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Swinehart

[11] **3,881,606**

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[54] **SLIDING NEST FEEDING APPARATUS**

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[73] Assignee: **Wisco Industries, Inc.**, Oregon, Wis.

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[51] **Int. Cl.**..... **B26d 7/06**; B65g 47/76; B21d 43/20

[58] **Field of Search** ..... 214/1 BB; 408/4, 69, 70, 408/710; 83/417, 435.1, 437, 426; 72/419, 420, 424, 428

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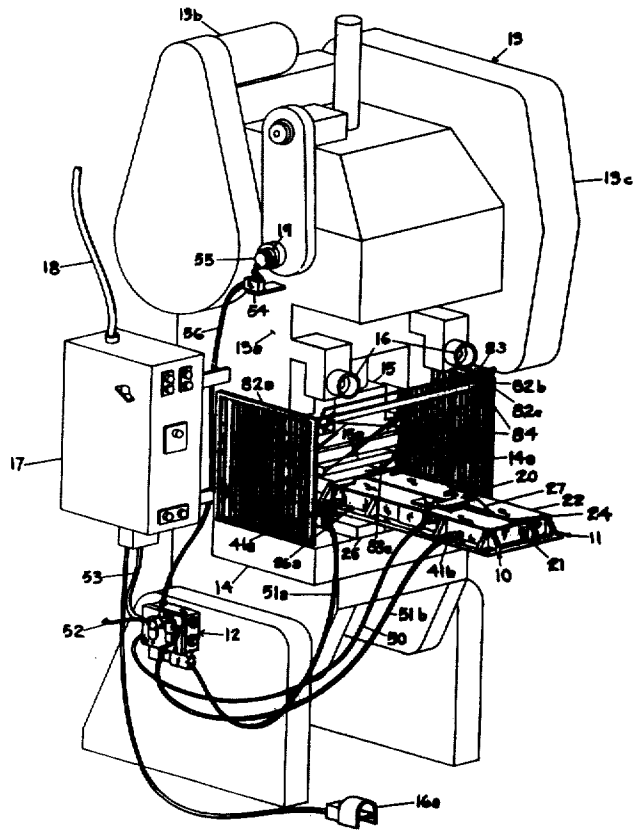
[57] **ABSTRACT**

A feeding apparatus for a punch press or other similar machine, which utilizes a movable nest to convey a workpiece into the working area of the machine. Vertical support for the workpiece is provided by slide plates which extend from a loading position to the working area. The nest is supported and moved by a carriage and drive system located beneath the slide plates, and which attaches to the nest through a narrow slot in the plates. The movement of the nest and the actuation of the punch press are controlled automatically by a control unit, so that the machine operator need only load the nest in its loading position and depress the run switch of the punch press. A fully automatic mode is also provided. Barriers may be provided between the loading position and the working area through which the locating nest and workpiece are permitted to pass, but which will prevent the insertion of the operator's hand into the working area of the machine.

