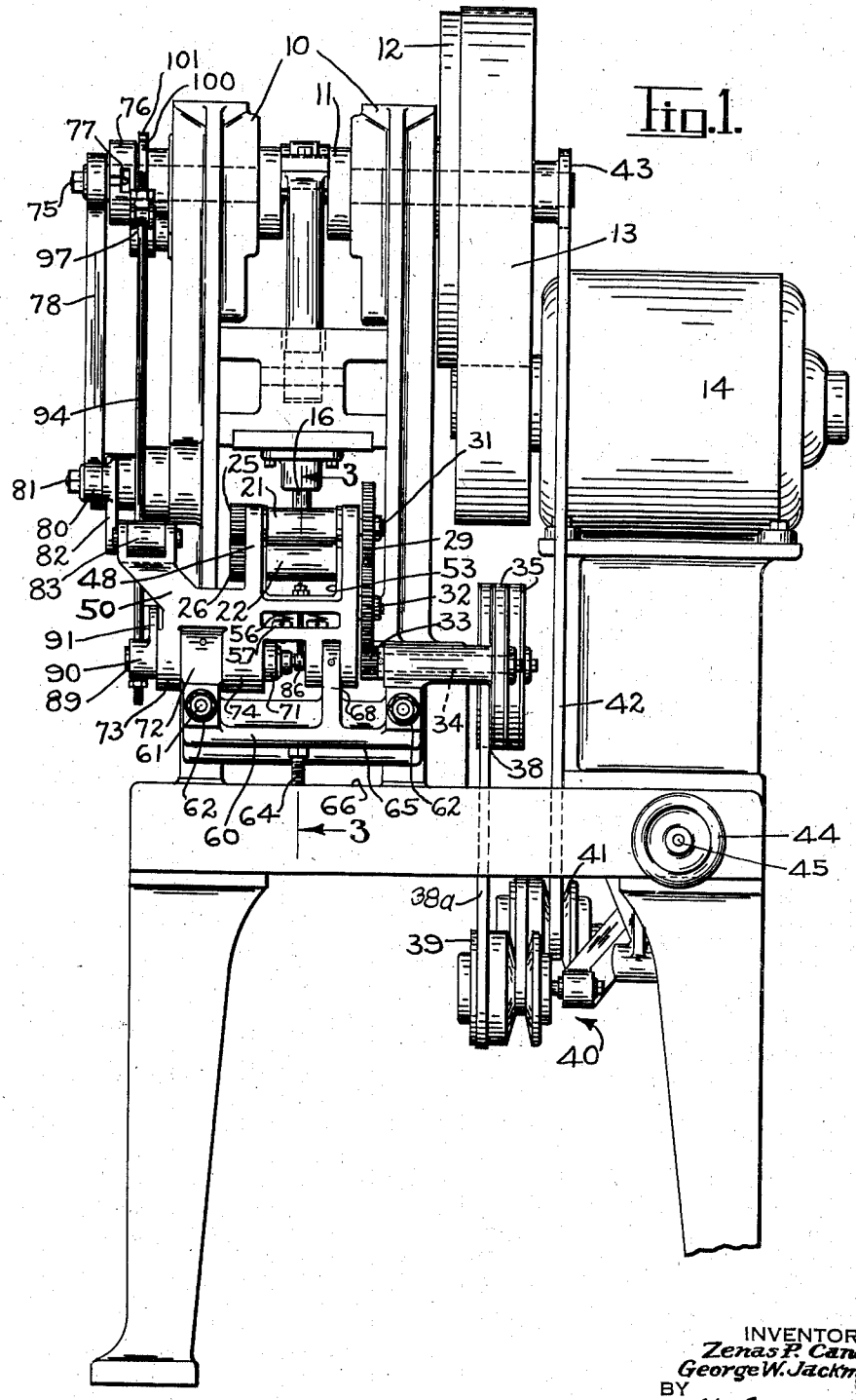
Dec. 30, 1941. Z. P. CANDEE ET AL 2,268,242

RAPID PUNCH PRESS

Filed Jan. 18, 1939 4 Sheets-Sheet 1

Fig. 1.



