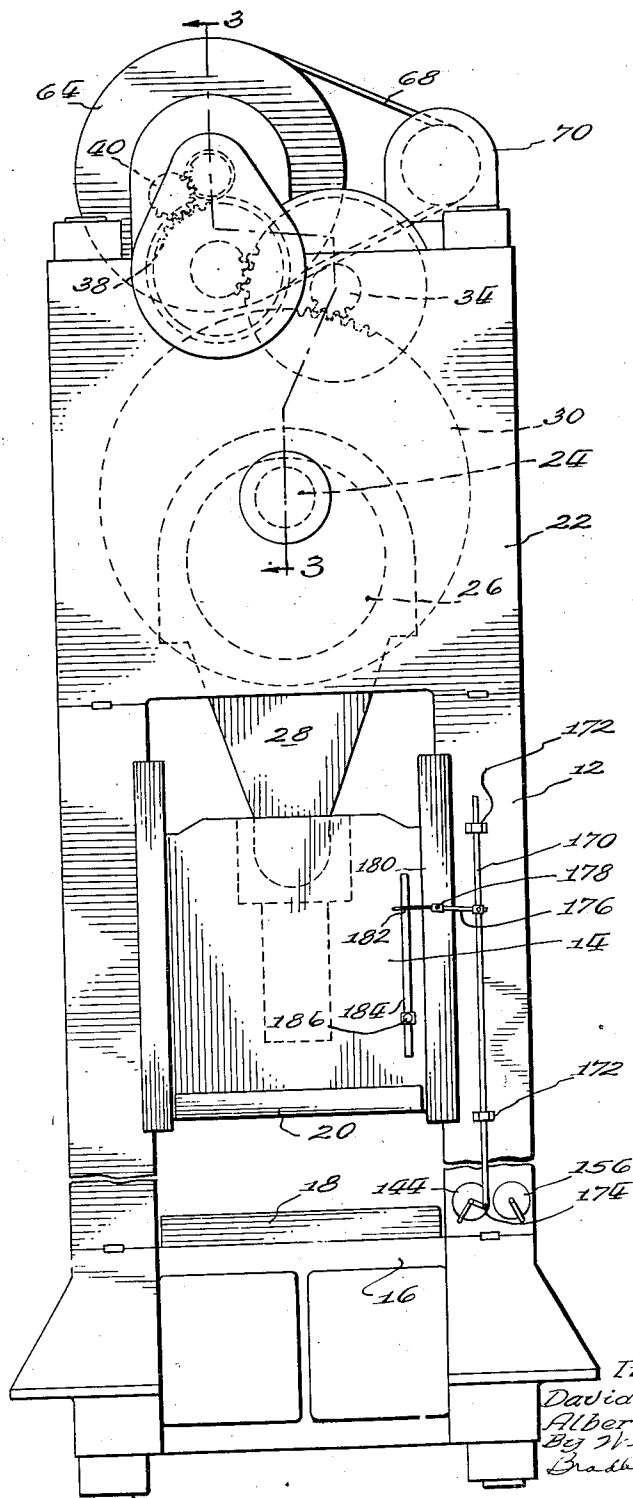
2,286,943

PUNCH PRESS

Filed Oct. 14, 1940

3 Sheets-Sheet 1

Fig. 1.