7 Claims, 7 Drawing Figures



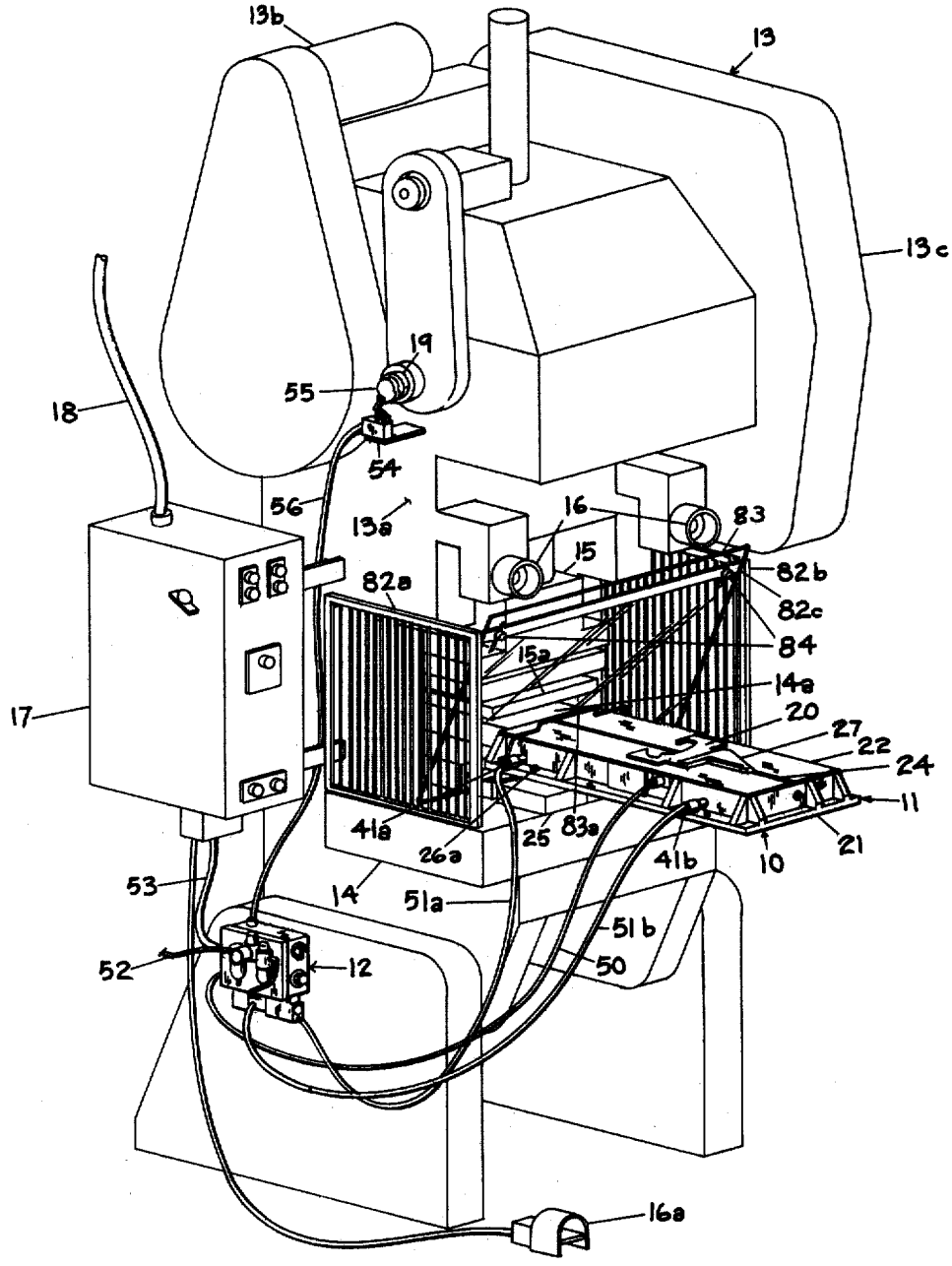

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Fig. 1

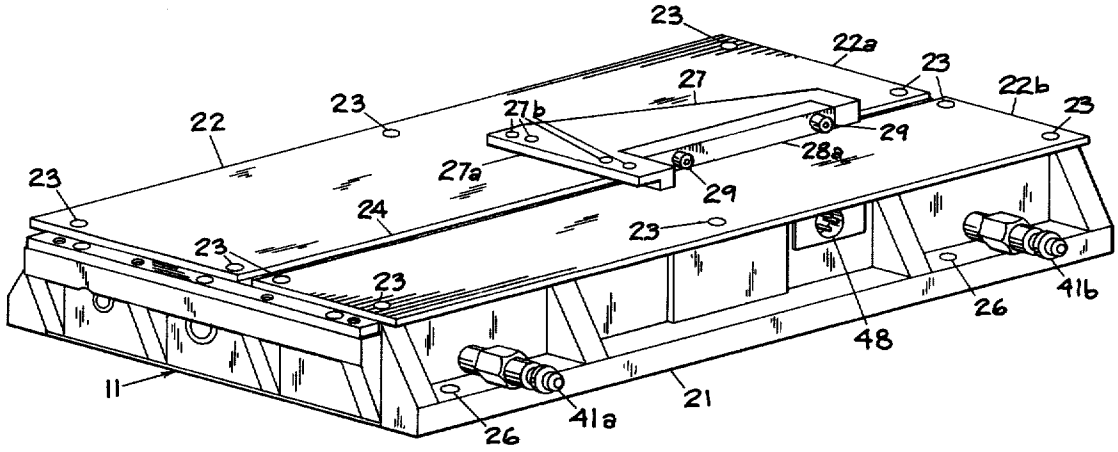
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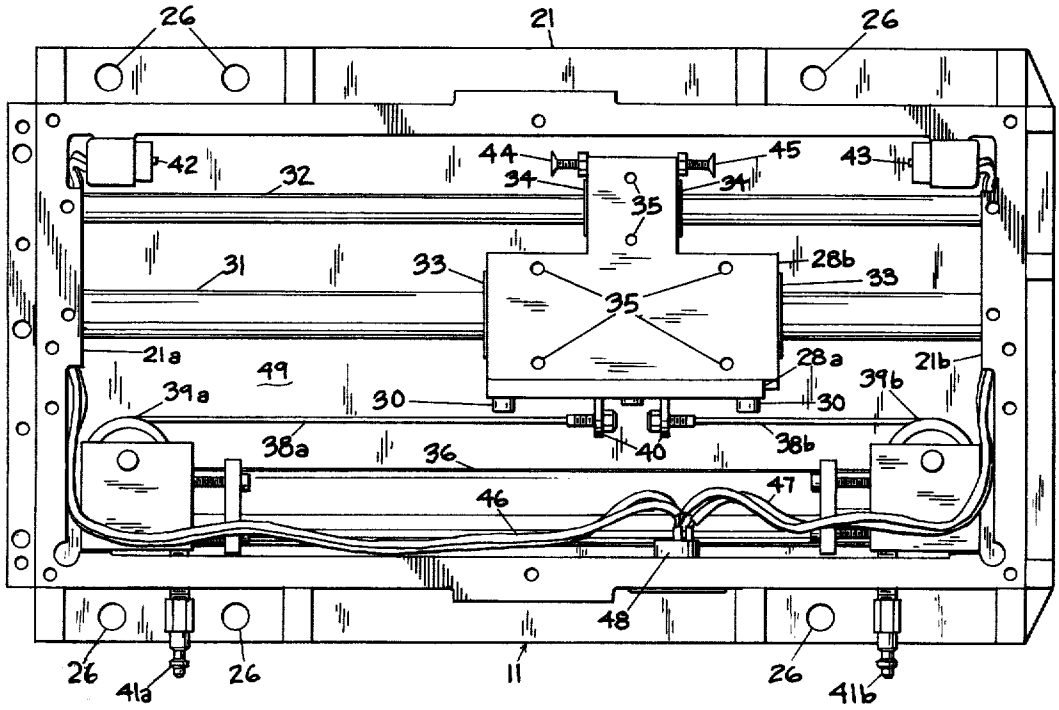