INVENTOR
Zenas P. Candee.
George W. Jackman.
BY
H. G. Manning
ATTORNEY

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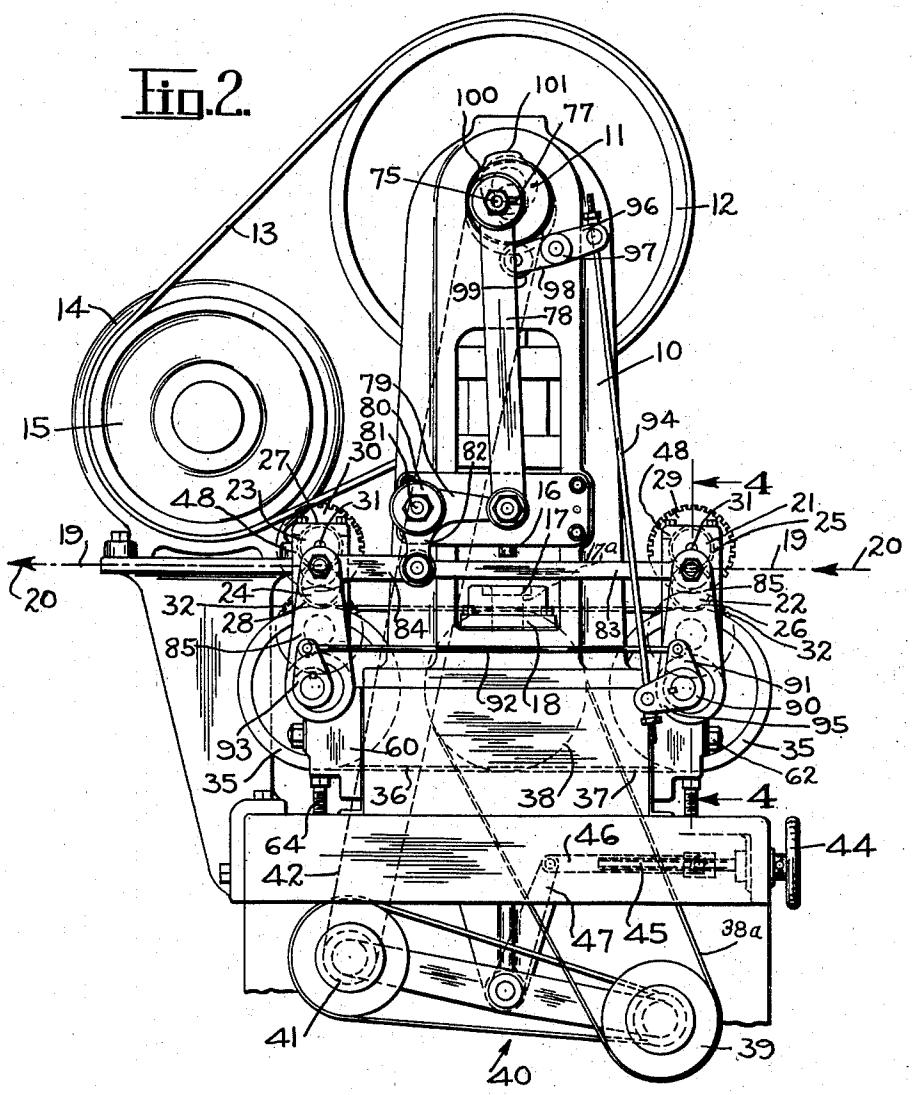
Fig. 2.



