

Nov. 12, 1968

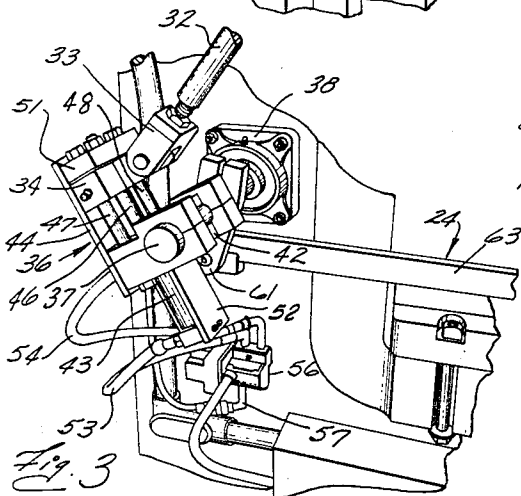
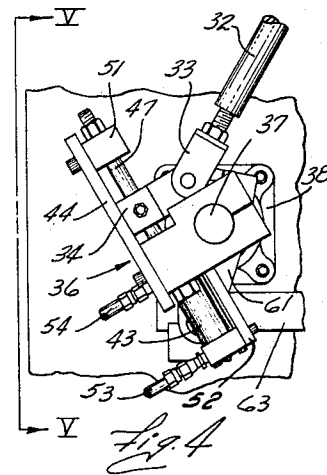
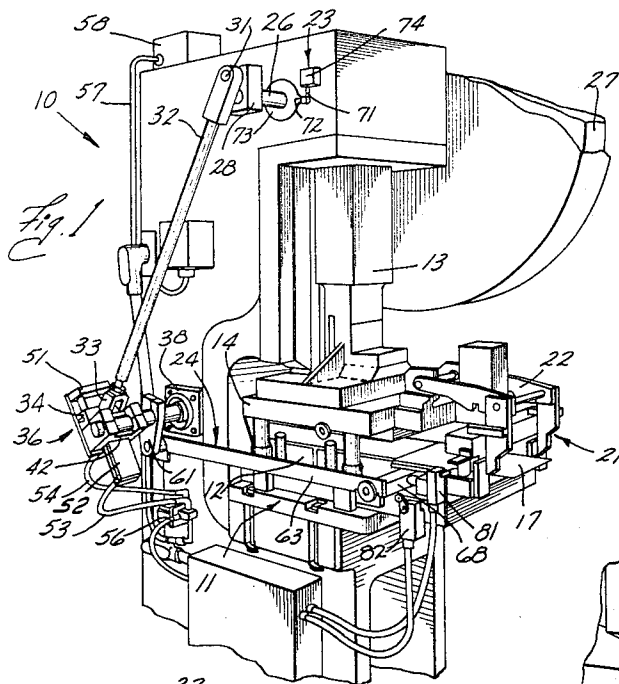
L. A. FRANKS ET AL

