Dec. 6, 1966 E. F. GREWE 3,289,507

SELF-CORRECTING FEED DEVICE FOR PRE-PRINTED SHEET STOCK

Filed Nov. 20, 1964 2 Sheets-Sheet 1

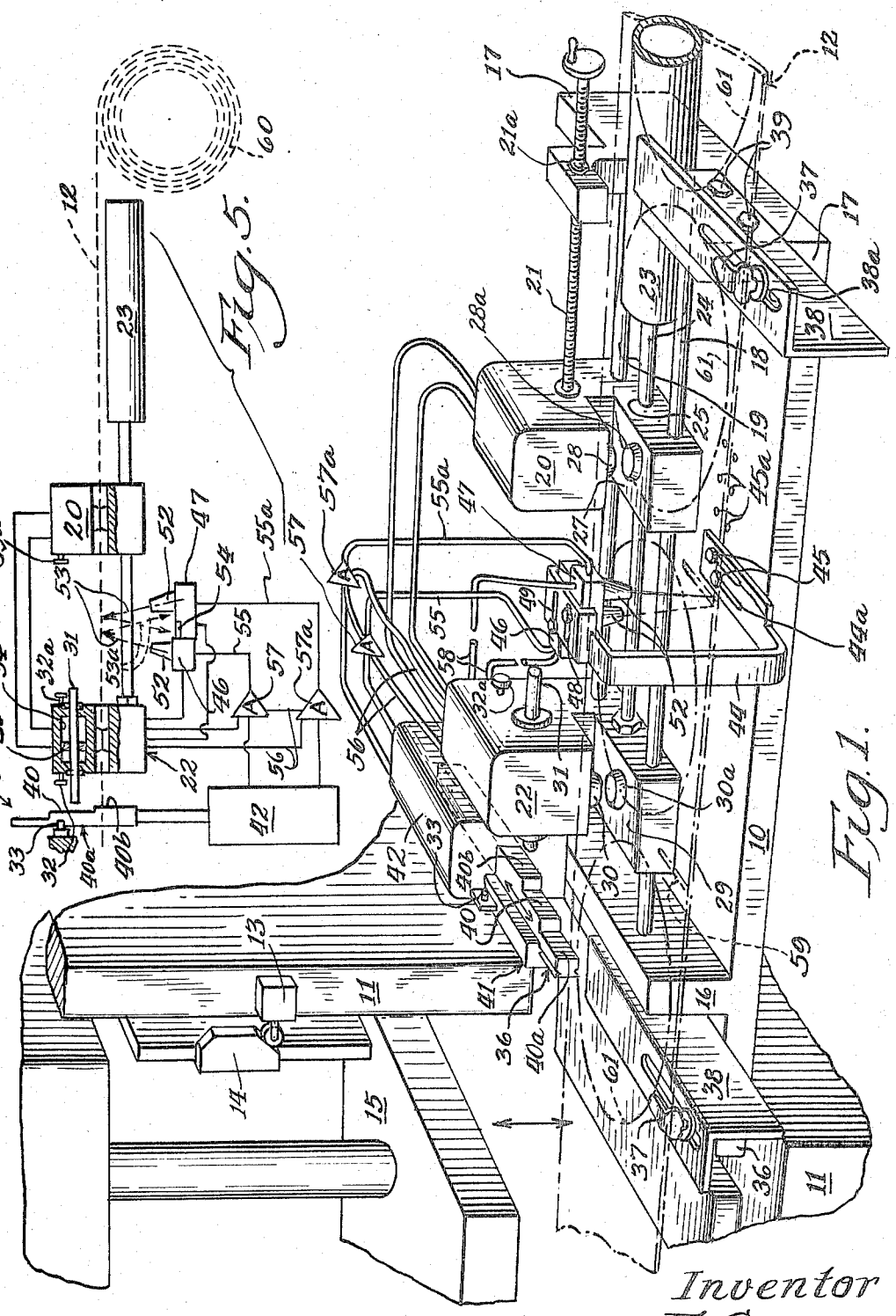


Fig. 1.