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BY
H. G. Manning
ATTORNEY

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Fig. 4

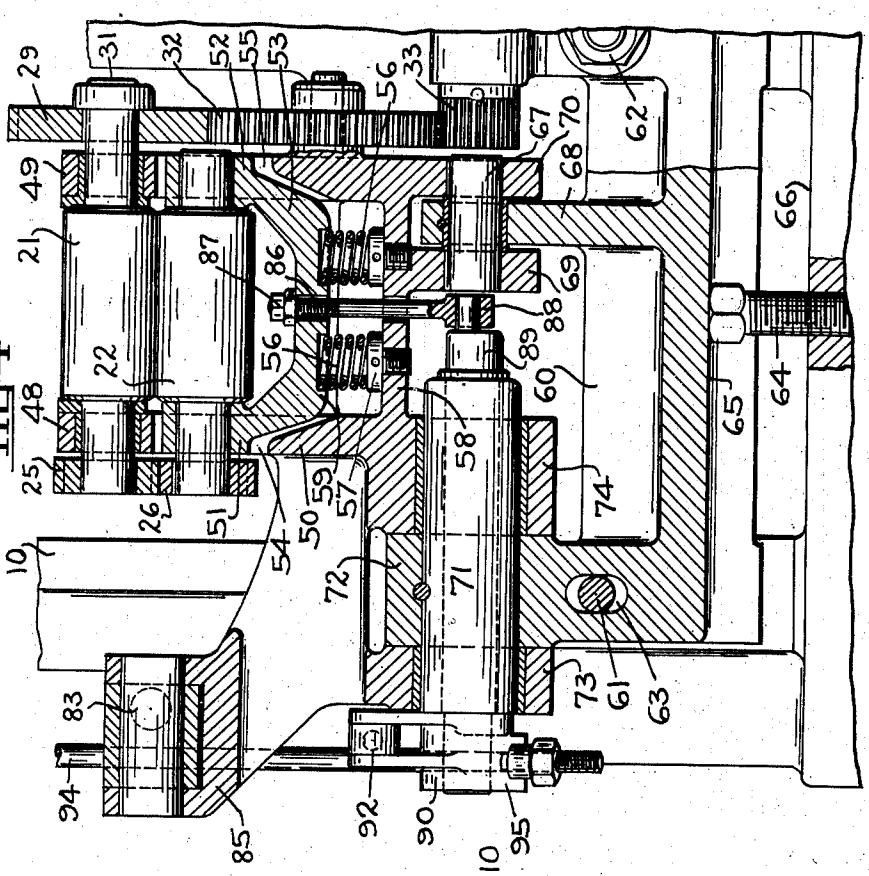
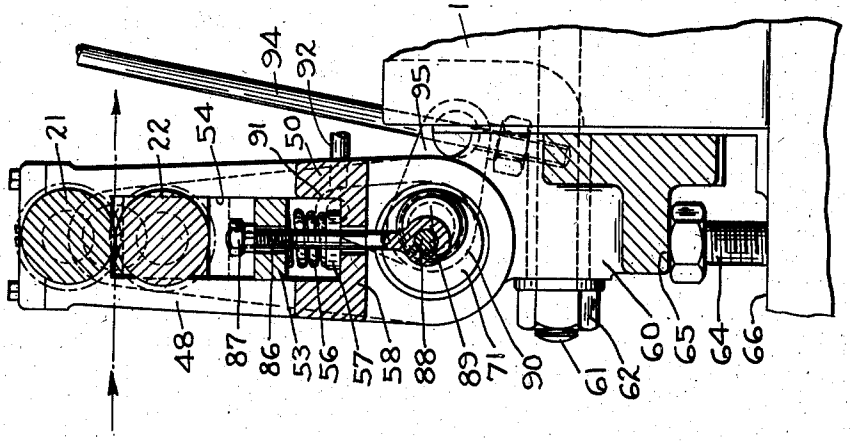


Fig. 3.



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ATTORNEY

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Filed Jan. 18, 1939 4 Sheets-Sheet 4

Fig. 5.

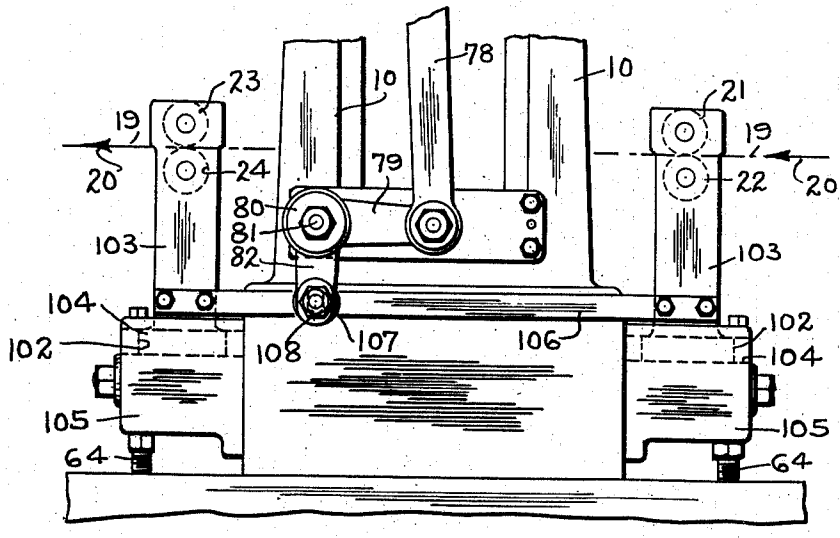
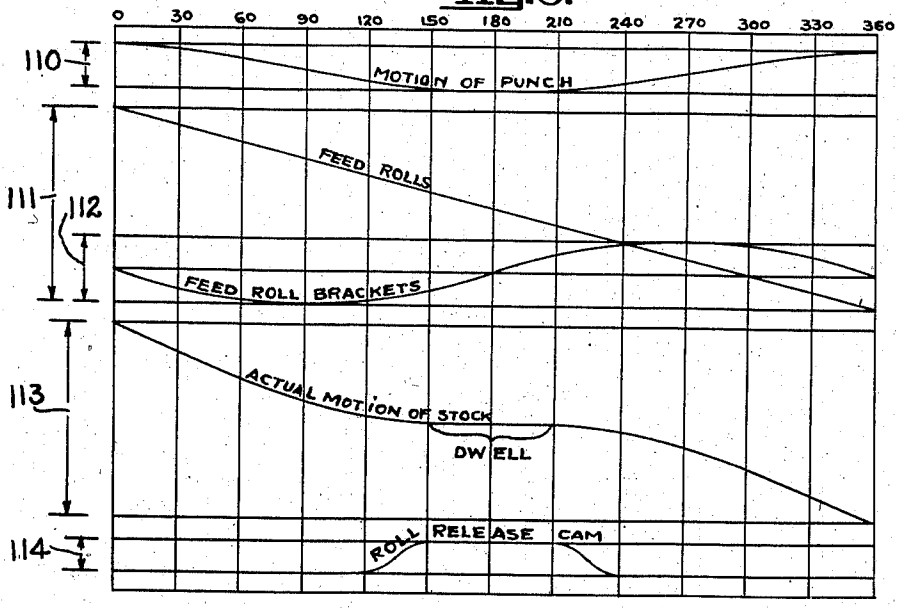