3,410,130

FEED PROGRESSION CHANGER

Filed Sept. 23, 1965

2 Sheets-Sheet 1



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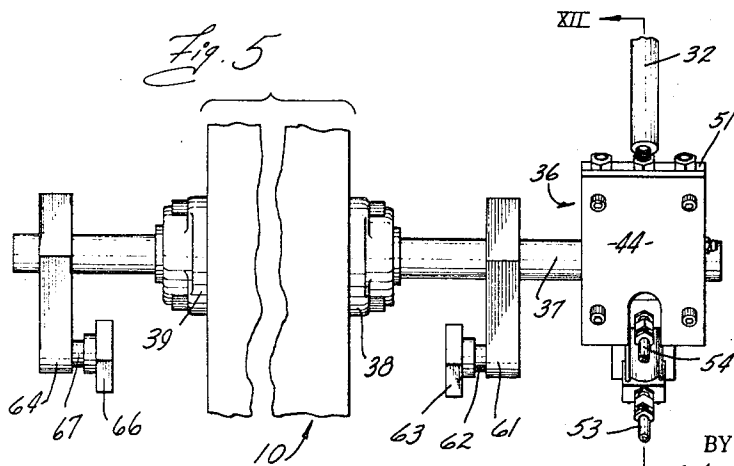
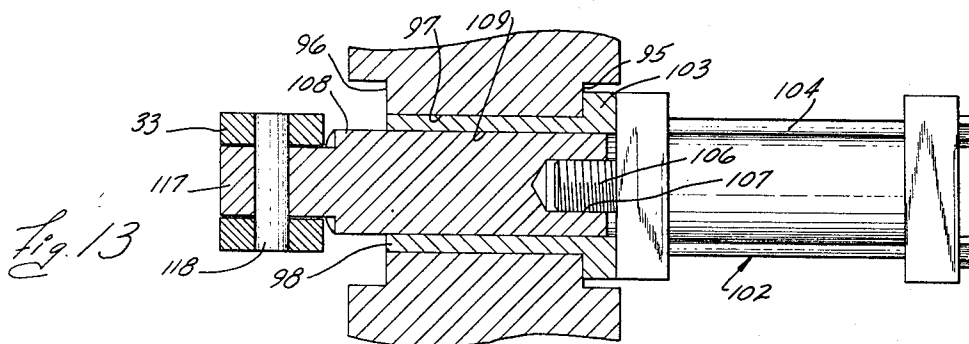
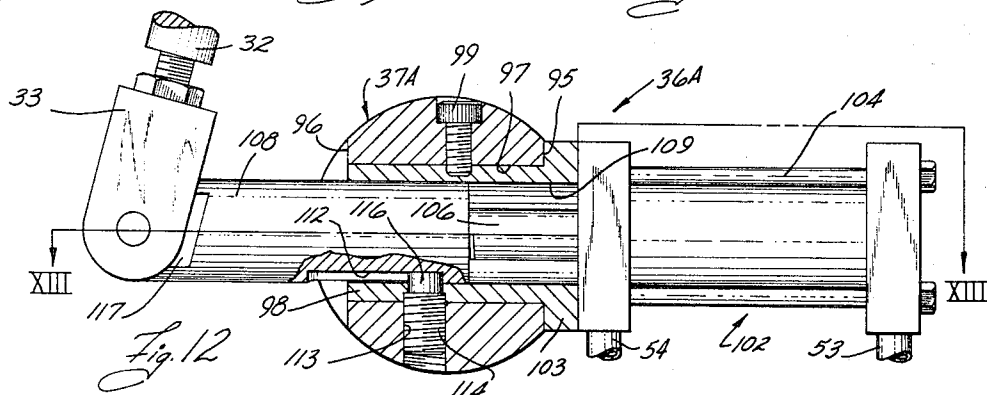
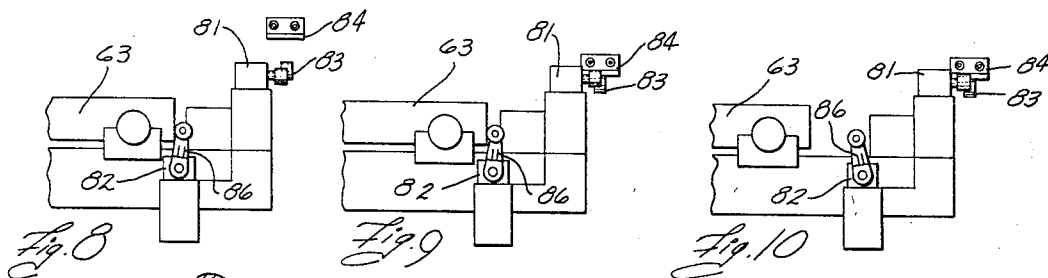
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2 Sheets-Sheet 2



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3,410,130

FEED PROGRESSION CHANGER

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ABSTRACT OF THE DISCLOSURE

A feed mechanism for advancing sheet material through a punch press and having actuating means connected to the feed mechanism for effecting reciprocating movement thereof. An electrically energized control means is mechanically connected to the actuating means for changing the amount of movement of the feed mechanism. First switch means is connected to the control means and it is adapted to energize the control means when an operation, such as a shearing operation, is carried out at selected intervals as the sheet material is fed through the press. Second switch means is connected for maintaining the control means energized for one cycle of operation of the punch press following actuation of the first switch means.

