March 31, 1942. A. CLEMENTS 2,278,243

SCREW PRESS

Filed Nov. 22, 1940 3 Sheets-Sheet 1

Fig. 1.

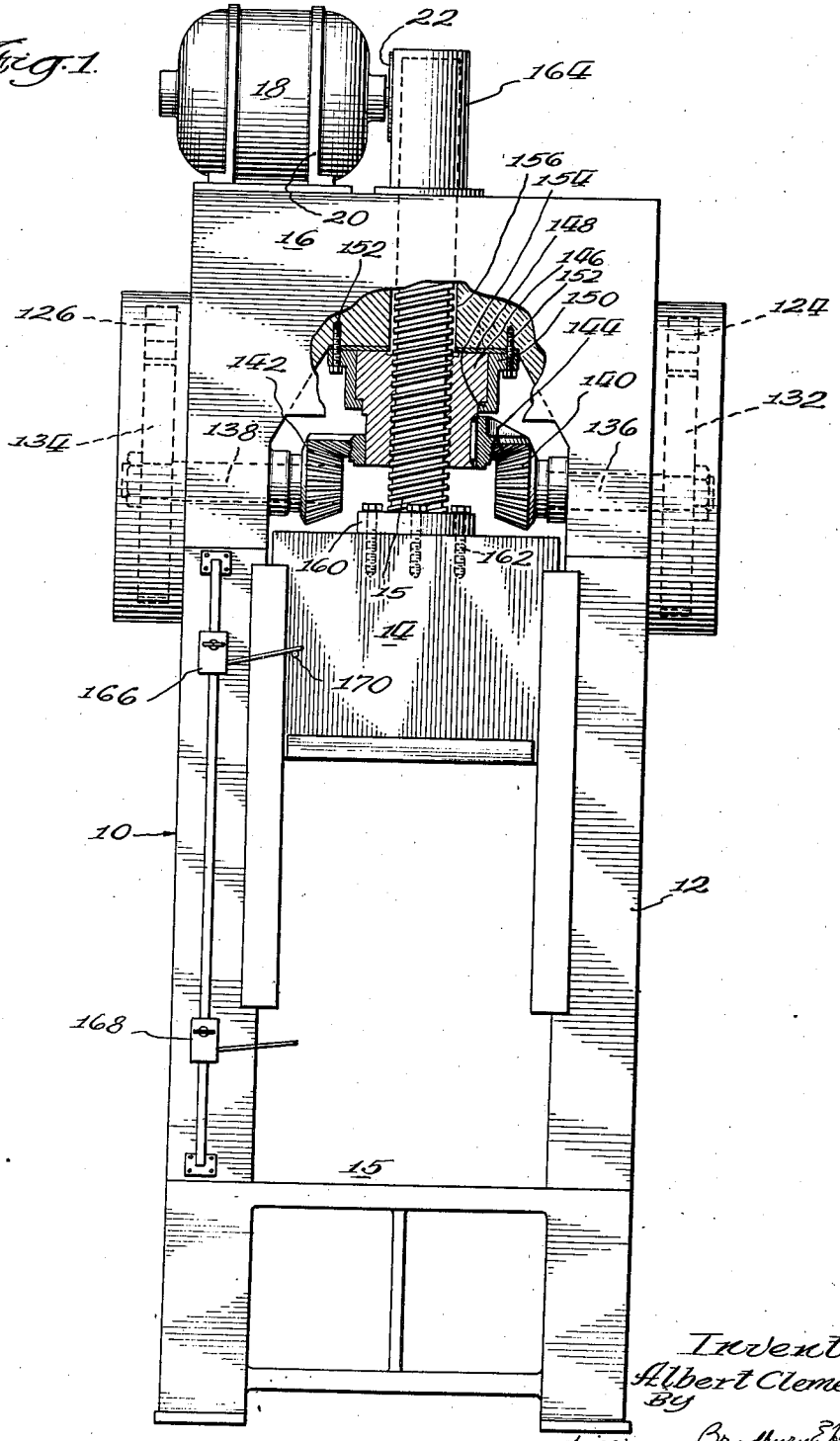

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Fig. 2.