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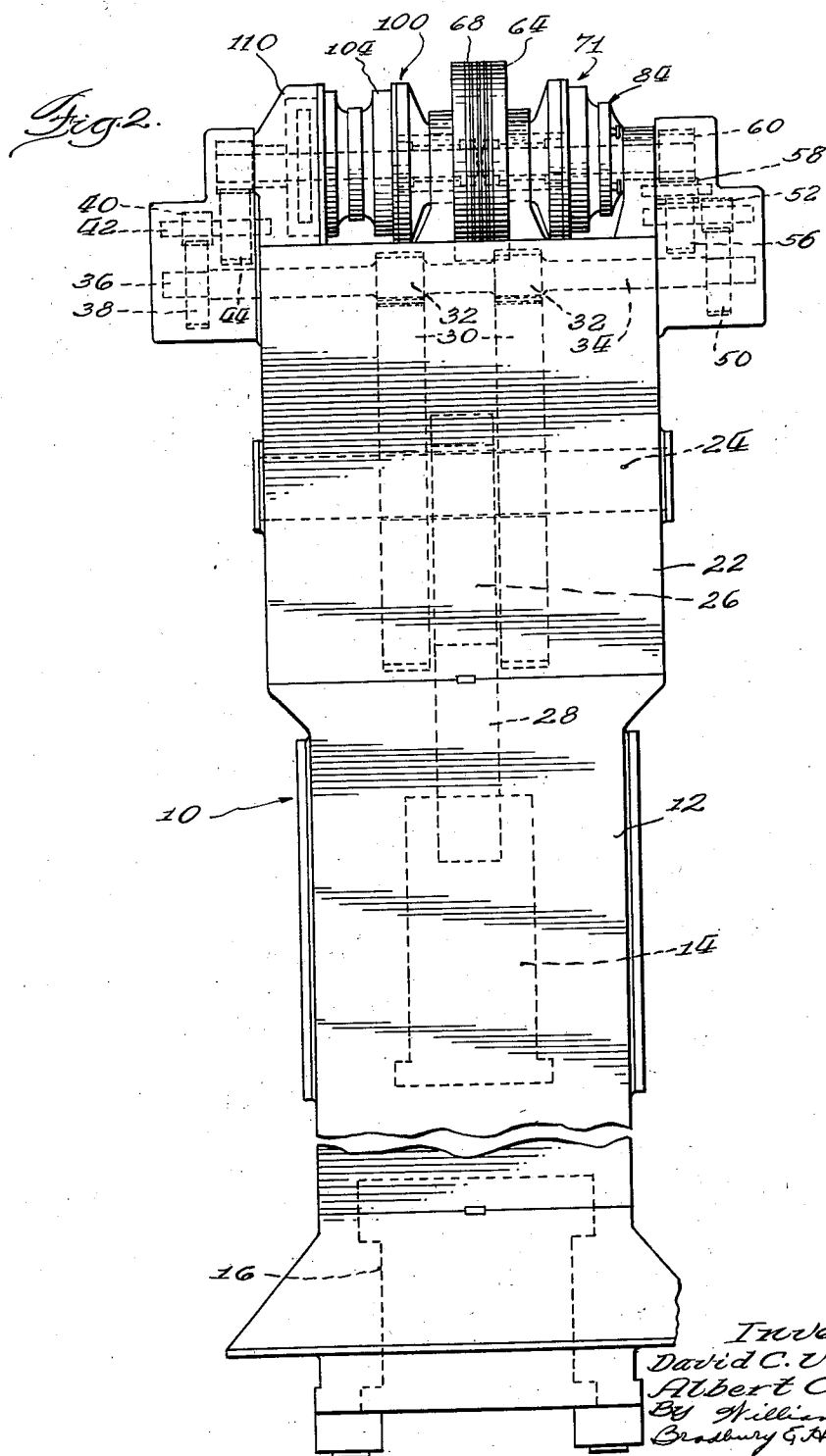
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PUNCH PRESS