This invention relates in general to a feed mechanism for advancing material through a punch press and, more particularly, to a type thereof whereby sheet material is advanced intermittently in predetermined amounts and whereby the amount of such advancement can be automatically changed at selected intervals.

Punch presses have been used for many years to perform repetitive operations upon a strip or ribbon of sheet material, for example, which is intermittently advanced by a reciprocating feed mechanism so that the operation on the sheet material is performed in a repetitive fashion. Such a press is used to form the fins of heat exchange coils, such as cooling coils. That is, a strip of sheet material is fed from a roll thereof between the dies of the press which not only punch openings in the fins, but also extrude or draw integral collars from the sheet material adjacent such openings. Usually the dies are of the progressive type having a plurality of punches of different shapes which are mounted so that each extruded opening is progressively formed in the sheet material as it is moved through the press.

In order to speed up the operation, it is customary to place the punches in rows and provide multiples of each type of punch in each row. That is, each row of punches in the direction of movement of the sheet material may have five different types of punches for progressively performing the operation, and each type of punch may be in duplicate or triplicate so that the advancement of the sheet material may be in increments of two or more times the centerline distance between two adjacent punches in one row.

Where the punches are provided in multiples of two, for example, and each finished fin requires an even number of holes per row, the press can operate at full capacity and a fin will be formed at the end of each fourth operation of the press, it being recognized that the press also includes a shear which is activated with the fourth punching operation of the press.

Heretofore, it has been difficult to form on a press having duplicate punches a fin having an odd number of holes therein. For example, if a nine-hole fin were desired, either the press had to be set on single step operation, thereby cutting its output in half, or it was necessary to manually change the feed progression at the end of each fourth operation of the press so that the fifth operation of the feed mechanism would produce a single hole ad-

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vancement. That is, the feed mechanism would effect four two-hole advancements followed by one one-hole advancement and then be returned again to a two-hole advancement.

Accordingly, a primary object of this invention has been the provision of a feed mechanism for advancing sheet material through a punch press at uniform, intermittent intervals of movement, said mechanism including a device for changing automatically the amount of advancement or feed progression of the sheet stock through the punch press after a selected number of operations, and then returning the operation to its original pattern of progression.

A further object of this invention has been the provision of a feeding mechanism having a feed progression changer, as aforesaid, which is relatively easy to adapt for use on existing punch presses, which is easy to maintain and adjust, which operates from normally available sources of energy, which is relatively inexpensive to install, and which is virtually foolproof in its operation.

Other objects and purposes of this invention will become apparent to persons familiar with this type of equipment upon reading the following specification and examining the accompanying drawings, in which:

FIGURE 1 is a perspective, fragmentary view of a punch press embodying the invention.

FIGURE 2 is an enlarged fragment of the structure appearing in FIGURE 1.

FIGURE 3 is an enlarged fragment of the structure appearing in FIGURE 1.

FIGURE 4 is a side elevational view of a fragment of the structure appearing in FIGURE 1.

FIGURE 5 is a broken, rear elevational view of a portion of the punch press as viewed from the cutting line V-V in FIGURE 4.

FIGURE 6 is a fragmentary top view of a strip of sheet material in which the openings have been punched.

FIGURE 7 is a sectional view taken along the line VII-VII in FIGURE 6.

FIGURE 8 is a schematic fragment of the press shown in FIGURE 2.