Fig. 5.

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Fig. 2.

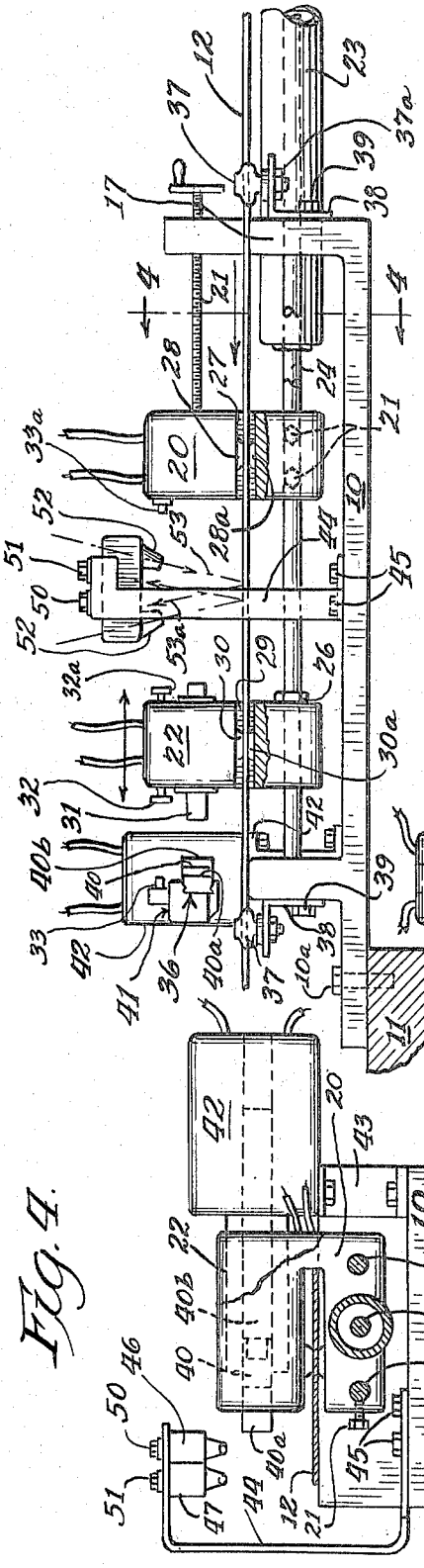


Fig. 3

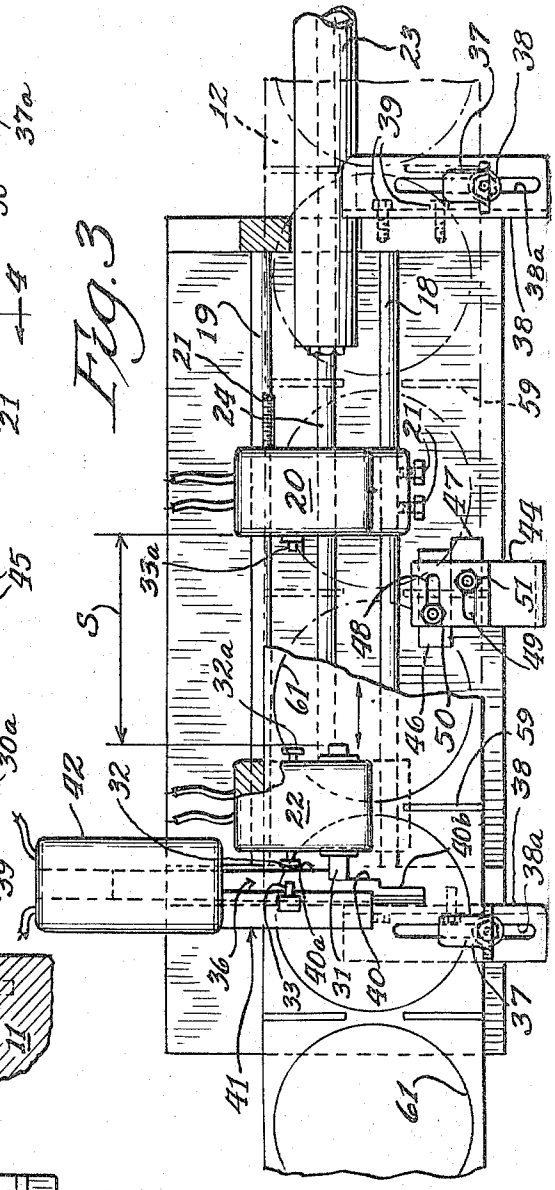


Fig. 4.



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# SELF-CORRECTING FEED DEVICE FOR PRE-PRINTED SHEET STOCK

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6 Claims. (Cl. 83—74)

This invention relates to a device for accurate, continuous feeding of pre-printed sheet material to a punch press or the like, and has particular reference to the combination of a reciprocating hitchfeed type of feeding device and stroke-adjusting means adapted to detect both over- and under-feeding of the sheet and automatically compensate therefor.

Hitchfeed devices are commonly used with machines such as punch presses to feed sheet material such as metal, plastic, cardboard or other material into position to be punched and formed, in the exemplary case herein illustrated, into containers, covers or other articles. When such sheet material is printed, such as with labels, advertising or decorative designs, it is essential, in order that each unit appear uniformly and properly printed, that the feeding equipment be provided to assure accurate register of the sheet with the punch at all times. A circular design for a dish or container, for example, must be precisely centered in successive feeding operations to a punch press so as to avoid design irregularities and distortions in the punched product.

In order to avoid registration error, manufacturers have, in the past, used flat sheets cut in predetermined lengths from coil stock or the like, each being printed with a limited number of blanks. The forward edge of the sheet is then used to establish registry, and each such sheet is started with the printed design in exact register with the punch press. While registration error and/or feed errors are cumulative with each successive punching operation, slight error is not likely to be serious in a short run with such a limited number of pre-printed blanks.

It is preferred to use printed sheet stock in coiled form because of the obvious economy of a continuous press run as compared with press runs that are interrupted at frequent intervals to insert flat sheets. Also, printing is easier and labor costs and "down" time are greatly reduced.