Filed Oct. 14, 1940

3 Sheets-Sheet 2



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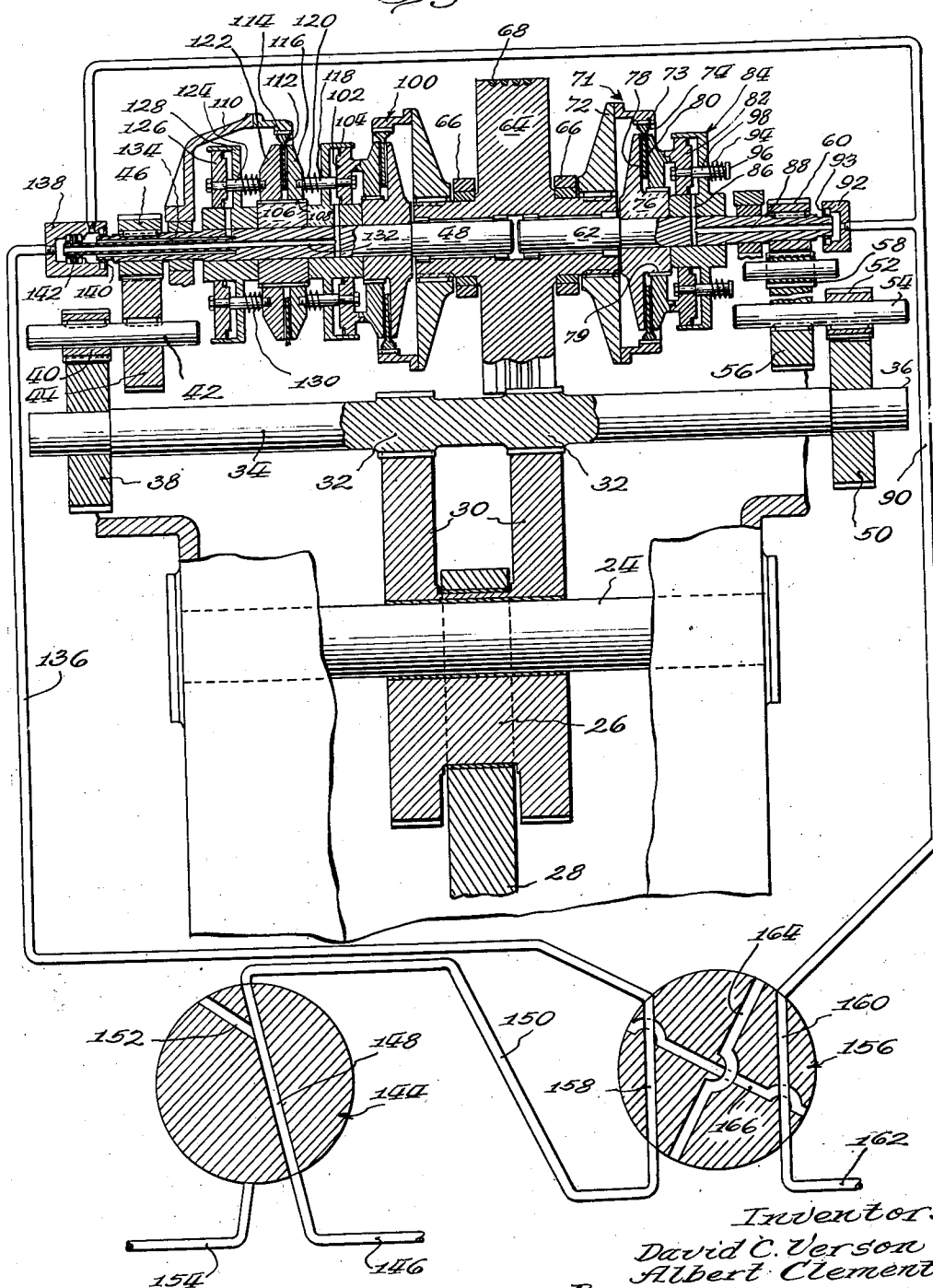
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PUNCH PRESS

Filed Oct. 14, 1940

3 Sheets-Sheet 3

Fig. 3.



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UNITED STATES PATENT OFFICE

2,286,943

PUNCH PRESS

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Application October 14, 1940, Serial No. 361,040

9 Claims. (Cl. 192—144)

This invention relates to punch presses, and more particularly to a mechanical punch press having a stroke of variable length.

The term "punch press" is used in its generic sense in this application and is meant to include press brakes, extruding presses and similar metal deforming machines.

In the past, the principal disadvantage of mechanical presses, as compared with hydraulic presses, was that although a mechanical press could be constructed to have a long stroke and might, therefore, be admirably suited for some particular manufacturing processes, yet such a press was not readily adaptable for use in drawing operations wherein a shorter stroke was adequate. The principal disadvantage inherent in a press having an invariable stroke is that such a press having a long stroke of, say, thirty inches, for instance, must necessarily have a comparatively slow cycle of operation, since the crank or eccentric must be started from its uppermost position, moved downwardly through its lowermost position and back upwardly to its uppermost position again. If the effective stroke desired from such a press is short, for instance only four inches, it will still be necessary to move the slide from its uppermost position downwardly to within four inches of the bottom of its stroke before doing any work on the metal to be deformed. Likewise, the entire upward stroke from the lowermost position of the crank to its uppermost position is similarly wasted since no work is done.

Therefore, the principal object of our invention is to provide a punch press wherein the length of stroke may be predetermined and preset from a minimum of nothing to a maximum of the full stroke for which the machine is intended.

An additional object is the provision of such a press wherein the length of stroke may be preset without the necessity for complicated adjustments to the crank mechanism itself.

Still a further object of our invention is the provision of a mechanical punch press wherein the adjustment of the stroke is such a simple operation that it is feasible to use successive strokes of different lengths in a manufacturing process, if desired.

An additional object of our invention is the provision of a punch press having a stroke of variable length wherein the time of the cycle of operation of the press is progressively shorter as the stroke is shortened.