FIGURE 9 is a fragment of said press similar to that shown in FIGURE 8 with parts thereof in different positions of operation.

FIGURE 10 is a fragment similar to that shown in FIGURE 8 with parts thereof in different positions of operation.

FIGURE 11 is a diagram of the electrical circuitry utilized in the invention and illustrating the switch circuit.

FIGURE 12 is a sectional view taken along the line XII-XII in FIGURE 5 and showing an alternate crank device.

FIGURE 13 is a sectional view taken along the line XIII-XIII in FIGURE 12 with the piston retracted.

For convenience in description, the terms "upper," "lower" and words of similar import will have reference to said feed mechanism and the press with which it is associated as appearing in FIGURE 1, which discloses the front and right sides of said punch press. The words "inner," "outer" and derivatives thereof will have reference to the geometric center of said feed mechanism and parts of the press associated therewith.

General construction

The press 10 (FIGURE 1) may be of any substantially conventional type including a bed 11 supporting a lower die 12 and a vertically reciprocable column 13 supporting an upper die 14. The relative movement of the column 13 and bed 11 causes the dies 12 and 14 to perform punching operations on a strip of sheet material 17. In this particular embodiment, the punches 18 (FIGURE 2) are mounted on the lower die and corresponding openings, not shown, are provided in a conventional manner in the upper die 14, whereby the openings 19 are

formed in said sheet material 17, which may be metal.

A shear 21 (FIGURES 1 and 2) is mounted on the front end of the bed 11 and connected by linkage 22 to electrically actuated mechanism, including the counter 23 (FIGURE 1). By this means, a cutting movement of the shear 21 is effected in response to a preselected downward movement of the column 13, but usually not with each downward movement thereof.

A feed mechanism 24 (FIGURES 1 and 2) is embodied in the press 10 for the purpose of effecting intermittent advancements (usually uniform) of the sheet material 17 through the press 10 between the dies 12 and 14 thereof. Said feed mechanism 24 includes a drive shaft 26 (FIGURE 1) which is connected in a substantially conventional manner to the power source, such as a motor (not shown), and to a flywheel 27. A crank 28 is mounted upon the drive shaft 26 and has a crank pin 31 pivotally supporting one end of the connecting rod 32 upon the crank 28. The other end of the connecting rod 32 is adjustably secured to a yoke 33 which is in turn pivotally mounted upon the slide block 34 of the crank device 36. A shaft 37 is mounted upon the press 17 by means of the bearings 38 and 39 (FIGURE 5) and preferably extends completely through the press 10.

The crank device 36 includes a crank web 42 which is rigidly secured to the rightward end of the shaft 37. A pressure fluid actuator 43, which may be an air cylinder in this particular embodiment, is mounted upon the crank web 42 by means including the support plate 44, so that the piston 46 of the actuator 43 moves transversely of the shaft 37 and is radially spaced therefrom. A pair of guide rods 47 and 48 are mounted at one end of each upon the web 42 and extend on opposite sides of and substantially parallel with the piston 46 for rigid securement at their other ends to the end block 51. A back plate 52 is rigidly secured to and extends from the crank web 42 on the opposite side thereof from said end block 51 to support the actuator 43. The slide block 34 is rigidly secured to the outer end of the piston 46 and is slideably supported upon the guide rods 47 and 48 for movement lengthwise thereof between the block 51 and the crank web 42.

The opposite ends of the air cylinder 43 (FIGURE 3) are connected by conduits 53 and 54 to a solenoid operated valve 56 which is in turn connected by the conduit 57 to a source 58 of air under pressure.

A crank 61 (FIGURE 5) is mounted upon the leftward end of the shaft 37 and has a pin 62 pivotally secured to one end of the connecting bar 63. A crank 64 and connecting bar 66, which may be similar to the crank 61 and connecting bar 63, respectively, are interconnected by a pin 67. The front ends of the two connecting bars 63 and 66 are connected to the opposite ends of the feed bar 68 which supports the means, not shown, by which the sheet material 17 is engaged and advanced in response to normal operation of the feed mechanism 24.