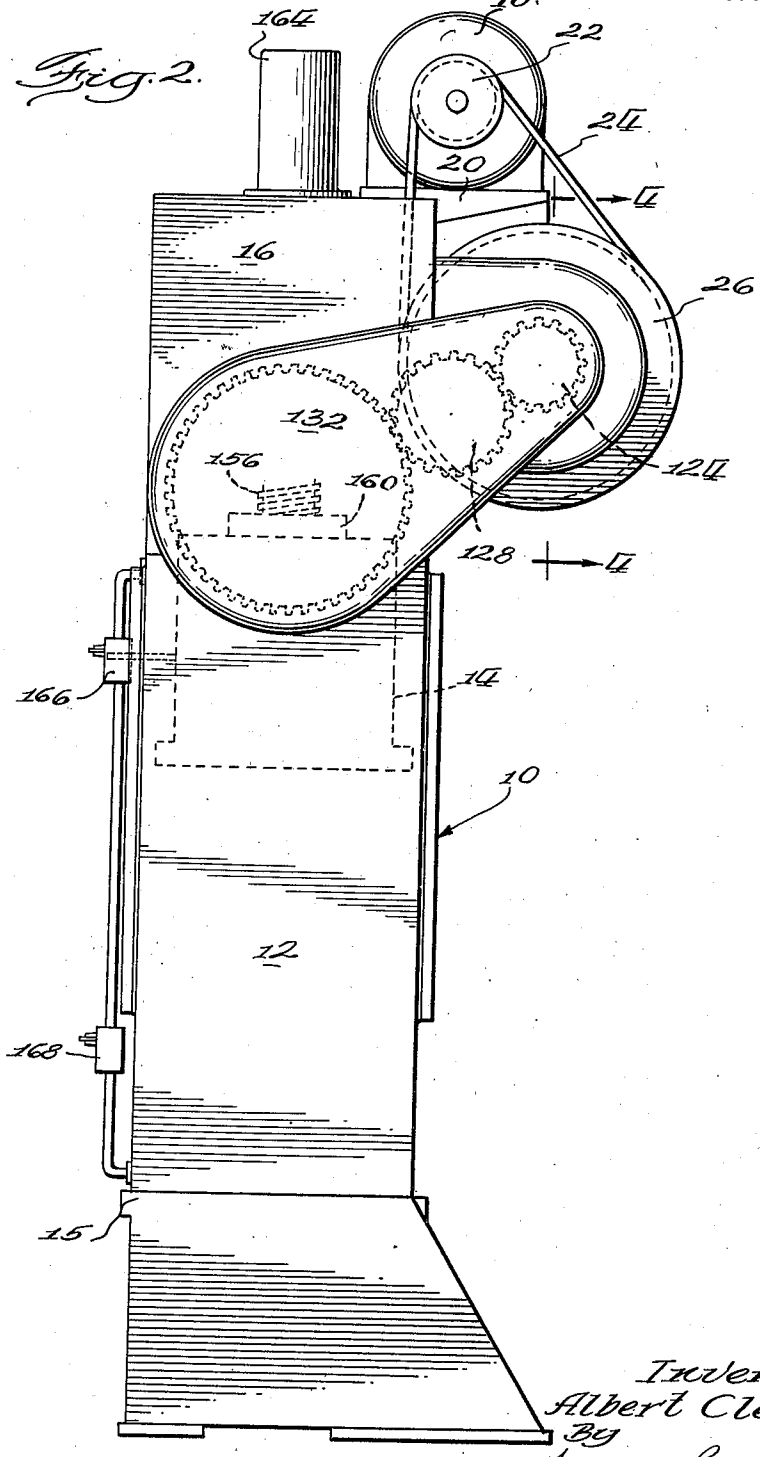

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Fig. 4.