As with sheet stock operations, slight variations between design spacing and feed stroke is cumulative through each successive feed stroke until it may produce serious "out-of-register" problems. In order to minimize such registration error, it was heretofore believed necessary, if the advantage of coil stock were to be gained, to use roll-type feeding devices which are usually quite costly. Thus the economic advantage of coil stock became neutralized. Even then, careful inspection must be maintained to detect registration difficulties as they develop and to adjust the feeding device when necessary.

It is the principal object of my invention to design register detecting and stroke adjusting means adapted to cooperate with hitchfeed devices of a known construction used to supply successive lengths of pre-printed coil stock to punch presses or the like wherein said register detecting and stroke adjusting means automatically detects deviations which tend to develop in the position of blanks being fed to the press, and shortens or lengthens the feed strokes accordingly to maintain accurate register.

It is another object of my invention to provide facilities which may be used with existing hitchfeed devices in a manner to adjust feed strokes automatically when a design on pre-printed sheet material starts to get out of register with the machine to which the material is being fed.



It is a further object of my invention to develop a device of this character which is simple, easily adjustable, and readily adaptable to the commonly used types of machines. These and other objects are accomplished as hereinafter described, reference being made to the accompanying drawings in which:

FIGURE 1 is a perspective view showing a hitchfeed and stroke-adjusting device embodying my invention combined with a punch press with pre-printed sheet material shown in phantom;

FIGURE 2 is a side view, partly in section, showing the device of FIGURE 1;

FIGURE 3 is a top view of said device;

FIGURE 4 is a view on the line 4—4 of FIGURE 2; and

FIGURE 5 is a schematic showing certain features of the operation of the subject invention.