The counter 23 (FIGURE 1) may be of a conventional type having electrical switch means 74 which is mechanically actuated to effect the counting operation. The counter 23 includes a counting arm 71, which is engaged by the lobe 72 on the cam 73 each time the drive shaft 26, to which said cam 73 is attached, is rotated. Thus, if the counter 23 is set for four counts, by appropriate adjustment thereof in a conventional manner, the switch 74 will be closed to energize suitable mechanism, not shown, whereby to actuate the shear linkage 22, hence the shear 21, each time the counter counts out four rotations of said shaft. The counter 23 is of the automatic resetting type, whereby the counting process will repeat itself indefinitely until the setting of the counter is changed.

The solenoid valve 56 (FIGURE 1) is connected to a circuit having a pair of switches 81 and 82, hereinafter referred to as the shear switch 81 and the feed switch 82. The switch circuit may be connected by the conduc-

tors 77 and 78 to a source of 110 volt D.C. potential, substantially as shown in FIGURE 11. The shear switch 81, which is normally open, includes a switch operator 83 (FIGURE 2) which is engageable by a flange 84 connected to the shear 21. The switch operator 83 and flange 84 are located so that the shear switch 81 is closed each time the shear 21 is moved to perform a cutting operation upon the sheet material 17. The feed switch 82 has an operator 86 which is engaged by the front end of the connecting bar 63 each time it is moved forwardly, whereby said feed switch 82 is opened. The linkage 22 for actuating the shear 21 is arranged and timed so that the normally closed feed switch is opened by the connecting bar 63 (FIGURE 8) before the normally open shear switch 81 (FIGURE 9) is closed by the flange 84. Moreover, the feed switch is permitted to return to its closed position by rearward movement of the connecting bar 63 (FIGURE 10) while the shear switch is still being held closed by the flange 84. Accordingly, if the cam 73 (FIGURE 1) has closed the counter switch 74, the relay 87 (FIGURE 11) will be energized and the normally open holding contacts 88 thereof will be closed by the relay 87 and held closed by the normally closed feed switch 82 after the flange 84 moves upwardly into its FIGURE 8 position and thereby permits the shear switch 81 to reopen without de-energizing the solenoid 89. That is, the relay 87 will continue to be energized through the feed switch 82.

Closure of the shear switch 81 will energize the solenoid 89 of the solenoid valve 56 whereby the air cylinder 43 will be actuated to extend the piston 46 from its FIGURE 4 position to its FIGURE 3 position and thereby increase the throw of the crank device 36. The stroke of the piston 46 is carefully selected so that, in this particular embodiment, the movement of the feed bar 68 will be reduced to 50% of its normal movement when the piston is in its FIGURE 3 position. Thus, the sheet stock will be advanced a distance equal to the centerline distance between the openings 19A and 19B (FIGURE 6) in the sheet material 17. Prior to this change in the throw of the crank device 36, the advancement of the sheet material 17 was equal to the centerline distance between alternate openings 19B and 19D, for example, in the sheet stock 17.

Re-engagement of the feed switch operator 86 by the connecting bar 63 will occur with the next advancement of the sheet material by the feed mechanism. This action will open the feed switch 82 thereby de-energizing the relay 87 and the solenoid 89 so that the crank device 36 is returned to its original, normal throw.

Operation

While the operation of the press 10, the feed mechanism 24 and the crank device 36, for the purpose of changing the feed progression of the sheet material 17, is probably evident from the foregoing descriptive material, a brief summary will be given. Where the fins being formed from the sheet material by the press 10 will have an even number of openings 19 in each row thereof of lengthwise of the sheet material 17, it will not be necessary to use the feed progression changing feature of the invention in a machine having even multiples of duplicated, adjacent punches 18. However, when this same machine is used to produce fins having an uneven number of holes in each row, then the circuitry including the solenoid 89 and relay 87 must be energized in a particular, repetitive pattern.