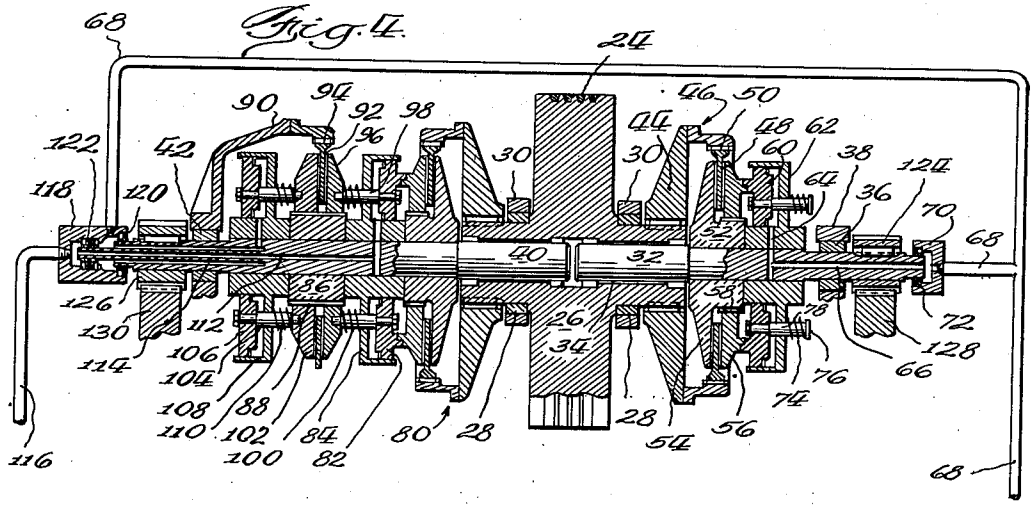
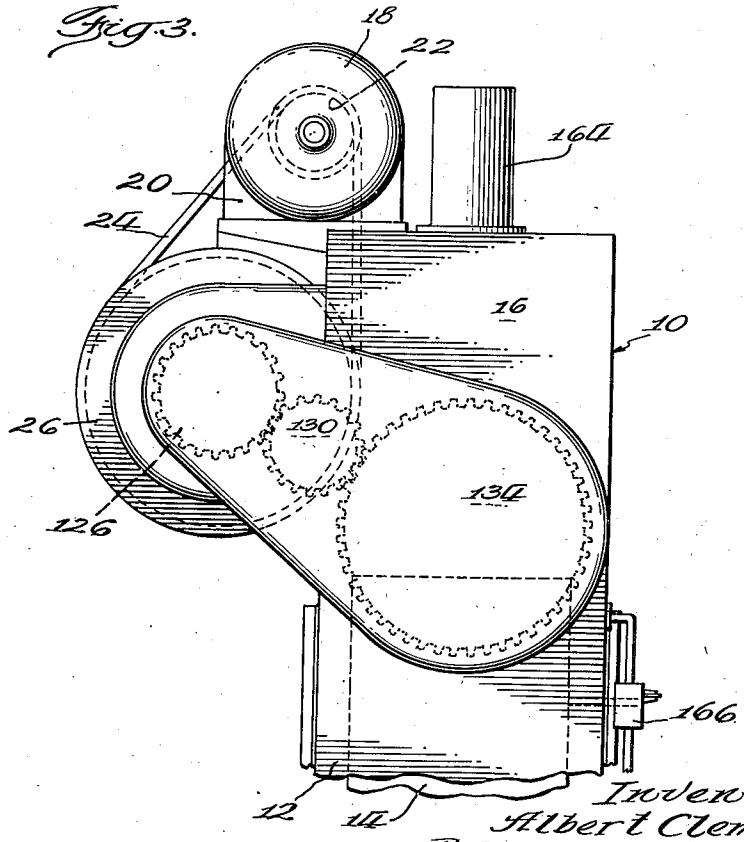


Fig. 3.



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Patented Mar. 31, 1942 2,278,243

UNITED STATES PATENT OFFICE

2,278,243

SCREW PRESS

Albert Clements, Berwyn, Ill., assignor to Verson Allsteel Press Company, Chicago, Ill., a corporation of Delaware

Application November 22, 1940, Serial No. 366,610

6 Claims. (Cl. 74—59)

My invention relates to a screw metal drawing and stamping press having a stroke of variable length.