Referring now to the drawings, the base of the self-adjusting sheet material feeding device embodying my invention is identified by the reference numeral **10**. The base **10** is adapted to be mounted on a punch press **11** to which continuous sheet material **12** is to be supplied by the feeding device. The feeder base **10** may be secured to the press **11** by means of bolts **10***a* or other fastening means as shown in FIGURE 2.

The feeding device is actuated by any suitable means. In a preferred embodiment, I use a limit switch **13** mounted on the press **11** in a position to be actuated by a cam plate **14** on the ram or upper die shoe **15** of the punch press **11**.

The base **10** is provided with upstanding lateral walls **16** and **17**, wall **16** being spaced from the end of the base **10** attached to the press **11**, and wall **17** being located at the other end of the base **10**.

Cylindrical rails **18** and **19** are interposed between the walls **16** and **17** secured thereto at their respective ends in parallel, spaced-apart relation as shown in FIGURES 1 and 3.

A stationary gripper **20** is slidably mounted on the rails **18** and **19** in a manner to permit its being positioned on said rails **18** and **19** as required to determine the length of the feed stroke in supplying the pre-printed sheet material **12** to the press **11**. In order to adjust the position of the stationary gripper **20**, it is provided with a threaded rod **21** projecting therefrom through the wall **17** and threadably engaged therewith. At its free end, the rod **21** may, if desired, be provided with a suitable crank or handle as shown. A nut **21***a* on the rod **21** may be tightened against the wall **17** to secure the rod **21** against turning when the stationary gripper **20** is in the exact position desired. It is to be understood that other positioning means may be used, if desired. For example, the stationary gripper **20** may be provided in its base with set screws **21** adapted to bear against the rails **18** and **19**. In my preferred embodiment, however, the threaded rod is used because it permits fine adjustment of the positioning of the stationary gripper **20**.

A reciprocating gripper **22** is slidably mounted on the rails **18** and **19** in the space between the wall **16** and the stationary gripper **20**. The reciprocating gripper **22** is operated by suitable means such as the two-way pneumatic cylinder **23** shown mounted in the wall **17** between the respective rails **18** and **19**. A shaft **24** connected to a piston in the cylinder **23** passes through an aperture **25** in the stationary gripper **20** and is secured to the reciprocating gripper **22**. The gripper-engaging end of the shaft **24** may be threaded for screw engagement in a suitable hole in said reciprocating gripper **22**, and nut **26** engaged on the threaded portion of the shaft may be tightened against the reciprocating gripper **22** to resist rotation of the shaft **24** during operation.

The stationary gripper 20 has a recessed portion 27 adapted to receive the margin of the sheet material 12. A retractable button 28 in the upper part of the stationary gripper 20 over the recessed portion 27 is adapted to be raised and lowered at selected intervals coordinated with the operation of the feeding device and the punch press 1. In its lowered position, the button 28 bears against a corresponding button 28*a* which is mounted on the lower surface of the recessed portion 27 in a manner to engage the sheet material 12 between said buttons 28 and 28*a*. The buttons 28 and 28*a* are preferably made of nylon or other material which will not scratch or otherwise mar the sheet material 12 during engagement therewith.

The reciprocating gripper 22 is similarly provided with a recessed portion 29, a retractable nylon button 30 on the upper portion thereof, and a fixed nylon button 30*a* on the lower surface of the recessed portion 29 to engage the margin of sheet material 12 in the same manner as the buttons 28 and 28*a* of the stationary gripper 20.

In order to minimize impact and smooth out operation, the reciprocating gripper 22 is provided with a suitable retarder device, in the present case taking the form of an air check plunger 31 which is mounted in and projects longitudinally with respect to the movable gripper 22. The plunger is arranged in alignment with and adapted to be actuated by engagement with the stop bar 36 on the one hand, and the stationary gripper 20 on the other, for bringing the movable gripper to a smooth stop.