Other objects and advantages will become apparent from the following description of a preferred embodiment of our invention, taken in

conjunction with the accompanying drawings in which similar characters of reference refer to similar parts throughout the several views:

Fig. 1 is a somewhat diagrammatic front view of a press embodying the present invention;

Fig. 2 is a left side view of the press illustrated in Fig. 1, and

Fig. 3 is a somewhat diagrammatic sectional view, taken in the direction indicated by the arrows along the line 3—3 of Fig. 1, showing the construction and arrangement of parts in the press crown. The control mechanism is also diagrammatically shown in this view.

In punch presses as ordinarily constructed, a heavy fly wheel is rotated at a substantially constant speed by a prime mover. When the operator presses the proper control, an electrical, mechanical or pneumatic means, or a combination of these control means, engages a clutch which connects the crank shaft to the fly wheel, while simultaneously a brake which prevents the crank shaft from moving is released. Thus, the fly wheel is connected to the crank and the energy stored in the fly wheel rotates the crank from its uppermost position downwardly through its lowermost position and upwardly toward its uppermost position once again. As the crank reaches this uppermost position, automatic mechanism comes into play to disengage the clutch between the fly wheel and the crank, while simultaneously the brake is applied. Thus, the crank shaft is stopped at this uppermost position in preparation for a second cycle.

It will be seen that this construction necessitates that the crank shaft always rotate through a complete revolution in order to complete a cycle of operation and that, therefore, the slide connected by a pitman to the crank shaft always passes through a full stroke.

In the press of our invention we also use a fly wheel which is driven at a constant speed by a prime mover. We connect this fly wheel alternately by means of a pair of clutches to two separate gear trains connected between the clutches and the crank. One of these gear trains contains an idler gear not found in the other gear train in order to reverse the direction of rotation of the crank shaft relative to the fly wheel. Thus, by engaging one clutch, we are able to swing the crank pin in one direction, while by engaging the other clutch, the crank shaft may be rotated in the opposite direction.

In connection with this arrangement we also provide a control mechanism which disengages which ever clutch has been previously engaged

and simultaneously applies the brake before the crank pin is returned to its uppermost position. Thus, for instance, starting with the crank pin positioned at a point in its cycle a matter of 45° or so from its lowermost position, a control is prearranged by the operator to determine the length of stroke desired. The punch press operating control is then actuated, thereby causing the control mechanism to release the brake and engage the appropriate clutch. The fly wheel then swings the crank through its lowermost position and upwardly once more to the point predetermined by the operator.

At this point in its cycle the automatic control mechanism will cause the clutch to become disengaged and the brake to be applied, thus stopping the press. When the operator next operates the press starting control, the mechanism will cause the other of the two clutches to be engaged simultaneously with the release of the brake, thereby causing the crank to be revolved in the opposite direction through its lowermost point and upwardly to the predetermined point, whereupon the clutch will become disengaged and the brake once more applied to stop the rotation of the crank shaft.

With such an arrangement in a press having a maximum stroke of, say, thirty inches, a stroke of fifteen inches will require a time cycle of only approximately one-half that of the full stroke cycle. This is because the short stroke requires that the crank shaft be rotated through only half of a complete revolution, and since the fly wheel revolves at a substantially constant rate, it will be seen that only half as many revolutions of the fly wheel will be required to rotate the crank a half revolution as would be required to rotate the crank a full revolution.

In the embodiment of our invention illustrated in the drawings we have shown a punch press having a stroke variable from zero to a maximum of approximately thirty inches. This press, indicated generally by the numeral 10, is comprised of a frame 12 and a slide 14. At the lower portion of the frame, a bed 16 supports a lower die element 18, while the lower surface of the slide 14 carries the cooperating die element 20. At the upper portion of the frame, the press is provided with a crown 22 which carries a cross shaft 24. At its center this shaft journals an eccentric 26 which is connected by means of an eccentric strap 28 to the press slide 14. Thus, rotation of the eccentric 26 causes the eccentric strap 28 to reciprocate the slide 14 toward and away from the bed 16. The eccentric 26 is secured at each side to a large gear 30, these gears being meshed with smaller pinions 32 carried upon a cross shaft 34 journaled at its ends at 36 in the press crown.

Referring particularly to Fig. 3, it will be seen that the left-hand end of the shaft 34 is keyed to a large gear 38 meshed with a pinion 40. The pinion is in turn mounted upon a short shaft 42 positioned parallel to the shaft 34 and journaled at its ends in the press crown. A large gear 44 carried upon this shaft 42 is meshed with a pinion 46 mounted upon a primary drive shaft 48.

Similarly, the right-hand end of the shaft 34 is provided with a gear 50 meshed with a pinion 52 carried by a short shaft 54. This short shaft 54 also carries a large gear 56 meshed with an idling or reversing gear 58 which, in turn, is meshed with a pinion 60 keyed to a second primary drive shaft 62.