In general the press of the present invention consists of a reciprocating slide to which a die member is attached. This slide is moved upwardly and downwardly by means of a rotating nut threaded to a long screw secured to the top of the slide. In the operation of the press the nut is first rotated in one direction to move the slide downwardly to the desired point whereupon the slide or a member movable therewith actuates a limit switch which causes the nut to be rotated in the opposite direction thus retracting the slide.

When the slide reaches the upper limit of its stroke of predetermined length, a second limit switch is actuated and the motion of the slide ceases. By shifting the positions of the two limit switches, the lower and upper limits of the stroke of the slide may be predetermined so that an operator will merely need to actuate a starting control in order to effect a cycle of operation of the press, that is, after a metal blank has been placed in position, the operator will actuate the starting control. This will cause the engagement of a clutch and the release of a brake thus causing the slide to move downwardly and again upwardly to its starting position.

This novel press embodies most of the advantages inherent in hydraulic presses and like hydraulic presses is readily adaptable to uses requiring a long stroke at comparatively uniform speed. During the course of the following description, it will also become apparent that the length of stroke of the press embodying the present invention is readily variable to accommodate the press to a multitude of metal drawing and stamping operations. In the present press an arrangement is shown whereby the die may be retracted to its uppermost position more rapidly than it is moved downwardly during its working stroke, thus enabling the completion of a cycle of operation in less time that would be required if the slide were moved at a constant speed. In general, therefore, it is an object of the present invention to provide a novel mechanical press embodying the above desirable features.

It is a more specific object of the present invention to provide a novel screw press having a stroke of variable length.

An additional object is to provide a screw press having most of the advantages inherent in hydraulic presses.

Still another object is the provision of a screw press having most of the desirable features of hydraulic presses without the inherent limitations of such presses and which can be manufactured at comparatively low cost as compared to hydraulic presses of similar capacity.

Still another object of the present invention is to provide a mechanical press having a stroke of variable length and in which the return stroke of the slide is faster than the working stroke.

Still another object of my invention is the provision of a novel mechanical screw type 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 my invention taken in conjunction with the accompanying drawings in which similar characters of reference refer to similar parts throughout the several views and in which:

Fig. 1 is a front elevation of a press embodying the present invention with a portion of the crown thereof broken away to show the operating mechanism therein;

Fig. 2 is a side elevation of the press shown in Fig. 1 as observed from the right;

Fig. 3 is a left-hand side elevation of the upper portion of the press shown in Figs. 1 and 2; and

Fig. 4 is a somewhat diagrammatic longitudinal vertical sectional view through the clutch and brake mechanism of the press and may be considered as taken in the direction of the arrows along the line 4—4 of Fig. 2.

In the embodiment of my invention illustrated in the drawings, I have shown a screw type press having a stroke variable from zero to the maximum for which the particular press is designed. 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 15 is adapted to support a lower die element, not shown, while the lower surface of the slide 14 carries a cooperative die element, also not shown in the drawings. At the upper portion of the frame the press is provided with a crown 16 at the top of which a driving motor 18 is mounted upon brackets 20.

The pulley 22 of the motor 18 is connected by means of a multiple V belt drive 24 to a heavy flywheel 26 journaled upon a horizontal transverse axis in bearing members 28. These bearing members are, in turn, fixed in brackets 30 which extend inwardly and are secured to the rearward face of the crown 16. A right-hand

driving shaft 32 has its inner end piloted in a bearing member 34 provided in the right-hand portion of the flywheel 26 in axial alignment with the outer bearing surface of the flywheel. Near its outward end, the shaft 32 is journaled to rotate in a bearing 36 carried from the press crown upon a bracket 38 similar to the previously mentioned brackets 30.