Additionally, in order to signal the arrival of the gripper at one or the other of its terminal positions, limit switches 33 and 33*a* conveniently disposed on stop bar 36 and the gripper 30, respectively, are placed in the path of appropriate bump screws 32 and 32*a* disposed on either of the movable grippers. The construction of the retarder is familiar, with the plunger 31 passing through an air cylinder 34 within the reciprocating gripper 22 and is provided with a piston 35, as shown in FIGURE 5, which functions in either direction against air trapped in the cylinder 34 to act as a retarder. Thus, when the reciprocating gripper 22 moves through its forward or feed stroke, the plunger 31 would be in the position shown in FIGURE 5 with the bump screw 32*a* disengaged from the limit switch 33. Upon contacting suitable stopping means such as the stop bar 36, the plunger 31 retards the forward movement of the reciprocating gripper 22 due to the compression of air in the cylinder 34 and the slow seepage thereof past the piston 35.

The pneumatic cylinder 23 is placed in reverse operation by lowering of the die 15 so as to actuate the limit switch 13 and the reciprocating gripper 22 is retracted thereby. The said gripper 22 continues to be retracted until the plunger 31 strikes the stationary gripper 20 and the piston moves to its full left position.

In order to maintain proper lateral positioning of sheet material 12 in the recesses 27 and 29 of the stationary and reciprocating grippers 20 and 22, respectively, the walls 16 and 17 are provided with stock guides 37 which are adjustably engaged in slots 38*a* of L-brackets 38 secured to the walls 16 and 17 by means of bolts 39. The guides 37 are held in selected positions in the slots 38*a* of the L-brackets 38 by means of nuts 37*a*.

In accordance with my invention, I use a stroke-limiting stop bar 36 which has a plurality of faces and which is selectively positionable as required by incipient registration error in feeding the pre-printed sheet material 12 to vary the length of the feed stroke as required to compensate for such error. Thus, I provide the stop bar 36 with stepped faces 40, 40*a* and 40*b*. The stop bar 36 is reciprocably mounted is a supporting arm 41 with a suitable grooved track as shown, mounted on a housing 42 which contains means for selectively extending or retracting the stop bar 36 from a neutral position. Commercial units of this type are readily available and the details of construction and operation are therefore well known in the art. The housing 42 is mounted on the wall 16 by means of a suitable bracket 43. The housing 42 is positioned so that when the stop bar 36 is in its neutral position, the face 40 will be located in the path of movement of the plunger 31 so as to be contacted thereby at the end of the forward or feed stroke of the reciprocating gripper 22.

In order to vary the position of the stop bar 36, I employ sensors positioned over the sheet material 12. For this purpose, I provide a bracket 44 mounted on the base 10 in a position between the respective walls 16 and 17 in a manner to provide a support over the margin of the sheet material 12 on the opposite side from the grippers 20 and 22. The bracket 44 is secured to the base 10 by means of bolts 45 which are engaged in any selected pair of tapped holes 45*a* in said base 10. The lower portion of said bracket 44 may be provided with elongated slots 44*a* through which the bolts 45 are engaged, thus permitting lateral adjustment of the bracket 44 with respect to the sheet material 12. Two photoelectric cell or electric eye units 46 and 47 are mounted in slots 48 and 49 in the top of the bracket 44 over the sheet material 12. The slots 48 and 49 are aligned with the direction of movement of the sheet material 12 so as to permit longitudinal adjustment of the electric eye units 46 and 47, with respect to said sheet material 12. The units 46 and 47 are secured in the slots 48 and 49 by means of bolts 50 and 51.

Each of the electric eye units 46 and 47 is provided with a light tube 52 which focuses a beam of light 53 from a source within the unit on a predetermined position on the sheet material 12. The beam of light 53 is angled slightly so that a corresponding beam 53*a* will be reflected back at a complementary angle to a light-sensing cell 54 in said unit 46 or 47, as the case may be. When the spot at which beam of light 53 is not reflective, little or no beam 53a will be reflected back to the light-sensing cell 54. When the sheet material 12 is transparent or translucent, the light-sensing cell 54 may, of course, be located under the sheet material 12.