Fig. 6.



INVENTOR
Zenas P. Candee.
George W. Jackman.
BY
H. G. Manning
ATTORNEY

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2,268,242

UNITED STATES PATENT OFFICE

2,268,242

RAPID PUNCH PRESS

Zenas P. Candee and George W. Jackman, Waterbury, Conn., assignors to The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., a corporation of Connecticut

Application January 18, 1939, Serial No. 251,583

11 Claims. (Cl. 164—89)

This invention relates to press machinery, and more particularly to an improved rapid punch press in which a strip of stock is continuously fed into the press by a roll feed which has a reciprocating motion to cause the stock to have zero velocity during the punching operation.

In the conventional type of roll feeding mechanisms in which the roll housings are stationary, the rolls are inoperative during one portion of the press cycle, and operative to feed the stock to the dies during another portion of said press cycle. With such machines it is necessary to accelerate the feed rolls from zero velocity to maximum velocity, and again reduce the speed to zero during each cycle of the press. Due to the inertia of the rolls and their driving means, the rolls are difficult to start and stop, and have a tendency to over-travel at the end of their operative action. To offset this inertia and over-travel tendency, strong starting mechanism and brakes are required, with their attendant disadvantages. The intermittent starting and stopping of the rotating parts seriously affects the accuracy of feeding the stock. This is especially true in high speed punch presses having a rapidly reciprocating punch requiring relatively high velocity of stock feeding. When it is attempted to operate presses at high speed with comparatively long feeds, it has been found that the bad effects from the feed roll inertia increase as the square of the speed and a maximum feeding velocity is eventually reached which cannot be exceeded without loss of accuracy of feed.

By means of the present invention, the above and other disadvantages have been overcome and a rapid punch press has been produced in which the stock feeding rolls are continuously rotated—eliminating the need of starting and stopping mechanisms, and making it possible to obtain faster feeding and operation of the punch press.

One object is to provide a mechanism of the above nature having cooperating continuously rotating stock feed rolls mounted in housings which are adapted to oscillate back and forth in the path of the stock feed.

Another object is to provide a rapid punch press of the above nature in which the feed rolls are released from the stock during the punching operation, and in which means are provided for raising and lowering the rolls together with their driving mechanism to compensate for different thicknesses of the stock and the level on which it is being fed.

A further object of this invention is to provide an improved stock feeding mechanism of the above nature which will be relatively inexpensive to manufacture, simple in construction, readily manipulated, compact, and very efficient and durable in use.

With these and other objects in view, which will appear as the description proceeds, there have been illustrated in the accompanying drawings two forms in which the principles and features of this invention may be conveniently embodied in practice.

In the drawings:

Fig. 1 is a front elevational view of a punch press embodying the invention.

Fig. 2 is a side elevational view of the same.

Fig. 3 is an enlarged sectional view of the same, the section being taken on the line 3—3 of Fig. 1.

Fig. 4 is an enlarged sectional view of the same, the section being taken on the line 4—4 of Fig. 2.