Fig. 2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41a
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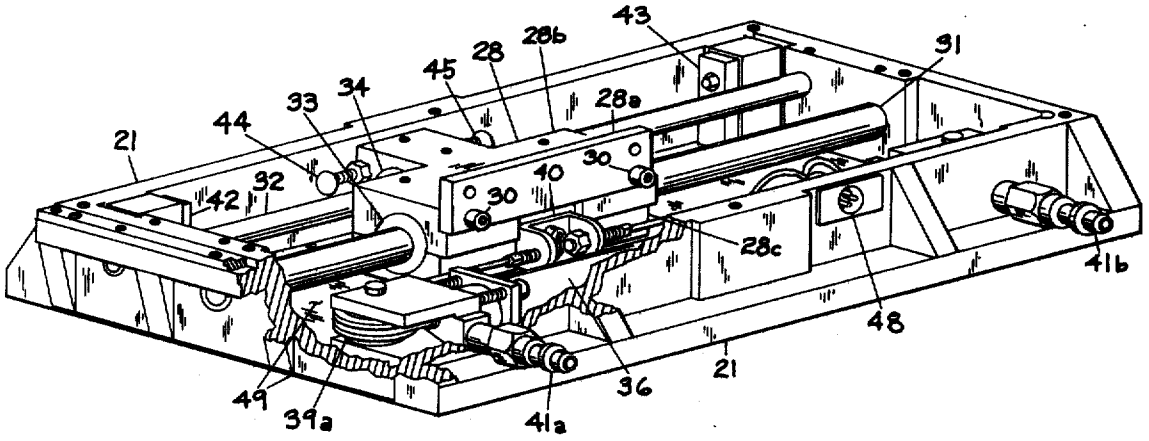
Fig. 3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39a
41a