The ratios of the two gear trains between the ends of the primary drive shafts 48 and 62 and the shaft 34 are the same, excepting that the idling or reversing gear 58 found in the right-hand train is not present at the left-hand side of the press, thus causing the two primary drive shafts 48 and 62 to rotate at the same speed, but in opposite directions.

The two primary drive shafts 48 and 62 are in axial alignment with their outer ends journaled in suitable bearing members in the press crown. The inner ends of these shafts are closely adjacent each other and are journaled to rotate relative to a fly wheel 64. This fly wheel 64 is carried in bearing members 66 in the press crown, and is rotated by a multiple V belt drive, indicated at 68, by means of an electric motor 70.

At its right-hand side the fly wheel 64 is keyed to a bell-like member 72 of a clutch 71 which, in turn, carries an annular clutch driving disc 74. This disc 74 is free to move longitudinally slightly with respect to the bell 72, but is secured against relative arcuate motion by means of the expedient of a splined coupling 73 between the bell and disc.

Within the bell 72, a collar 76, keyed to the shaft 62, is provided with an outwardly radiating annular clutch driven plate 78 which is positioned closely adjacent the face of the driving disc 74. A similar annular clutch driven plate 80 is positioned on the opposite or outward side of the driving disc 74 and is free to move longitudinally relative to the clutch plate 78 on splines 79, but is prevented from rotating relative to this plate.

A piston 82, operating in a cylinder 84 secured to the shaft 62, acts to urge the driven plate 80 toward the driven plate 78 when the cylinder 84 is placed under pneumatic pressure. This cylinder receives air under pressure through a port 86 which communicates with a longitudinally extending passage 88 in the shaft 62. Air is fed to or exhausted from this passage 88 through an air line 90 and cap 92. The cap 92 fits over the outer end of the shaft 62 and is sealed to the shaft by a cup washer 93 or other suitable rotary seal. Thus, by admitting air under pressure to the air line 90, air is caused to flow through the cap 92, passage 88, and thence through the port 86 into the cylinder 84. The resulting increase in pressure in the cylinder 84 moves the piston 82 toward the fly wheel, thus pushing the clutch plate 80 against the disc 74. Continued movement of this piston urges the clutch disc 74 against the inner clutch plate 78 so that the clutch disc 74 is tightly clamped between the two driven plates 78 and 80, thus causing the shaft 62 to revolve with the fly wheel 64.

A plurality of coil springs 94 bear with one of their ends against the outer face of the cylinder 84 and with their other ends against heads 96 of clutch release pins 98 which extend through openings in the cylinder 84 and are connected at their inner ends to the piston 82. These springs urge the piston toward the right, thus disengaging the clutch when air is permitted to flow from the cylinder 84.

A similar clutch 100 is arranged at the left-hand side of the fly wheel 64 and similarly connects the fly wheel to the shaft 48 when engaged. This clutch is actuated by a piston 102 acting in a pneumatic cylinder 104 in the same manner as piston 82 actuates the previously mentioned clutch 71.

Directly to the left of the clutch cylinder 104 the shaft 48 is provided with a collar 106, the

external face of which is splined at 108. A bell 110, secured to the crown at the left-hand side of the machine, extends inwardly and surrounds the shaft and at approximately the mid point of the collar 106 is provided with an annular brake disk 112. The connection between the brake disk 112 and the bell 110 is splined at 114 to permit a limited longitudinal movement of the brake disc, but prevents relative rotation between these elements.

An annular brake plate 116 is slidable on the splines at 108 and is secured to the outer ends of clutch release pins 118. These pins extend through the cylinder 104 and are secured at their opposite ends to the piston 102, while the portions of the pins between the cylinder 104 and the brake plate 116 pass through coil springs 120. Thus, these springs 120 act in the same manner as the spring 94 to release the clutch when air is exhausted from the space within the cylinder 104. In addition, it will be seen that since their outer ends are connected to the brake plate 116, the springs will urge this brake plate against the brake disk 112 simultaneously with the disengagement of the clutch 100.