Fig. 5 is a front view of a modified form of the invention in which the feed roll supports are reciprocated in a straight line instead of oscillated in the path of the stock being fed.

Fig. 6 is a chart showing the graphs of the relative motions of certain of the operative parts of the machine.

Referring now to the drawings wherein like reference characters denote corresponding parts throughout the several views, the numeral 10 designates the frame of a punch press of standard construction, including a rotatable crank shaft 11, a flywheel 12 secured on one end of the crank shaft 11, and a belt 13 drivingly connecting a pulley 15 mounted on the shaft of a variable speed motor 14 to the flywheel 12. The crank shaft 11 is adapted to vertically reciprocate a punch 16 with respect to a die 17 having an opening 17a therethrough and which is secured on a die plate 18 for causing said die and punch to sever products from a strip of stock 19 located therebetween.

The strip of stock 19 is fed through the press in the direction of the arrows 20 shown in Figs. 2, 3 and 5 by means of two pairs of cooperating continuously rotating feed rolls, one pair consisting of the rolls 21 and 22 being located in front of the press, and the other pair consisting of the rolls 23 and 24 being located at the rear of the press. The rolls 21 and 22 of the front pair are drivingly connected by meshed gears 25 and 26, while the rolls 23 and 24 of the rear pair are drivingly connected by meshed gears 27 and 28. The upper rolls 21 and 23 of each pair are provided with gears 29 and 30 respectively, secured to the ends 31 of the shafts of said rolls.

The gears 29 and 30 are adapted to mesh with idler gears 32 which in turn are in mesh with pinion gears 33.

Each of the gears 33 is connected through a shaft 34 to a pulley 35, which is drivingly connected by means of a belt (36 or 37) to a common pulley 38, which in turn is drivingly connected, as by a belt 38a, to a pulley 39 forming part of a variable speed mechanism, generally indicated by the numeral 40. The variable speed mechanism 40 includes a pulley 41 which is drivingly connected by a belt 42 to a pulley 43 mounted on one end of the crank-shaft 11. By means of the above construction, it will be seen that the front rolls 21 and 22 and the rear rolls 23 and 24 will be continuously rotated while the press is in operation by means of the variable speed motor 14. It will also be seen that the speed of said rolls may be varied by manually adjusting the variable speed mechanism 40 by means of a hand wheel 44 secured to a threaded stud 45, which is connected by a link 46 to an operating arm 47 of the variable speed mechanism 40. For a full description of a variable speed mechanism of a similar type, reference should be made to Patent No. 1,662,660, issued to H. C. Clay, March 13, 1928, and assigned to the Reeves Pulley Company of Columbus, Indiana.

Oscillating roll supports

The upper feed rolls 21 and 23 are journaled in spaced-apart uprights 48 and 49, forming an integral part of an oscillating bracket 50, and the lower feed rolls 22 and 24 are journaled in spaced apart uprights 51 and 52 (Fig. 4) forming part of a bracket 53, which is arranged to slide up and down within the bracket 50. The uprights 51 and 52 of the sliding bracket 53 are disposed in vertical guideways 54 and 55 formed in the uprights 48 and 49, respectively.

In order to constantly urge each slidable bracket 53 upwardly, provision is made of a pair of compression springs 56, each reacting between tension adjusting screw plugs 57 threaded into a horizontal partition 58 of the bracket 50, and the base 59 of said bracket 53, whereby the strip of stock 19 will be firmly gripped between the pairs of rolls.

Each of the oscillating brackets 50 (see Figs. 1 and 4) is pivoted to a fixed bracket 60, which is secured to the machine frame 10 by horizontal threaded studs 61 and nuts 62. The studs 61 pass through vertically elongated holes 63 formed in the bracket 60 and screw threaded into the adjacent portion of the frame 10. Both of the brackets 60 are adjustable vertically by means of a screw 64 having an upper head which engages a shoulder 65 on the bracket 60 and screw-threads into the table top 66 of the press frame 10, said brackets 60 being clamped in any desired adjusted position by tightening the nuts 62 on the studs 61.

The pivotal joint between the oscillating bracket 50 and the fixed bracket 60 is constituted partly by a horizontal pin 67 extending through and rotatable in an upright 68 extending upwardly from the bracket 60, said pin 67 also extending through and being fixed to a pair of spaced lugs 69 and 70 depending from the oscillating bracket 50. The remainder of the pivotal joint comprises an elongated horizontal sleeve 71 passing through and fixed to an upright 72 extending upwardly from the bracket 60, and also passing through a pair of spaced-apart lugs 73 and 74 depending from the bracket 50 and freely rotatable on the sleeve 71. It will be understood that the pulleys 35 also rotate about the same axis as that of the bracket 50.