Fig. 4

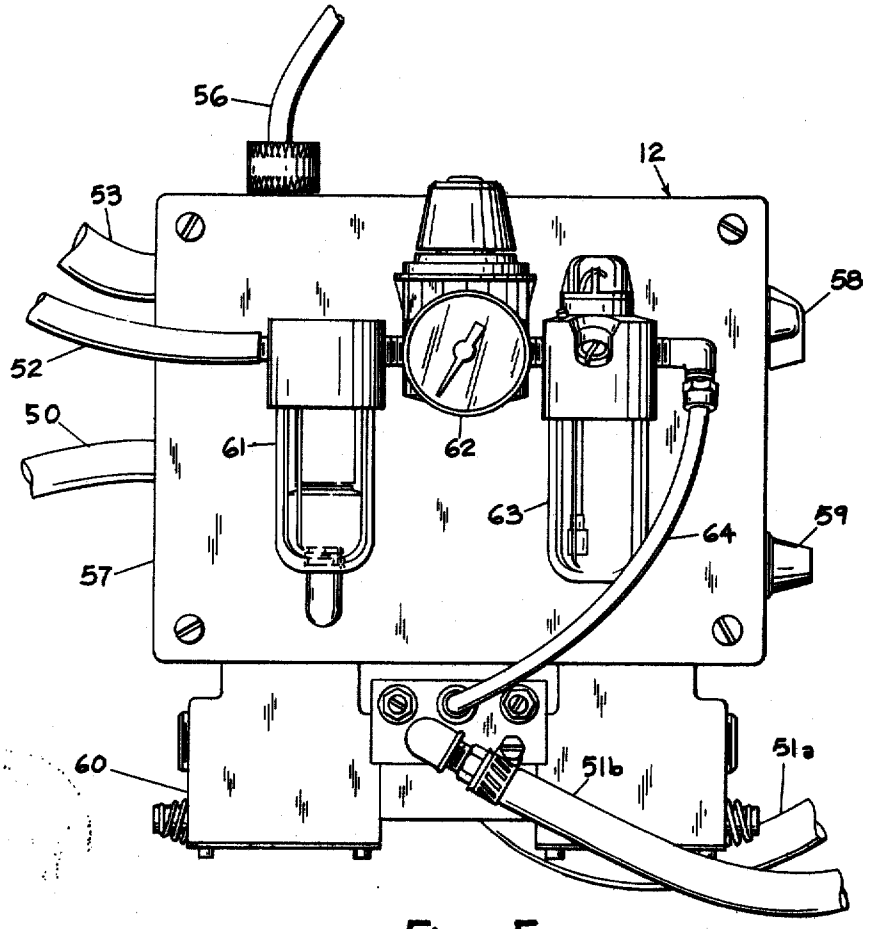
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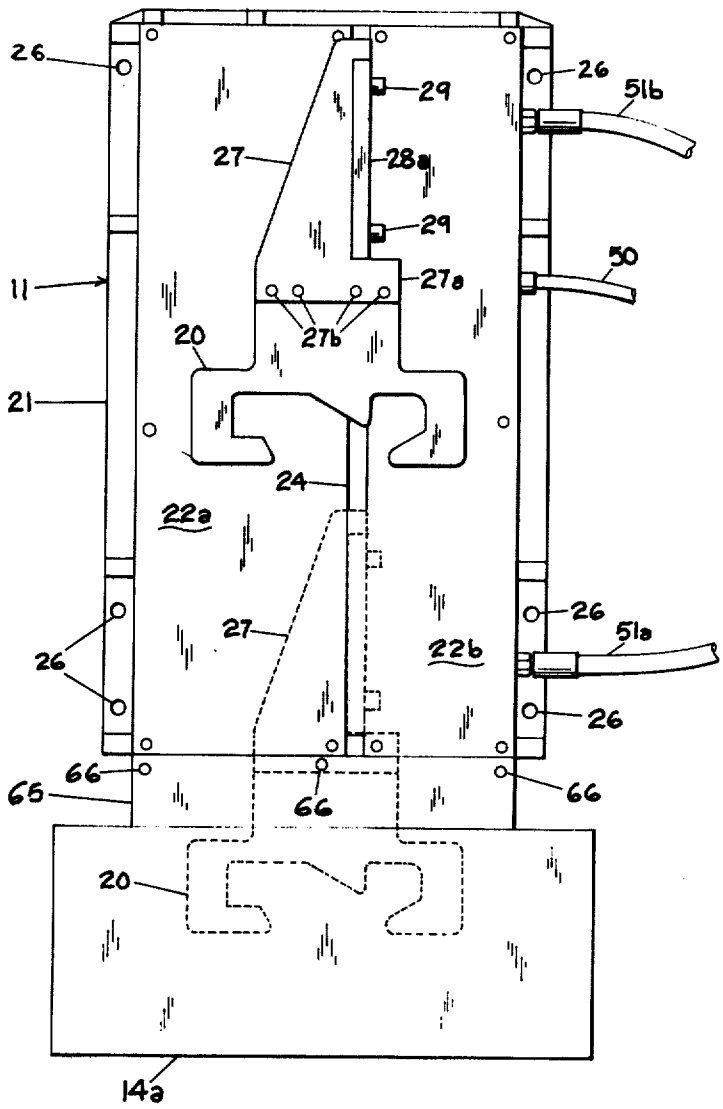