A similar shaft 40 is journaled in the left-hand portion of the flywheel 26 in axial alignment with the right-hand shaft 32, while near its outward end this shaft 40 is carried to rotate in a bearing member 42 similar to the bearing member 36. With this arrangement the flywheel is free to revolve relative to shafts 32 and 40 while these two shafts are free to rotate relative to each other as well as to the flywheel. During operation of the press the flywheel is driven at a substantially constant speed by the motor 18 and thus is a source of kinetic energy which, through mechanism to be described is adapted periodically to be connected to the press slide to reciprocate this slide downwardly and again upwardly to its retracted position.

At its right-hand side the flywheel 26 is keyed to a bell-like member 44 of a clutch 46 which, in turn, carries an annular clutch driving disc 48. This disc is free to move longitudinally slightly with respect to the bell 44 but is secured against relative accurate movement by the expedient of a splined coupling 50 between the bell and the disc.

Within the bell 44 a collar 52 keyed to the shaft 32 is provided with an annular clutch driven plate 54 which is positioned closely adjacent the face of the driving disc 48. A similar annular clutch driven plate 56 is positioned on the opposite or outward side of the driving disc 48 and is free to move longitudinally relative to the clutch plate 54 on splines 58 formed around the circumference of the collar 52 but is prevented from rotating relative to the plate 54 by these splines.

An annular piston 60 operating in a cylinder 62 secured to the shaft 32 acts to urge the driven clutch plate 56 toward the driven plate 54 when the cylinder 62 is placed under pneumatic pressure, thus clamping the floating clutch driving disc 48 between clutch plates 54 and 56. This cylinder receives air under pressure through a port 64 which communicates with an outwardly extending passage 66 in the shaft 32. Air is fed to or exhausted from this passage 66 through an air line 68 and cap 70. The cap 70 fits over the outer end of the shaft 32 and is sealed to the shaft by a cup washer 72 or other suitable rotary seal. Thus, by admitting air under pressure to the air line 68, this air is caused to flow through the cap 70, passage 66, and thence through the port 64 into the cylinder 62. The resulting increase in pressure in the cylinder 62 moves the piston 60 toward the flywheel thus pushing the clutch plate 56 against the disc 48. Continued movement of this piston urges the clutch disc 48 against the inner clutch plate 54 thus packing the clutch and causing the shaft 32 to revolve with the flywheel 26.

A plurality of coil springs 74 bear with one of their ends against the face of cylinder 62 and with their other ends against the heads 76 of clutch release pins 78 which extend through openings in the cylinder 62 and are connected at their inner ends to the piston 60. These springs urge the piston toward the right, thus disengaging the clutch when air is exhausted from the cylinder 62.

A similar clutch 80 is arranged at the left-hand side of the flywheel and similarly connects the flywheel to the shaft 40 when engaged. This clutch is actuated by a piston 82 acting in a pneumatic cylinder 84 in the same manner that piston 60 actuates the previously mentioned clutch 46.

Directly to the left of the clutch cylinder 84 the shaft 40 is provided with a collar 86. The external face of which is provided with splines 88. A bell 90 formed as a portion of the bracket that supports the bearing member 42 extends inwardly and overhangs the shaft 40 and at approximately the midpoint of the collar 86 is provided with an annular brake disc 92. The connection between the brake disc 92 and the bell 90 is splined at 94 to permit a limited longitudinal movement of the brake disc while preventing relative rotation between these elements.

An annular brake plate 96 is slideably mounted upon the splines 88 and is secured to the outer ends of clutch release pins 98. These pins extend through the cylinder 84 and are secured at their opposite ends to the piston 82, while the portions of the pins between the cylinder 84 and the brake plate 96 pass through coil springs 100, thus these springs 100 act in the same manner as the springs 74 to release the clutch when air is exhausted from the space within the cylinder 84. In addition it will be seen that since their outer ends are connected to the brake plate 96, these springs will urge this brake plate against the brake disc 92 simultaneously with the disengagement of clutch 80.