The respective sensors (electric eye units 46 and 47) are connected by means of wires 55 and 55*a* through suitable amplifier units 57 and 57*a* to the actuator 42. In the present case, the sensors are initally focused on a painted spot having relatively low reflectivity, and in keeping with the invention, respond to changes in reflectivity to adjust the gipper stroke. Specifically, unit 46 is connected to a solenoid in the actuator 42 which, when energized by a signal from the unit, operates to position the stop bar 36 in the path of the movable gripper. The signal is generated when the reflected beam 53 is, in this exemplary case, intensified because it is reflected from the bare sheet rather than from the light absorbing printing. In this case, the stop bar 36 is caused to move outwardly to position the face 40*b* where the plunger 31 will strike said face 40*b* rather than the face 40.

In a like manner, eye unit 47 is connected to another solenoid in the housing 42 which operates to retract the stop bar 36 upon receiving an appropriate signal so that face 40*a* is in a position to be engaged by the plunger 31. It will be appreciated that the sensors are set up to detect a change in reflectivity, and it is not material whether a reduction or intensification is employed to generate the needed signal. The described procedure is exemplary only. The reciprocating gripper 22 is provided with wires 56 to the amplifiers 57 and 57*a* which supply electricity to energize said amplifiers at certain times during the operating cycle of my feed device.

The respective electric eye units 46 and 47 are electrically connected to the limit switches 33 and 33*a* by means of wires 58 in a manner to shunt out the electric eye circuits during the forward stroke of said reciprocating gripper 22. When the forward limit switch 33 is actuated by bump screw 32 as the plunger 31 strikes the stop bar 36, the circuits through wires 58 are restored

so that the light-sensing cells 54 in the electric eye units 46 and 47 will respond to a reflected beam 53*a* from the surface of the sheet material 12. Signals from the electric eye units 46 and 47 resulting from detection by the cells 54 of reflected beams 53*a* are not transmitted to the solenoids in the housing 42 until the amplifiers 57 are energized by full retraction of the reciprocating gripper 22, thus actuating limit switch 33*a* as explained above.

The sheet material 12 to be supplied to the punch press 11 by the feeder device is provided with printed register markings or "eye spots" 59 along the margin of said sheet material 12 which passes under the electric eye units 46 and 47. The eye spots 59 are positioned on centers exactly the same distance apart as the pre-selected stroke length "S" of the reciprocating gripper 22. In the exemplary form shown, the eye spots 59 are transverse printed lines projecting inwardly on said sheet material 12 at right angles to the path of its movement.

In view of the commercial availability of the devices contemplated herein, such as the hitchfeed, the extending and retracting means, and the electric eye units, I have explained only those portions of their construction and operation which are necessary to an understanding of the cooperation therebetween as contemplated in my invention. My invention is not limited to specific forms of such devices but relates generally to any combination of devices adapted to sense suitable register markings, to detect inaccurate positioning of such markings due to over- or under-feeding, and to communicate appropriate signals to a stepped bar, wedge, cam or other means for varying the stroke length of a reciprocating hitchfeed type of device. It is not important whether the operating units are operated mechanically, electrically, hydraulically or pneumatically, or by some combination of such means.

In regard to the stop bar 36, I have shown it as a stepped device with faces 40, 40*a* and 40*b*, but I am aware that other variable stop devices such as a wedge or a cam could be used to provide an adjustable stop for the plunger 31.

Before placing my self-adjusting feeding unit in operation, a coil or roll 60 of pre-printed sheet material 12 is first placed in position as shown in FIGURE 5 to be fed by the hitchfeed to a punch press 11. The stop bar 36 is in neutral position. The stationary gripper 20 is adjusted from the stop bar 36 a distance equal to the spacing of the repetitive pattern or design 61 on the sheet material 12 so that each stroke "S" of the reciprocating gripper 22 will advance the sheet material 12 that exact distance. The leading edge of the sheet material 12 is positioned at the punch in exactly the location where it is to be punched for proper registration of the pattern or design 61 with the die 15. The stock guides 37 are adjusted to hold the sheet material 12 against lateral displacement. The electric eye unit 46 is adjusted so that its light beam 53 is initially forward on the "eye spot" 59 printed on the sheet material 12. The corresponding beam 53 from the electric eye unit 47 is also directed at said sheet material 12 on the "eye spot" 59. The reciprocating gripper 22 and the punch press 11 are then ready for operation.