Fig. 5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65
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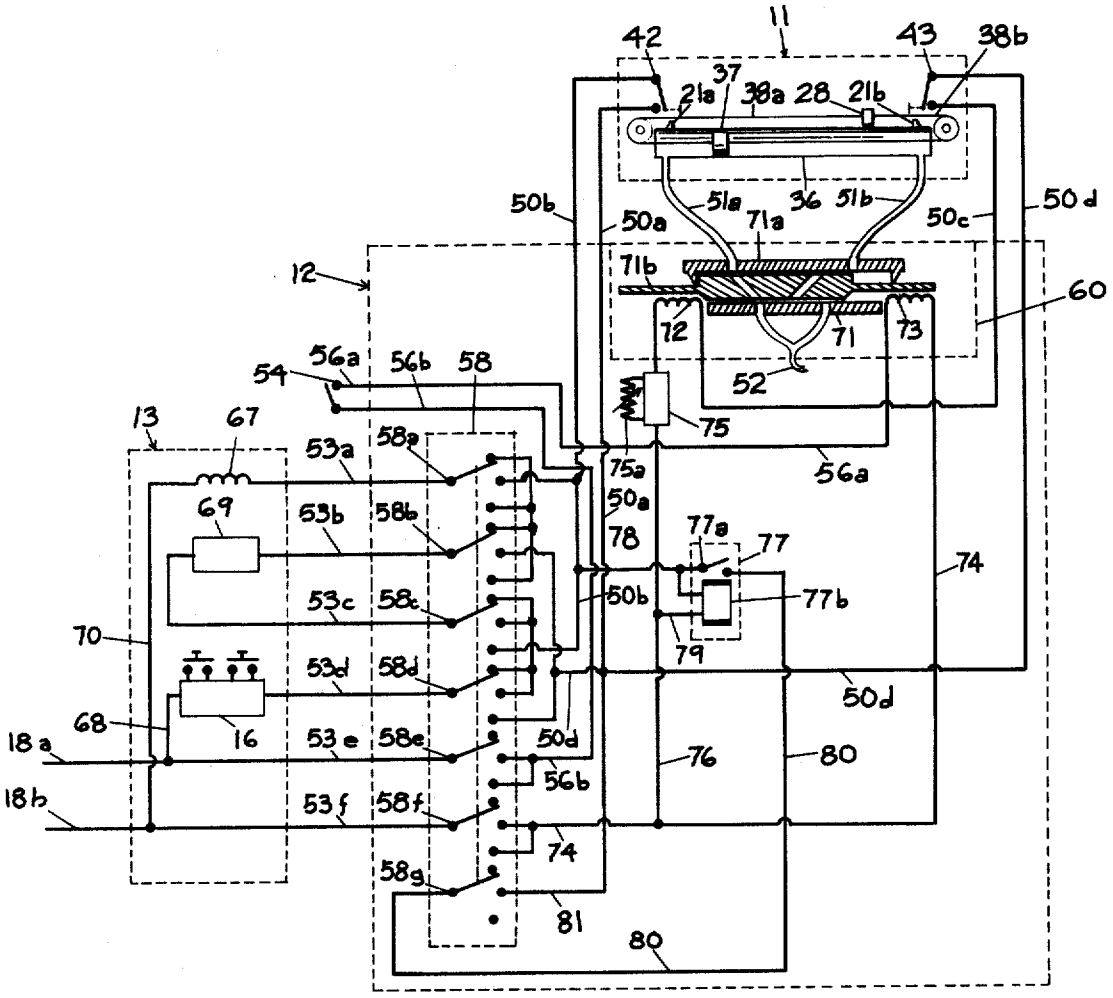
14a