With a fin having nine holes in each row, for example, the counter 23 is set so that every fifth rotation of the drive shaft 26 will cause the counter 23 to close the counter switch 74, whereby the relay 87 and solenoid 89 are energized as soon as the shear switch 81 is closed by the downward movement of the shear 21 to cut off the fin. As described above, the relay 87 will continue to be energized through the holding contacts 88, where-

by to energize the solenoid 89 until the feed mechanism 24 substantially completes a cycle of operation and the counting bar 63 again moves forwardly to open the feed switch 82. During this period of time, the stroke of the crank device 36 will be held to its minimum value so that said movement of the feed mechanism 24 will be 50% of its normal movement. Thereafter, each movement of the feed mechanism 24 until the counter switch 74 is again closed by the cam 76 will be the normal distance whereby the sheet material 17 is advanced the normal two-hole distance, as discussed above.

It will be apparent from the foregoing disclosure that the principles of the invention discussed herein can be applied equally to a press having progressive dies with other multiples of identical adjacent punches, such as three and four punches. Also, the stroke of the piston 46 can be adjusted to reduce the normal advancement of the sheet material from four-hole distances, for example, to any one of the lesser hole distances, as may be required, to provide the desired number of holes per fin length. It will also be recognized that all of the conventional fixtures, such as strip slitters, not shown, can be provided on the press for performing their usual functions without affecting the performance of the invention. Moreover, while a pressure fluid actuated cylinder 43 is used to change the stroke of the crank device 36 in this particular embodiment, other means may be found advantageous, so long as they can be made to operate responsive to the functioning of a circuit substantially as shown in FIGURE 11.

Modified construction

As shown in FIGURES 12 and 13, a modified crank device 36A may be mounted upon and connected to a modified crankshaft 37A for the purpose of performing the functions of the crank device 36 (FIGURE 4) in the principal embodiment. For this purpose, the shaft 37A may be provided with a pair of parallel flats 95 and 96 and a transaxial opening 97 which preferably penetrates the flats 95 and 96 at right angles thereto. A flanged bushing 98 is inserted into the opening 97 where it is held by the screw 99. A pressure fluid actuated device, such as the air cylinder 102, is mounted upon the flange 103 of the bushing 98 by the bolts 104. The air cylinder 102 may be connected by the conduits 53 and 54 to the solenoid valve 56 shown in FIGURE 3.

The air cylinder 102 has a piston 106 with a threaded end which is received into the threaded recess 107 in one end of the cylindrical bar 108, which is snugly but axially slideably disposed within the opening 109 in the bushing 98. Accordingly, the bar 108 is reciprocated axially in response to operation of the air cylinder 102 in substantially the same way that the slide block 34 of FIGURE 4 is reciprocated by the pressure fluid actuator 43.

The bar 108 has an elongated keyway 112 (FIGURE 12) in its outer surface. The shaft 37A has a threaded opening 113 into which the stop pin 114 is threadedly received so that its inner end 116 is slideably disposed within the keyway 112. The location and sizes of the keyway 112 and stop pin 114 are such that they will precisely control the axial movement of the bar 108.

The outer end of the bar 108 is flattened on opposite sides to provide a tongue 117 which is pivotally connected to the yoke or clevis 33 by means of the pivot pin 118. The yoke 33 is attached to the connecting rod 32 in the same manner as shown in the principal embodiment of FIGURE 4. Accordingly, the crank device 36A serves to vary the stroke of the feed mechanism 24 (FIGURE 3) in response to operation of the solenoid valve 56 and in substantially the same manner that the crank device 36 performs the same function. However, the structure of the crank device 36A (FIGURE 12) is somewhat less complicated than the corresponding structure of the crank device 36 shown in FIGURE 4

which latter structure has been designed for heavy-duty service. It will be apparent that other changes may be made in the specific type of crank device which is utilized to effect the change in the stroke of the feed mechanism.