Feed roll oscillating mechanism

Both of the front and rear oscillating brackets 50 are adapted to be rocked with respect to the fixed brackets 60 by means of an eccentric crank pin 75 mounted in an extension 76 of the crank shaft 11. The eccentricity of the pin 75 is adapted to be adjusted by means of a screw 77. A downwardly extending link 78 connects the crank pin 75 to a horizontal arm 79 of a common bell crank lever 80 pivoted to the frame 10 at 81. The other vertical arm 82 of the bell crank 80 is connected to the front oscillating bracket 50 by a link 83, and to the rear oscillating bracket 50 by a link 84, whereby both brackets 50 will rock in unison. The links 83 and 84 are joined to the respective oscillating brackets 50 by pivot pins mounted in a pair of inclined arms 85 extending upwardly from the outer end of said brackets respectively.

Roll releasing mechanism

In order to release the rolls 21, 22 and 23, 24 from gripping engagement with the strip of stock 19 during the punching operation, provision is made of a pair of vertical studs 86 which are extended upwardly through suitable apertures in each of the oscillating brackets 50 and the sliding brackets 53 (see Figs. 3 and 4), said studs 86 having lock nuts 87 threaded on their upper ends to engage said brackets 53. By means of this construction, the depression of the studs 86 will cause the brackets 53 to slide downwardly along the vertical guideways 54 and 55 to separate the lower rolls 22 and 24 from the upper rolls 21 and 23. The lower end of each releasing stud 86 is rotatably mounted on a short eccentric shaft end 88 extending from a rock shaft 89 journaled in the sleeve 71. As clearly shown in Figs. 2 and 3, the shaft 89 of the front oscillating bracket 50 has a bell crank lever 90 secured thereto, one arm 91 of said lever being connected by a cross bar 92 to an arm 93 secured to the rock shaft 89 of the rear oscillating bracket 50, whereby both front and rear rock shafts 89 will be rocked in unison.

An upwardly extending rod 94 is connected at its lower end to the other arm 95 of the bell crank lever 90. The upper end of said rod 94 is connected to the outer arm 96 of a rocking lever 97 pivoted to the frame 10 adjacent the crank shaft extension 76. The inner arm 98 of the lever 97 carries a roller 99 which rides on the periphery of a cam 100 rigidly mounted on the crank shaft 11 and adapted to rotate therewith. The cam 100 is provided with a raised camming lug 101, and said cam is timed to cause said lug to effect the release of the stock 19 from the grip of both pairs of rolls during the punching operation.

Modification

In the modified form of the invention shown in Fig. 5, provision is made of a pair of feed roll supporting brackets 103, which are adapted to slide instead of oscillate as in the first form shown in Figs. 1–4 inclusive. This is accomplished by providing a base 102 for each pair of feed roll supporting brackets 103, and disposing these bases 102 in slideways 104 formed in a pair of brackets 105. The supporting and sliding brackets 103 and 105 in all other respects are similar to the oscillating brackets 50 and 60 re-

spectively, described above. In the modified form of the invention shown in Fig. 5, the front and rear brackets 103 are joined together to operate in unison by a cross bar 106, to which is pivoted the arm 82 of the common bell crank lever 80 by means of a bolt 107 which passes through said arm 82 and through a vertically elongated slot 108 in said cross bar 106. As in the first form previously described, the bell crank lever 80 is rocked by the eccentric pin 75 of the crank shaft through the depending link 78 connected to the arm 79 (see Figs. 1 and 2).

Operation

In operation, when the motor 14 is started, the crank-shaft 11 will be rotated and the punch 16 reciprocated to act upon a strip of stock 19 passed between it and the die 17. The two pairs of cooperating feed rolls 21, 22 and 23, 24 are also caused to continuously rotate at the desired constant speed to pass the stock 19 through the press.

During each revolution of the crank-shaft 11, the punch 16 will be reciprocated to act in cooperation with the die 17 upon the stock 19 disposed therebetween.