Fig. 6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51b
50c
50d
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71b
60
72
71
73
52
54
56a
56b
58
75
13
67
53a
58a
75a
56a
69
53b
58b
50a
78
77a
77
74
53c
58c
50b
77b
70
79
53d
58d
50d
68
16
53e
58e
76
80
18a
56b
18b
53f
58f
74
58g
81
80

Fig. 7

SLIDING NEST FEEDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to a device for feeding workpieces to the work area of a punch press or similar machine.

2. Description of the Prior Art

Despite the obvious dangers inherent in the manual feeding of punch presses and similar machines, manual feeding has been the general practice. Automated feeding devices have been developed for situations where operations are being performed on large production quantities of workpieces suitable for mechanical feeding. Such automated feeding devices have tended to be ill-adapted or prohibitively expensive for short production runs or for handling workpieces with shapes which are not readily susceptible to mechanical feeding. Thus, manual feeding of punch presses and other similar machines has persisted because of its economy and adaptability.

When a punch press is to be manually fed it is common practice to affix a locating nest to the upper surface of the lower die. The locating nest generally comprises a flat piece of metal with a portion cut out to fit the outline of the particular workpiece being worked on. The machine operator places the workpiece by hand in the cut out portion of the nest, which is adapted to locate and restrain horizontal movement of the workpiece during the pressing operation. Usually the workpiece must be supported from below by the lower die so that the workpiece will be properly shaped when it is pressed between the upper and lower dies.

Experience has shown that any feeding system which requires or permits the operator to place one or both of his hands in the point of operation of a press, which has been defined as the area of the press where material is actually positioned and work is being performed (hereinafter sometimes referred to as the "work area"), is inherently dangerous and represents a substantial safety hazard. Recent federal safety regulations promulgated under the Occupational Safety and Health Act of 1970 (OSHA) greatly restrict hand feeding of presses, unless the point of operation opening is one-fourth inch or less.