In the preferred embodiment of the invention, the solenoid valve 56 is operated in response to the actuation of the switches 81 and 82 by movement of the shear and the feed mechanism, respectively. However, it will be recognized that the switches which operate the solenoid valve 56 can be actuated by other moving parts of the press 10 which are coordinated with the movements of the shear and feed mechanism. For example, said switches can be combined with the counter switch 74 and operated by additional cams mounted on the drive shaft 26 (FIGURE 1). The cams could be sequenced so that the solenoid valve 56 would be operated in the same manner as it is by switches 81 and 82.

Thus, although a particular preferred embodiment of the invention has been disclosed herein for illustrative purposes, it will be recognized that variations or modifications of such disclosure, which come within the scope of the appended claims, are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a punch press, the combination comprising:
 - a reciprocal feed mechanism for intermittently advancing a strip of sheet material in predetermined amounts through die means for forming repetitive distortions in said sheet material;
 - means for performing an operation upon said sheet material in response to a selected number of advancements thereof;
 - actuating means connected to the feed mechanism for effecting reciprocating movement thereof, whereby said intermittent advancement is produced;
 - electrically energized control means mechanically connected to said actuating means for effecting a change in the operation thereof, whereby the amount of the movement of said feed mechanism is changed;
 - a source of electrical energy;
 - first switch means connected between said source and said control means, and means for closing and then opening said first switch means in response to the operation of said actuating means, whereby said control means is momentarily connected to said source;
 - second switch means connected in parallel with said first switch means between said source and said control means;
 - means for opening and then closing said second switch means by operation of said feed mechanism, said second switch means being closed before said first switch means opens, whereby said control means effects said change in the operation of said actuating means.
2. In a punch press, the combination comprising:
 - cooperating die means for forming repetitive distortions in a strip of sheet material;
 - feed mechanism for intermittently advancing said strip in predetermined amounts through said die means;
 - first actuating means for performing an operation upon said sheet material in response to a selected number of advancements thereof through said press;
 - second actuating means connected to the feed mechanism for effecting movement thereof;
 - electrically energized control means connected to said second actuating means for effecting a change in the operation thereof, whereby the amount of movement of said feed mechanism is changed;
 - a source of electrical energy;
 - first switch means connected between said source and said control means, and means for closing and then opening said first switch means in response to the operation of the first actuating means, whereby said

control means is momentarily connected to said source;

second switch means connected in parallel with said first switch means between said source and said control means;

means for opening and then closing said second switch means by operation of said feed mechanism, said second switch means being closed before said first switch means opens, whereby said control means effects said change in the operation of said second actuating means for the subsequent advancement of said strip.

3. The structure of claim 2, wherein said first actuating means is a shear;

wherein said second actuating means includes crank means having a crank arm with an adjustable throw, connection of said electrical control means with said source effecting a change in said throw, whereby the advancement of said sheet material is changed.

4. A structure according to claim 2, wherein said second actuating means includes shaft means, first crank means connected between said shaft means and said feed mechanism, a source of mechanical energy and second crank mechanism connected between said source of mechanical energy and said shaft means;

pressure fluid operated means for changing the throw of said second crank means and a source of pressure fluid connected thereto, the flow of pressure fluid from said source to said pressure fluid operated means being controlled by said control means, whereby energization of said control means increases the throw of said second crank means and thereby reduces the movement of said feed mechanism.

5. A structure according to claim 2, wherein said control means includes a solenoid connected in series with said first switch means and with said second switch means, a solenoid relay in parallel with said solenoid, said solenoid relay having self-holding contacts in series with said second switch means, whereby said solenoid is energized after said first switch means is opened and remains energized until said second switch means is opened by the next operation of said feed mechanism; and

including time switch means connected to said source of electrical energy and operated by said second actuating means for effecting the operation of said first actuating means only after a predetermined number of movements of said feed mechanism.