Since it is obviously necessary that the metal stock must be standing still while the punch engages it and locks the metal, punch and die together momentarily, the feed roll housings are given an oscillating motion in the first form of the invention (and a sliding motion in the second form) timed to produce a short period of dwell in the resultant motion of the strip stock at the time the actual punching takes place. This is accomplished by causing the oscillating feed roll housing when it is traveling in the opposite direction from the metal stock to move at practically the same speed as said stock, so as to compensate for the forward speed thereof. Mathematically, the back and forth motion of the feed roll housings will be equal to the amount of the advance of the stock divided by "pi" (3.1416). In other words, the speed of the feed roll housing is intermittently brought to zero once each cycle to cancel out the speed of the continuous advance of the metal stock produced by the constant rotation of the feed rolls. The feed rolls will also be preferably separated once each cycle to release their grip upon the metal stock to make possible the use of stock centering pilots. This is accomplished by the action of the cam 100, the lug 101 of which engages the roller 99 on the lever 97 to cause the rod 94 to move up and down for rocking the bell crank lever 90 and pulling downwardly upon the sliding brackets 53 to move the lower rolls 22 and 24 away from the upper rolls 21 and 23 respectively.

During the remainder of the cycle the stock 19 will be fed along to dispose it in position for the next stroke of the punch. The amount of movement required of the stock 19 during each cycle between strokes of the punch will, of course, be dependent upon the size and shape of the article being punched.

The operation of the invention may be further explained by reference to the motion chart shown in Fig. 6, wherein the upper graph 110 represents the reciprocating movement of the punch 16 during one cycle of the press, or revolution of the crank-shaft 11. The next graph 111 represents a straight line showing the constant peripheral speed of rotation of the stock feeding rolls 21, 22 and 23, 24 during the same cycle. The third graph 112 represents the movements of the oscillating feed roll supporting brackets 50. The graph 113 represents the composite or resultant actual movement or feed of the stock produced by combining the graphs 111 and 112, and shows the actual motion of the stock relative to the center of the stationary die. The bottom graph 114 represents the cycle of motion of the feed roll release cam 100 for separating the lower rolls 22 and 24 from the upper rolls 21 and 23.

It will be clear from the above that the stock 19 will be advanced through the press during the major portion of its cycle when the punch 16 is not engaging the stock, and that the stock will "dwell" at zero velocity when the punch is in engagement with said stock.

One advantage of this invention is that the feeding movement of the stock 19 will be much smoother than in previous presses, due to the great reduction of inertia effects in the moving parts of the roll feed mechanism.

A further advantage is that due to the continuous rotation of the rolls 21, 22 and 23, 24, no expensive start and stop mechanism therefor is necessary with its attendant inaccuracy of feeding and limitation on the maximum speed of the punch press.

Although it is considered preferable to oscillate the feed rolls in a swinging movement by pivoting the brackets 50 to the stationary frame, the feed rolls may be mounted in sliding supports as shown in Fig. 5. In both cases, however, the maximum oscillating or sliding movement of the feed rolls may be varied by adjusting the eccentricity of the crank-pin 75 by means of the screw 77. Also the speed of rotation of the feed rolls may be varied by adjustment of the variable speed mechanism 40, and the roll brackets 50 or 103 may be raised and lowered with respect to the punch and die by means of the adjusting screws 64.

While there has been disclosed in this specification, two forms in which the invention may be conveniently embodied in practice, it is to be understood that these forms are shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosures, but may be modified and embodied in various other forms without departing from its spirit. In short, the invention includes all the modifications and embodiments coming within the scope of the following claims.

Having thus fully described the invention, what is claimed as new and for which it is desired to obtain Letters Patent is:

1. In a punch press having a die and a reciprocating punch cooperating with said die, mechanism to feed a strip of stock between said punch and die while the latter are separated including a pair of continuously rotating feed rolls for gripping said stock, a support for said feed rolls, means to move said support backwardly away from said punch and die to produce a "dwell" in the forward travel of said stock during the punching operation, and automatic means to separate said rolls to release the stock from gripping action thereby just prior to and during said punching operation.

2. In a stock feeding mechanism for a punch press or the like, a pair or cooperating constantly rotated stock gripping and feeding rolls, a sliding support for said rolls, means to reciprocate said roll support to produce a "dwell" in the forward travel of said stock of sufficient duration

as to permit the punching operation to take place, and cam operated means to separate said feed rolls to release the stock gripped thereby during the punching operation.

3. In a punch and die press, a frame, a vertically adjustable support carried by said frame, an oscillating bracket pivoted to said support, a vertically sliding bracket mounted in said oscillating bracket, said brackets carrying cooperating stock feeding rolls, means to cause said oscillating bracket to move rearwardly at such a speed as to produce a dwell in the resultant forward motion of said stock during the punching operation, and means to also move said sliding bracket downwardly to release said rolls from said stock during said punching operation.