At the opposite side of the brake disk 112 the splined collar 106 is provided with a similar slidable brake plate 122 which is connected by brake release pins 124 to a brake release piston 126 slidable in a cylinder 128. The cylinder 128 is secured to the shaft 48 in the same manner as the cylinder 104. Thus, movement of the piston 126 toward the left pulls the brake release pins 124 toward the left, thus pulling the brake plate 122 away from the disk 112. Coil springs 130 surround the pins 124 and bear with their opposite ends against the plate 122 and the release cylinder 128, so that the brake plate 122 is normally pushed toward the right by these springs. The two cylinders 104 and 128 are connected by concentric passages 132 and 134 in the shaft 48 to air lines 136 and 90, respectively, through the medium of a cap 138 having a pair of rotary seals 140 and 142 so that air may be admitted to or exhausted from either the cylinder 104 or the cylinders 84 and 128 together.

When at rest, all of the cylinders will be at substantially atmospheric pressure. Thus, both of the clutches will be disengaged while the springs 120 and 130 act to urge the brake plates 116 and 122 from opposite directions against the brake disk 112, thereby preventing rotation of the shaft. Simultaneously with the engagement of the clutch 100, the brake plate 116 will be drawn toward the right and the brake released. If, on the other hand, cylinder 84 is placed under pressure to engage clutch 71, the arrangement of the air lines is such that brake release cylinder 28 is simultaneously placed under pressure to move the brake plate 122 to the left and release brake disk 112, thereby permitting free rotation of the driving mechanism. It will be seen, therefore, that by alternately engaging and disengaging clutches 100 and 71, the eccentric 26 is alternately driven through the gear trains at alternate sides of the press, while all of the braking is done through the gear train at the left-hand side of the press, as viewed in Fig. 3.

The control mechanism shown diagrammatically in the drawings is merely an example of one type of control by means of which the press may be operated in the manner we have described.

Referring to the lower portion of Fig. 3, we

have shown a manually and automatically operable rotary valve 144 which, when revolved in a counter-clockwise direction, assumes the position shown. In this position air passes from an air receiver, not shown, through the conduit 146 and by way of a passage 148 in the air valve to a conduit 150, thus putting the conduit 150 under pneumatic pressure. When the valve 144 is rotated in a clockwise direction, air passes from the conduit 150 by way of a branch passage 152 in the air valve, through the air valve passage 148 and thence to an exhaust line 154. Thus, with the valve 144 rotated to its clockwise position, the air in conduit 150 is exhausted to the atmosphere, thus placing this conduit at substantially atmospheric pressure.

The conduit 150 leads to a rotary selector valve 156 which serves to distribute the air to either one or the other of the press clutches. Thus, with the valve 156 rotated to its counterclockwise position as shown, air under pressure passes from the conduit 150 through a passage 158 in the valve 156 and through air line 136 leading to cylinder 104. Simultaneously the air line 90 is connected by means of a passage 160 in the air valve to an exhaust line 162, thus placing cylinders 128 and 84 at substantially atmospheric pressure. With the valve rotated to its counterclockwise position, air line 90 will be connected to the conduit 150 through the medium of a passage 164 in the valve 156, while air line 136 will be connected to the exhaust line 162 by means of a valve passage 166.

With this arrangement the operator will, for instance, swing an appropriate lever which moves valve 156 to the position shown. Then valve 144, which previously had been in its clockwise position, is swung in a counter-clockwise direction to the position shown. Air then passes from the air receiver, not shown, through the air line 146, passage 148, conduit 150, passage 158, and air line 136 to the cylinder 104. This moves piston 102 to the right and engages clutch 100 while simultaneously releasing the brake. The fly wheel then swings the eccentric through the medium of the gearing at the left-hand side of the press through the portion of the cycle desired, whereupon air valve 144 is swung to its clockwise position, thus permitting the air in cylinder 104 to escape through air line 136, passage 158, conduit 150, air valve passages 152 and 148 to the exhaust line 152. This permits the springs 120 to disengage the clutch and apply the brake, thus stopping the press.

Before the next stroke of the press, the selector control lever is moved to rotate valve 156 to its clockwise position so that when valve 144 is again rotated to its counter-clockwise position as shown, air will pass from the air line 146 through passage 158, conduit 150, valve passage 164 and air line 90 to cylinders 84 and 128, thus engaging clutch 71 and moving brake plate 122 to the left to release the brake. The eccentric is then driven through the gearing at the right-hand side of the press, thus swinging the eccentric in the opposite direction through its lowermost point and upwardly to the proper position, whereupon air valve 144 is again swung in a clockwise direction to permit air to be exhausted from the cylinders 84 and 128 to stop the press. During the above cycle cylinder 104 is connected to the atmosphere through air line 136, valve passage 166 and exhaust line 162.