At the opposite side of the brake disc 92 the splined collar 86 is provided with a similar slidable brake plate 102 which is connected by brake release pins 104 to a brake release piston 106 slidable in a cylinder 108, thus movement of the piston 106 toward the left pulls the brake release pins 104 toward the left, thus pulling the brake plate 102 away from the disc 92. Coil springs 110 surround the pins 104 and bear with their opposite ends against the plate 102 and the cylinder 108 so that the brake plate 102 is normally pushed toward the right by these springs. The two cylinders 84 and 108 are connected by concentric passages 112 and 114 in the shaft 40 to air lines 116 and 68, respectively, through the medium of a cap 118 having a pair of rotary seals 120 and 122 so that air may be admitted to or exhausted from either the cylinder 84 or the cylinders 108 and 62 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 100 and 110 act to urge the brake plates 96 and 102 from opposite directions against the brake disc 92 thereby preventing rotation of the shaft 40. Simultaneously with the engagement of clutch 80 the brake plate 96 will be drawn toward the right and the brake released. If, on the other hand, cylinder 62 is placed under pressure to engage clutch 46, the arrangement of the air lines is such that brake release cylinder 108 is simultaneously placed under pressure to move the brake plate 102 to the left thereby releasing the brake to permit free rotation of the driving mechanism.

Near its outer end, the shaft 32 is keyed to a pinion 124, while the coaxial shaft 40 is also keyed to a similar pinion 126. These pinions

124 and 126 mesh with a pair of intermediate gears 128 and 130, respectively, which, in turn, are meshed with a pair of large gears 132 and 134. Although the two gears 132 and 134 of the present embodiment are of the same size, the pinion 124 is considerably smaller than the similar pinion 126 and since the shafts carrying the gears 132 and 134 are in axial alignment, the intermediate gear 128 is larger than the intermediate gear 130. The difference in the sizes of the two driving gears is so arranged that the large gear 132 is driven at a somewhat slower speed than the large gear 134. As will appear more fully subsequently, this is done so that the return stroke of the press slide will be accomplished in less time than the downward or working stroke.

A short shaft 136 is keyed to the large gear 132 and extends inwardly through the crown 16 to a position approximately one-third of the distance across the crown while a similar shaft 138 is keyed to the gear 134 and extends inwardly through the crown in axial alignment with the shaft 136. The inner ends of these shafts are provided with bevel gears 140 and 142, respectively, meshing with a large ring gear 144 rotatable in a horizontal plane positioned at approximately the center of the crown.

This ring gear 144 is keyed to a rotatable nut 146, the upper face of which is flat and bears against a bronze annular thrust plate 148 secured against the lower face of the crown. An annular retaining ring 150 surrounds the nut 146 and is attached to the lower face of the crown by bolts 152. This ring serves to hold the nut in place by means of a flange 154 at its outer end which extends inwardly to embrace a shoulder formed upon the nut. The retaining member 150 therefore permits the nut to be freely rotatable but prevents the axis of the nut from becoming displaced and also prevents endwise movement of the nut. Directly above the nut a cylindrical opening 156 extends through the top of the crown. This opening is of somewhat greater diameter than the threaded opening through the nut and provides a passage for a comparatively long screw 158 threaded to the nut 146.

The lower end of this screw 158 carries an annular flange 160 which is secured to the upper face of the slide 14 by means of a plurality of circumferentially spaced cap screws 162. Thus the screw and slide are moved together either upwardly or downwardly by the nut 146, depending upon the direction of rotation of the latter. The upper end of the opening 156 through the top of the crown is closed by a cap 164. This cap is intended merely to close the opening 156 and provide a housing into which the upper end of the screw 158 can extend when the slide 14 is retracted to its uppermost position.

The control of the press I have shown is intended to be exercised by upper and lower limit switches 166 and 168, respectively, which cooperate with a pin 170 secured to the slide 14, that is, the limit switches 166 and 168 are shifted to any desired position vertically upon the press frame so that as the slide moves upwardly, the upper switch 166 will be tripped by the pin 170 thus energizing a circuit to stop the press, while similarly, downward movement of the slide trips the lower limit switch 168, thus momentarily stopping the press and subsequently thereafter reversing its stroke to return the slide 14 to its retracted position.