The operation of the feeding device is started by retraction of the upper die shoe 15 of the punch press 11. As the die shoe 15 is raised, it actuates the limit switch 13, thus causing the following sequential steps to occur:

(a) the button 30 of the reciprocating gripper 22 closes, thus firmly gripping the edge of the sheet material 12.

(b) the button 28 in the stationary gripper opens, thus releasing the margin of the sheet material 12.

(c) the reciprocating gripper 22 is caused to move forward through its feed stroke, thus advancing a predetermined length of sheet material 12 to the punch press 11.

(d) the plunger 31 on the reciprocating gripper 22 strikes the stop bar 36, thus retarding the forward movement of the gripper 22 and bump screw 32 actuates limit switch 33.

(e) the reciprocating gripper 22 stops.

(f) the die shoe 15 is lowered, to perform its punching operation and, during its downward stroke, it actuates limit switch 13.

(g) the button 28 in the stationary gripper 20 closes to hold the sheet material 12. At the same time, the button 30 in the reciprocating gripper 22 raises to release said sheet material 12.

(h) the reciprocating gripper 22 moves through its reverse stroke until its plunger 31 strikes the stationary gripper 20, thus retarding the reverse movement of the gripper 22 and bump screw 32*a* actuates the limit switch 33*a*.

(i) the two electric eye circuits through wires 55 and 55*a* are closed and the amplifiers 57 are energized. The light beam is reflected and its intensity registered on the light-sensing cells. A change, or lack of change of beam intensity results in the generation an an appropriate signal to the actuator 42.

(1) if the light beams are, by virtue of sheet position, focused on the "eye spot," the solenoids in the housing 42 will position the stop bar 36 in the neutral position indicating no change in beam intensity.

(2) if the "eye spot" 59 is too far forward, the electric eye unit 46 will actuate the mechanism in the housing 42 which causes the stop bar 36 to be extended so that the raised face 40*b* will be positioned to slightly reduce the length of the next feed stroke.

(3) if the "eye spot" 59 is short of the position for correct register, the electric eye unit 47 will actuate the solenoid in the housing 42 which will retract the stop bar 36 to position the face 40*a* where the plunger 31 will strike it when the reciprocating gripper 22 makes its next forward stroke.

As the die shoe 15 is raised after the punching operation, it again actuates the limit switch 13 upwardly in a manner to re-cycle the feeding device.

If the feeding device is properly set, several feeding operations should occur before the cumulative error would be sufficient to be detectable by either of the electric eye units 46 or 47. In a preferred form, registration error of .005 inch or more in either direction would be detected. Thus, if the error per stroke were .002 inch, the error would be detected after three strokes. If the error were due to overfeeding, the electric eye unit 46 would detect the error and signal the solenoid in housing 42 to extend the stop bar 33 during one cycle to compensate with a feed stroke of slightly reduced length. Underfeeding would be detected by electric eye unit 47 which would cause retraction of the stop bar 36 during one feed cycle to lengthen that feed stroke by the difference in position between the neutral face 40 of the stop bar 36 and the shallow face 40*a*. In a device set to detect error of .005 inch or more, the faces 40*a* and 40*b* of the stop bar 36 should be approximately .005 lower and higher respectively than the neutral face 40.

In normal operation, it is expected that the cumulative error might be sufficient to activate the compensating means every fifth to tenth cycle or stroke. In this manner, through slight shortening or lengthening of the feed stroke stop bar 36 whenever such compensation is required to maintain accurate registration, the feeding device could supply a full coil of sheet material 12 to the punch press 11 without manual adjustment or attention.