Referring to Fig. 1, an automatic and simple arrangement is shown for stopping the press

at the desired point in its cycle. This arrangement consists of a vertical bar 170 which extends along the press column and is adapted to reciprocate in guides 172. The lower end of this bar is pivotally connected to the valve 144 at 174 so that movement of this bar in an upward direction swings the valve 144 in a counter-clockwise direction, while downward movement of this rod swings the valve 144 in a clockwise direction.

This rod 170 is automatically moved downwardly to shift the valve 144 to its clockwise position by means of a generally horizontal lever 176 pivoted to the bar 170 and to a pin 178 fixed in the press frame and spaced somewhat inwardly from the bar 170. The end of the lever 176 opposite to that pivoted to the bar 170 is provided with a leaf spring 182 which extends transversely in front of the press slide 14. Behind the leaf spring 182 the press slide is provided with a vertically extending rail 184 to which a movable stop member 186 may be clamped at any point. As the slide moves upwardly, the stop member 186 carried therewith impinges against the leaf spring 182 and moves the leaf spring upwardly, thus shifting the rod 170 downwardly and rotating the valve 144 to its clockwise position and, by the arrangement previously described, stops the press. With the press slide in this position against the spring member 182, the valve is maintained resiliently in this position.

To start the next cycle of operation after shifting the selector valve 156, the operator shifts the valve 144 to its counter-clockwise position against the pressure of the spring 182 and holds it there momentarily until the slide has moved downwardly sufficiently to carry the stop member 186 away from the spring 182. The operator then removes his hand from the control lever of valve 144 so that when the slide moves upwardly again, the stopping member 186 will be able once more to shift the rod 170 downwardly to stop the press. The member 186 may be clamped at any point along the rail 184 so that the press slide may be permitted to move upwardly to the desired point before it automatically disengages the clutch and applies the brake.

Having thus described our invention, what we desire to secure by United States Letters Patent is:

1. In a variable stroke mechanical punch press of the type having a press frame, a slide reciprocable in the frame, rotatable means to reciprocate said slide, a fly wheel, and means to rotate said fly wheel in one direction: means including a clutch operable selectively to drive said rotatable means in one direction from said fly wheel, means including another clutch selectively operable to drive said rotatable means from said fly wheel in another direction, a brake to prevent rotation of said rotatable means, and means to release said brake substantially simultaneously with the engagement of either of said clutches and to apply said brake whenever both of said clutches are disengaged.

2. In a device of the class described having a press frame, a slide reciprocable in said frame, rotatable eccentric means to reciprocate said slide, and a fly wheel: a pair of gear trains selectively operable to rotate said rotatable eccentric means from said fly wheel, means selectively to drive said rotatable eccentric means through alternate of said gear trains, means au-

tomatically to stop the rotation of said rotatable means at any selected position of said slide during upward movement of said slide, said means including a brake, and automatic means to disestablish driving relationship between said fly wheel and said rotatable eccentric means and substantially simultaneously to apply said brake.

3. In a punch press of the type having a frame, a slide reciprocable in said frame, rotatable eccentric means to reciprocate said slide, and a rotatable fly wheel: selectively engageable clutch means operable selectively to drive said rotatable eccentric means from said fly wheel in either direction, brake means to prevent rotation of said rotatable eccentric means, pneumatic means selectively to operate said clutch means and to operate said brake means, and means to control the flow of air to and from said pneumatic means, whereby said rotatable eccentric means may be revolved through less than a complete revolution and whereby said rotatable eccentric means may be rotated alternately in opposite directions.

4. In a mechanical punch press having a frame, a slide reciprocable in the frame, eccentric means connected to said slide and adapted when rotated through one complete cycle of revolution to cause said slide to move from its uppermost position to its lowermost position and to return to its uppermost position, a flywheel and means to rotate said flywheel at a substantially uniform velocity: clutch means adapted selectively to connect said flywheel to said eccentric means to cause said flywheel to rotate said eccentric means in one direction or alternatively to cause said eccentric means to be rotated in the opposite direction, brake means adapted when applied to stop rotation of said eccentric means, means to apply said brake means when said clutch means is disengaged and to release said brake means when said clutch means is engaged, and pre-set automatic means operative after the start of a cycle brought about by engagement of said clutch means and release of said brake means to disengage said clutch means and to apply said brake means after said eccentric means has moved through a portion of a cycle including movement through its lowermost position but before said eccentric means has moved through a complete cycle.