The use of limit switches to start and stop various cycles of operations in automatic machinery, including metal deforming machinery, is too well known to require detail description here. It will be sufficient, therefore, to point out that these limit switches, through the medium of electric circuits, operate solenoid air valves which admit air to or exhaust air from the conduits 68 and 116 in the manner described below.

The operation of the press of my invention is as follows: With the electric motor 18 operating, the flywheel 26 will be rotated at a comparatively constant speed. Before the commencement of the cycle of operation, however, the two clutches 46 and 80 will be disengaged and the brake shoes 96 and 102 will be clamped against the brake disc 92 by the coil springs 100 and 110. This is the condition assumed by the machine when the air lines 116 and 68 are at substantially atmospheric pressure.

After a blank to be formed has been placed over the lower die member, air under pressure is admitted to conduit 68. This air is communicated through passage 66 to clutch cylinder 62 thus engaging clutch 46 while simultaneously air under pressure is communicated by conduit 114 to brake release cylinder 108 thus drawing brake plate 102 to the left. The flywheel therefore rotates the shaft 32 and through the medium of the gear train comprised of the pinion 124, intermediate gear 128, and large gear 132, rotates the shaft 136 at a reduced rate of speed. The bevel gear 140 carried by this shaft, in turn, rotates the ring gear 144 at a reduced speed and this ring gear, in turn, revolves the nut 146, thus causing the screw 158 and slide 14 to move downwardly to produce a working stroke. When the slide has substantially reached its desired lower limit, the lower limit switch 168 is actuated. This switch, through the medium of its electric circuit and solenoid valves causes air to be exhausted from the conduit 68, thus permitting springs 74 to disengage clutch 46 and simultaneously to permit springs 110 to apply pressure against the brake plate 92. The press, therefore, comes to rest. Almost simultaneously therewith air is admitted under pressure to conduit 116. This air is communicated through conduit 112 with air cylinder 84, thus causing piston 82 to be moved to the right to engage clutch 80 and simultaneously to retract the brake plate 96. The release of the brake together with the engagement of clutch 80 causes shaft 40 to rotate with the flywheel 26 and through the medium of the pinion 126, intermediate gear 130, and large gear 134, to rotate the shaft 138. The rotation of this shaft is communicated by means of bevel gear 142 and ring gear 144 to the nut 146. The nut, therefore, is revolved in the opposite direction to that previously mentioned and causes the screw 158 and slide 14 to be moved upwardly.

As the press approaches the upper limit of its stroke, limit switch 166 is tripped and through the medium of its solenoid air valve causes air to be exhausted from the conduit 116 with the result that clutch 80 is disengaged and brake plate 96 is forced by springs 100 against the brake disc 92. The press, therefore, comes to rest and is in condition for a succeeding cycle of operation.

It will be seen, therefore, that merely by adjusting the positions of its limit switches 166 and 168, the upper limit and the lower limit of the stroke of the press can be determined.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States is:

1. For use in a metal deforming machine of the type in which a slide is reciprocable in a frame and in which the slide carries a screw threaded through a nut rotatable in the frame so that rotation of the nut in one direction causes downward movement of the slide while rotation of the nut in the opposite direction causes upward movement of the slide: means for moving said slide through a complete and variable stroke by means of a motor having insufficient capacity to deform the metal being worked comprising, a motor, a heavy flywheel, means to drive said flywheel from said motor to store kinetic energy in said flywheel, a pair of clutches driven by said flywheel, a gear train connecting said flywheel to said nut when one of said clutches is engaged, a reversing gear train connecting the flywheel to said nut when the other of said clutches is engaged, brake means to prevent the rotation of either of said gear trains, and control means to effect the operation of said brake means and said clutch means in a desired sequence, said control means being adjustable to determine the length of stroke of said slide, whereby continuous operation of said motor will build up kinetic energy in said flywheel, and whereby said kinetic energy can be used to revolve said nut in either direction during predetermined intervals to effect upward or downward movement of said slide to a greater or lesser extent.