While I have shown and described my invention in a preferred form, I am aware that changes can be made in the specific features and arrangements without departing

from the spirit of my invention, the scope of which is determined by the following claims.

I claim as my invention:

1. In combination, a punch press or the like having a die adapted to form a work piece from a ribbon of sheet stock, said sheet stock being pre-printed with a repetitive design, a reciprocating feed device adapted to move said ribbon of sheet stock into said punch press so that a pre-printed design is in register with said die to permit the forming of said work piece therefrom, said feeder device having a reciprocating gripper device, movable between forward and rear stops, said gripper device adapted to engage said ribbon of sheet stock and move the same an amount equal to the distance between successive designs thereon, one of said stops being automatically adjustable for adjusting the length of the stroke of said gripper, and sensor means connected with said adjustable stop and adapted to detect error in the length of the stroke of said gripper, and automatically adjust said adjustable stop to correct said error.

2. The combination as set forth in claim 1 wherein said sensor means comprises a narrow beam of light reflected from the surface of said sheet stock at a predetermined angle, and a light-sensitive cell disposed in the path of said reflective beam and adapted to respond to changes in the intensity of said reflected beam, and means for communicating and translating changes in intensity into changes in position of said adjustable stop for correcting errors in the stroke of said feeder.

3. In combination, a punch press or the like having a die adapted to form a work piece from a ribbon of sheet stock, said sheet stock being pre-printed with a repetitive design, a reciprocating feed device adapted to move said ribbon of sheet stock into said punch press so that a pre-printed design is in register with said punch press to permit the forming of said work piece therefrom, said feeder device having a reciprocating gripper device, movable between forward and rear stops, said gripper device adapted to engage said ribbon of sheet stock and move the same equal to the distance between successive designs thereon, one of said stops being automatically adjustable and comprising a bar member having a plurality of steps formed thereon, and means for moving said bar member so as to dispose a predetermined step in the path of said movable gripper member thereby adjusting the length of the stroke of the same, and sensor means connected with said adjustable stop and adapted to detect error in the length of the stroke of said gripper, and automatically adjust said adjustable stop to correct said error.

4. The combination as set forth in claim 3 wherein said sensor means comprises a narrow beam of light reflected from the surface of said sheet stock at a predetermined angle, and a light-sensitive cell disposed in the path of said reflective beam and adapted to respond to changes in the intensity of said reflected beam, and means for communicating and translating changes in intensity into changes in position of said adjustable stop for correcting errors in the stroke of said feeder.

5. The combination as set forth in claim 3 wherein said sensor means comprises a narrow beam of light adapted to pass through said sheet stock at a predetermined angle, and a light-sensitive cell disposed in the path of said beam and adapted to respond to changes in the intensity of said beam, and means for communicating and translating changes in such intensity into changes in position of said adjustable stop for correcting errors in the stroke of said feeder.

6. In combination, a punch press or the like having a die adapted to form a work piece from a ribbon of sheet stock, said sheet stock being pre-printed with a repetitive design, and an eye spot between each said design, a reciprocating fed device adapted to move said ribbon of sheet stock into said die so that a pre-printed design is in register with said punch press to permit the forming of said work piece therefrom, said feeder device having a reciprocating gripper member, movable between forward and rear stops, said gripper device adapted to engage said ribbon of sheet stock and move the same an amount equal to the distance between successive designs thereon, one of said stops being automatically adjustable for adjusting the length of the stroke of said gripper, and sensor means including a pair of lights angularly displaced from the printed surface of said stock, and adapted to project a beam of light on an eye spot, said beam being reeficted from said surface, and a pair of light-sensitive cells disposed in the path of said reflected beams, said cells being individually and selectively connected with said adjustable stop at the end of each stroke of said movable gripper, so that changes in the intensity of the reflected beam to one of the cells resulting from the beam incident on said stock being on someplace other than the eye spot are transmitted to said adjustable stop for causing movement thereof to adjust the stroke of said gripper.

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