4. In a punch and die press, a frame, an oscillating bracket pivotally mounted in said frame, a spring pressed bracket slidably mounted within said oscillating bracket, said brackets carrying cooperating stock feeding rolls, means to cause said oscillating bracket to move said rolls in an opposite direction with respect to the movement of said stock at such a speed as to produce a dwell in the resultant forward motion of said stock during the punching operation, a vertical stud connected to said slidable bracket and depending therefrom, and cam-operated means to depress said stud and slidable bracket to release said rolls from said stock during the punching operation.

5. In a punch and die press, a frame, an oscillating bracket pivotally mounted in said frame, a spring pressed bracket slidably mounted within said oscillating bracket, said brackets carrying cooperating stock feeding rolls, means to cause said oscillating bracket to move said rolls rearwardly with respect to the forward movement of said stock at such a speed as to produce a dwell in the resultant forward motion of said stock during the punching operation, a vertical stud adjustably connected to said slidable bracket and depending therefrom, and cam-operated means to depress said stud and slidable bracket to release said rolls from said stock during the punching operation.

6. In a punch press having a die and a reciprocating punch cooperating with said die, mechanism to feed a strip of stock between said punch and die while the latter are separated including a pair of continuously rotating feed rolls for gripping said stock, a support for said feed rolls, means to move said support backwardly away from said punch and die to produce a "dwell" in the forward travel of said stock during the punching operation, means to separate said rolls to release the stock from gripping action thereby just prior to and during said punching operation, and manually controlled means to vary the speed of said rolls operable without stopping said press.

7. In a press having a die and a reciprocating punch cooperating with said die, mechanism to feed a strip of stock between said punch and die while the latter are separated, including a frame, two reciprocating brackets located at opposite sides of said die and punch, each carrying a continuously rotating upper feed roll in the upper part thereof, spring-pressed brackets slidably mounted in each of said reciprocating brackets and each carrying a continuously operated lower feed roll for cooperating with said upper feed rolls, means to move said reciprocating brackets back and forth in unison for producing a "dwell" in the forward travel of said stock during the operation of the punch and die located therebetween, and means operated in unison to move said slidable brackets downwardly to release the stock from gripping action just prior to and during said punching operation.

8. In a punch and die press, a frame, an oscillating bracket pivotally mounted in said frame, a spring pressed bracket slidably mounted within said oscillating bracket, said brackets carrying cooperating stock feeding rolls, crank-operated means to cause said oscillating bracket to move rearwardly with respect to said stock at such a speed as to produce a "dwell" in the resultant forward motion of said stock during the punching operation, a vertical stud connected to said slidable bracket and depending therefrom, and cam-operated means to depress said stud and slidable bracket to release said rolls from said stock during the punching operation.

9. In a press having a die and a reciprocating punch cooperating with said die, mechanism to feed a strip of stock between said punch and die, while the latter are separated including a frame, two reciprocating brackets located at opposite sides of said punch and die, each carrying a continuously rotating upper feed roll in the upper part thereof, adjustable brackets slidably mounted in each of said reciprocating brackets and each carrying a continuously operated lower feed roll for cooperating with said upper feed rolls, means to move said reciprocating brackets back and forth in unison for producing a "dwell" in the forward travel of said stock during the operation of the punch and die located therebetween, and means operated in unison to move said slidable brackets downwardly to release the stock from gripping action just prior to and during said punching operation.

10. In a punch and die press, mechanism to feed a strip of stock between the punch and die while the latter are separated, including a pair of continuously rotating rolls for gripping and feeding said stock, adjustable means to vary the speed of rotation of said feed rolls, a support for said feed rolls, adjustable means to move said support backwardly and forwardly from said punch and die variable amounts to compensate for the speed of rotation of said feed rolls, whereby a zero velocity or dwell will result in the forward travel of said stock during the punching operation, and means to automatically separate said rolls from said stock during the punching operation.

11. In a punch and die press, means to feed a strip of stock between the punch and die while they are separated, including a pair of continuously rotating rolls for gripping and feeding said stock, adjustable means to vary the speed of rotation of said feed rolls, a support for said feed rolls, and adjustable means to move said support backwardly and forwardly from said punch and die by variable amounts in such a manner that on the backward motion of said support the resultant speed of said stock is zero.

ZENAS P. CANDEE.
GEORGE W. JACKMAN.