2. For use with a metal deforming machine having, a frame, a slide reciprocable in the frame, a nut journaled to rotate in the frame, a gear train to rotate said nut in one direction, a second gear train to rotate said nut in the opposite direction, a screw attached to said slide and threaded through said nut: a heavy rotatable flywheel, means to drive said flywheel, a brake to prevent rotation of said nut, a pair of selectively operable clutch means to connect said flywheel to either of said gear trains, and means acting substantially simultaneously with the engagement of either of said clutch means to release said brake.

3. For use with a metal deforming machine having a frame, a slide reciprocable in the frame, screw and nut means acting between said slide and said frame to move said slide when one of the elements of the screw and nut means is rotated relative to the other, a gear train to cause said relative rotation in one direction, a second gear train to cause said relative rotation in the opposite direction: a rotatable heavy flywheel, means to store sufficient kinetic energy in said flywheel to move said slide through a metal deforming stroke and selectively operable clutch means to connect said flywheel to either of said gear trains.

4. For use with a metal deforming machine having, a frame, a slide reciprocable in the frame, a nut journaled to rotate in the frame, a gear train to rotate said nut in one direction, a second gear train to rotate said nut in the opposite direction, a screw attached to said slide and threaded through said nut: a rotatable heavy flywheel, a pair of clutch means selectively operable to connect said flywheel to either of said gear trains, brake means acting between said frame and one of said gear trains adapted when engaged to prevent rotation of said nut and both of said gear trains, resilient means adapted normally to engage said brake means, and pneumatic means to overcome said resilient means and release said brake whenever either of said clutches is engaged.

5. For use with a variable stroke mechanical punch press having a press frame, a slide reciprocable in the frame, a rotatable screw and nut means acting between said slide and said frame to reciprocate said slide, a heavy flywheel, means to rotate said flywheel in one direction to store kinetic energy therein, means including a clutch selectively operable to rotate said rotatable means in one direction from said flywheel, means including another clutch selectively operable to drive said rotatable means from said flywheel in the opposite direction, a brake to prevent rotation of said rotatable means when engaged, 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, adjustable limit switch means adapted to be tripped by upward movement of said slide to a predetermined point, said limit switch means when tripped adapted to release said clutches and apply said brake, and other adjustable limit switch means adapted to be tripped by downward movement of said slide to a predetermined point, the last said limit switch means adapted when tripped to release one of said clutches and to engage the other of said clutches.

6. For use with a metal deforming machine having a frame, a slide reciprocable in the frame, screw and nut means acting between said slide and said frame to move said slide when one of the elements of the screw and nut means is rotated relative to the other; a gear train to cause said relative rotation in one direction, a second gear train to cause said relative rotation in the opposite direction, a rotatable heavy flywheel, means to store sufficient kinetic energy in said flywheel to move said slide through a metal deforming stroke, a pair of clutch driving elements mounted to rotate with said flywheel, a pair of clutch driven elements adapted selectively to be connected to said clutch driving elements, a shaft connected to one of said gear trains and to one of said clutch driven elements and piloted in one side of said flywheel, a second shaft connected to the other of said gear trains and to the other of said clutch driven elements and piloted in the other side of said flywheel, brake means adapted when applied to prevent rotation of one of said shafts, power operated means to engage one of said clutches, power operated means to engage the other of said clutches and to disengage said brake simultaneously with the engagement of the last said clutch, supplemental power operated brake means to engage said brake when the first said clutch is disengaged, control means adapted when actuated to engage one of said clutches and to disengage said brake to permit the kinetic energy in said flywheel to cause downward movement of said slide, automatic control means adapted when actuated to cause disengagement of the engaged clutch and engagement of the disengaged clutch so that kinetic energy in said flywheel will cause upward movement of said slide, and control means to limit the upward movement of said slide and to condition the mechanism for a succeeding stroke by causing disengagement of the engaged clutch and application of said brake.

ALBERT CLEMENTS.