A guard or stationary barrier which physically prevents entry of the hands between the dies is the most positive protection for the operator, but in the past, use of such guards has usually been impossible or impractical unless the workpieces have been readily susceptible to mechanical feeding. Accordingly, two common safety devices have been utilized which, though not preventing entry of the operator's hands into the press work area, do attempt to insure that the operator's hands will be removed from the work area before operation of ram or the slide of the press. One such device comprises dual hand controls which must both be pressed by the operator substantially simultaneously to cause the press to cycle. The other device includes cables physically attached to the operator's hands or arms which will pull the operator's hands out of the work area during initial movement of the press slide. Frequently a combination of both such devices will be employed. Nevertheless, operators have displayed great ingenuity in circumventing the protective operation of such devices. In addition, such devices can substantially reduce the production speed of a hand fed press.

Various devices have also been designed to feed the workpiece into the work area from a remote area. This eliminates the need for the operator to place his hands in the die area, and barriers may be placed around the die area to positively prevent his doing so. The operation of these feeding devices generally involves mechanical grasping of the workpiece and placement in the locating nest in the die area, in an operation analogous to manual feeding. These devices are often bulky and unsuited to small presses. Such devices also may not meet OSHA regulations when an operator is utilized to place workpieces in the feeding device, since the moving parts of the feeding device may themselves present a hazard to the operator.

SUMMARY OF THE INVENTION

I have invented a compact sliding nest feeding apparatus adapted to be used with existing presses and dies. My sliding nest feeding apparatus eliminates the need for an operator to place his hands in the work area as well as presenting no hazard to the operator from its own moving parts. My invention also increases the productivity of a human operator over conventional manual feeding.

My sliding nest feeding apparatus utilizes a movable locating nest, rather than a nest affixed to the lower die of a punch press or similar machine as is conventional. The nest is mounted for movement between a loading position outside the work area of a machine and a working position within the work area. The nest restrains horizontal motion of the workpiece contained therein, while vertical support is provided to the workpiece by slide plates which extend from the loading position to the work area (eg. the lower die), and on which the workpiece is slidably supported. The nest is moved by a carriage which rides beneath the slide plates and extends up through a narrow slot in the plates to attach to the nest. The slot, which runs longitudinally toward the working position of the machine, is one-fourth inch or less in width to prevent an adult human finger from being inserted therein, and thus meets OSHA safety standards.

The carriage is mounted by precision bearings riding on a pair of longitudinally extending bars, and is moved by a pneumatic drive system. The pneumatic drive system is operated by a control unit which is interconnected with the controls of the press or other machine with which the sliding nest feed is being used. On command from the machine, by depressing the punch press "Run" buttons, the control unit of the sliding nest feeding apparatus causes the nest to move from its remote loading position to a working position within the work area of the machine, actuates the machine when the nest is precisely located in its working position, and causes the nest to move back to its loading position when the machine has completed its operations on the workpiece contained within the nest. The sliding nest feeding apparatus also operates in a continuous mode wherein the nest continuously cycles between the working and loading positions, and dwells for a selected period of time in the loading position to permit the operator to hand load a workpiece into the nest.

Barriers, or guards, may be employed to enhance the safety of my sliding nest feeding apparatus by enclosing the work area of the punch press. Because of the low profile of the nest which moves into the work area, the opening in the barrier through which the nest and

workpiece passes need only be as high as the workpiece. The restricted opening in the barrier and the distance between the barrier and the work area of the press prevent the operator from inserting his hand into the work area.

Further objects, features and advantages of my invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings showing a preferred embodiment of a sliding nest feeding apparatus exemplifying the principles of my invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of my sliding nest feeding apparatus shown in combination with a punch press.