5. In a mechanical punch press having a frame, a slide reciprocable in the frame, eccentric means connected to said slide and adapted when rotated through one complete cycle of revolution to cause said slide to move from its uppermost position to its lowermost position and to return to its uppermost position, the distance between said uppermost and lowermost positions constituting the maximum length of stroke of said press, a flywheel and means to rotate said flywheel at a substantially uniform velocity: connecting means between said flywheel and said eccentric means by means of which said eccentric means can be rotated in either direction from said flywheel, adjustable control means to stop the rotation of said eccentric means during the upstroke of said slide when said slide is at any predetermined intermediate position between its uppermost and lowermost positions, and control means adapted to be operated thereafter for causing said slide to move from said intermediate position through its lowermost position and to an intermediate position substantially the same distance from its lowermost position as the prior intermediate position, said adjustable

means being adapted to stop the upward movement of said slide when it has reached the last said intermediate position.

6. In a mechanical punch press having a frame, a slide reciprocable in the frame, eccentric means connected to said slide and adapted when rotated through one complete cycle of revolution to cause said slide to move from its uppermost position to its lowermost position and to return to its uppermost position, a flywheel and means to rotate said flywheel at a substantially uniform velocity: clutch means adapted to connect said flywheel to said eccentric means to cause rotation of said eccentric means in one direction, other clutch means adapted to connect said flywheel to said eccentric means to cause said flywheel to rotate said eccentric means in the opposite direction, brake means adapted to restrain said eccentric means against rotation, means normally engaging said brake means when both of said clutch means are disengaged and disengaging said brake means when either of said clutch means is engaged, control means operative to engage one of said clutch means and to disengage said brake means to cause movement of said slide from an intermediate position through its lowermost position to substantially the same intermediate position at which said slide was started, the above movement being accompanied by rotational movement of said eccentric means in one direction and control means operative to condition said clutch means so that subsequent operation of the first control means will cause said flywheel to rotate said eccentric means in the opposite direction to cause said slide to move from its said intermediate position through its lowermost position and to return to its said intermediate position.

7. In a mechanical punch press having a frame, a slide reciprocable in the frame, rotatable means connected to said slide and adapted when rotated to cause movement of said slide through a cycle of operation, a flywheel and means to rotate said flywheel at a substantially uniform velocity: means to rotate said rotatable means from said flywheel in either direction and to restrain said rotatable means against rotation, said means comprising a clutch to connect said flywheel to said rotatable means by way of a forward driving gear train, a second clutch to connect said flywheel to said rotatable means by way of reversing gear train, brake means to restrain said rotatable means against rotation, pneumatic means adapted when in one position to cause engagement of said brake means and disengagement of both of said clutch means and when in another position to cause disengagement of said brake means and engagement of a selected one of said clutch means, and means to select which of said

clutch means is to be engaged by the last said means when in the second of its alternative positions.

8. In an eccentric type punch press having a frame, a slide reciprocable in the frame, eccentric means connected to said slide and adapted when rotated through one complete cycle of revolution to cause said slide to move from its uppermost position to its lowermost position and to return to its uppermost position, a flywheel and means to rotate said flywheel at a substantially uniform velocity: actuating and control means to cause said slide to move through a stroke shorter than its maximum stroke, the last said means comprising means to connect said eccentric means to said flywheel so as to cause rotation of said eccentric means in one direction, means to connect said eccentric means to said flywheel to cause rotation of said eccentric means in the opposite direction, means to restrain said eccentric means against rotation, and automatic control means to limit the upward movement of said slide to a pre-set position between its upper and lower limits, said control means adapted to disengage said connecting means and to apply said restraining means.

9. In a mechanical punch press having a frame, a slide reciprocable in the frame, eccentric means connected to said slide and adapted when rotated through one complete cycle of revolution to cause said slide to move from its uppermost position to its lowermost position and to return to its uppermost position, a flywheel and means to rotate said flywheel at a substantially uniform velocity: alternating operating brake and clutch means adapted alternately to restrain said eccentric means against rotation and to rotate said eccentric means from said flywheel, said clutch means being adapted to rotate said eccentric means in either direction, control means adapted to cause engagement of said clutch means and disengagement of said brake means to cause movement of said slide, and automatically operable means adapted to disengage said clutch means and to apply said brake means at any predetermined point of movement of said eccentric means after said slide has moved through its lowermost position, and means operative thereafter to cause said flywheel to again be connected to said eccentric means to cause rotation of eccentric means in the opposite direction, whereby said slide can be moved from an intermediate position, through its lowermost position, and returned to its intermediate position, and can successively be caused to move through a similar cycle without requiring said slide at any time to approach the upper limit of its stroke.

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