6. In a punch press, the combination comprising:

cooperating die means for forming repetitive distortions in a strip of sheet material;

feed mechanism for intermittently advancing said strip in predetermined amounts through said die means;

shear means for cutting said sheet material following a selected number of advancements thereof through said dies means;

actuating means connected to the feed mechanism for effecting movement thereof, whereby said sheet material is advanced;

electrically energized control means mechanically connected to said actuating means for effecting a change in the operation thereof, whereby the amount of the movement of said feed mechanism is reduced;

a source of electrical energy;

normally open first switch means and means for closing and then opening said first switch means in response to operation of said shear means, whereby said electrical control means is momentarily connected to said source;

normally closed second switch means connected in parallel with said first switch means, means for momentarily opening said second switch means by said feed mechanism before said first switch means is closed and for closing said second switch means before the closed first switch means opens, whereby said electrical control means effects said change in the

operation of said actuating means for an advancement of said strip following an operation of said shear means.

7. In a punch press having a pair of die means relatively movable toward and away from each other for forming a repetitive pattern of openings in a strip of sheet material, having drive means for effecting said movement of said die, and having shear means on said press for severing said strip transversely thereof in response to a predetermined number of advancements thereof, feed mechanism for advancing said sheet material through said die means by intermittent movements of uniform length, comprising:

first actuating means for operating said shear means;

timer means connected to said first actuating means for effecting operation thereof after a predetermined number of advancements of said sheet material by said feed mechanism;

a source of electrical energy;

first crank means connected to said drive means;

second actuating means including second crank means having a changeable throw and being connected between said feed mechanism and said first crank means, pressure fluid operated means for effecting the change of said throw;

a source of pressure fluid;

a solenoid valve for controlling the flow of pressure fluid from said source to said pressure fluid operated means;

first switch means connected between said electrical source and said solenoid valve, said first switch means being momentarily opened and then closed by each operation of said shear means, whereby said solenoid valve is opened and said throw is changed;

second switch means connected in parallel with said first switch means, said second switch means being opened and then closed by each operation of said feed mechanism, said second switch means being closed before said first switch means opens; and

relay means having a pair of self-locking contacts in series between said second switch means and said relay means, said relay means being in series with said first switch means, whereby said solenoid valve is energized through said second switch means after said first switch means opens and said second crank is held in its changed position by said pressure fluid operated means until the second switch means is opened by the next operation of said feed mechanism.

8. In a punch press having a feed mechanism for intermittently advancing a strip of sheet material in predetermined amounts through cooperating die means for forming repetitive distortions in said sheet material and having movable means for performing an operation upon said sheet material in response to a selected number of advancements of said material, the combination comprising:

power-driven means operably connected to said movable means for effecting said operation;

actuating means connected to said feed mechanism for effecting reciprocating movement thereof whereby said intermittent advancement is produced, said actuating means including a pressure fluid operated device for changing the stroke of said feed mechanism;

a source of pressure fluid;

electrically operated valve means for controlling the flow of pressure fluid to said pressure fluid operated device, whereby said stroke is changed;

a source of electrical energy; and

electrical control means connected to said valve means and operably connected to said power-driven means, said control means having first switch means responsive to said movement of said feed mechanism and second switch means responsive to the performance of said operation by said movable means.

9. In a punch press, the combination comprising:

a reciprocable feed mechanism for intermittently advancing sheet material stepwise through the punch press;
 actuating means including a variable throw crank for effecting reciprocation of said feed mechanism; 5
 fluid pressure operated means for varying the throw of said crank;
 valve means for supplying fluid pressure to said fluid pressure operated means;
 counting means responsive to the number of reciprocations of said feed mechanism; and 10
 control means responsive to said counting means and coupled to said valve means for adjusting the throw of said crank after a selected number of reciprocations of said feed mechanism.

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