FIG. 2 is a perspective view of the nest feed unit of my sliding nest feeding apparatus.

FIG. 3 is a top plan view of the nest feed unit with the upper slide plates removed to expose the internal parts of the unit.

FIG. 4 is a perspective view of the nest feed unit, with the upper slide plates removed and a portion of the frame broken away to expose the internal parts of the unit.

FIG. 5 is a front elevation view of the control unit portion of my sliding nest feeding apparatus.

FIG. 6 is a top plan view of the nest feed unit shown mounted adjacent to a schematically illustrated punch press lower die.

FIG. 7 is a schematic view of the electrical and pneumatic systems of my sliding nest feeding apparatus shown as inter-connected with the electrical system of a conventional punch press.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings wherein like numerals refer to like parts throughout the several views, a preferred embodiment of my sliding nest feeding apparatus is shown generally at **10** in FIG. **1**. The feeding apparatus **10** is composed of two basic units, a nest feed unit **11** and a control unit **12**. The nest feed unit **11** and the control unit **12** are both attached to a punch press shown generally at **13** in FIG. **1**. While the operation of my sliding nest feeding apparatus will be described in connection with a punch press of the type shown, the feeding apparatus is adaptable for use with any similar machine requiring precise positioning of a workpiece in a work area.

The punch press **13** is of conventional design, having a stationary bed **14** with a lower die **14a** mounted on it, and a slide **15** with an upper die **15a** mounted on the bottom of the slide in opposing relation to the lower die. The slide **15** is capable of reciprocating motion toward and away from the bed **14**, and the slide is guided in a definite path by the frame **13***a* of the press **13**. The area above the upper surface of the lower die **14***a* generally comprises the work area of the punch press, which is the area that must be avoided by the operator during operation of the press **13**.

Normal operation of the press commences with placement of a workpiece in the proper working position on the lower die **14***a*. The upper die **15***a* and the slide **15** descend from their upper position to their lower position to press the workpiece between the upper and lower dies, and then ascend back to their upper position to await the loading of another workpiece. The press may automatically eject the finished workpiece, or the workpiece may be removed manually, as desired. The press work cycle described above is initiated by depressing a pair of push buttons **16** which are the Run switches of the press. For safety reasons, the internal circuitry of the press requires that the two push buttons **16** be depressed at approximately the same time in order to initiate the press cycle. This safety feature is well known in the art, and is incorporated in many punch presses in an attempt to ensure that the machine operator has his hands out of the die area when the press cycle is initiated. My sliding nest feeding apparatus, however, permits control of the press by any other appropriate type of activating means, such as a foot switch **16***a*, since the safety of the operator does not depend on his use of both hands to activate the press. The push buttons **16** and auxiliary foot switch **16***a* comprise switch means which are electrically connected to a control box **17** containing most of the electrical controls for the press. For ease of description, the operation of the press will hereafter be described with reference to the push buttons **16**, but it is understood that the foot switch **16***a* is interchangeable therewith. A primary power line **18** provides a source of electrical power to the control box **17**, and it is preferable for the proper operation of my sliding nest feeding apparatus **10** that standard 120 volt r.m.s. A.C. power be provided.

The means by which mechanical power is supplied by the press **13** to reciprocate the slide **15** is typical of mechanical presses, although my sliding nest feeding apparatus can be employed with presses having other means for supplying mechanical power. The mechanical power means of the press **13** has a crankshaft **19**, the end of which extends from the press body as shown in FIG. **1**, and which makes one complete revolution each time the press goes through a work cycle. The crankshaft **19** is engaged with the slide **15** of the press **13** in such a manner that revolution of the crankshaft causes reciprocation of the upper die **15***a*. A solenoid operated clutch (not shown) is activated by the push buttons **16** to engage the crankshaft **19** with a mechanical power unit of any suitable and appropriate type. The power unit employed in the embodiment shown in FIG. **1** consists of an electric motor **13***b* driving a flywheel (not shown) within housing **13***c*.

My feeding apparatus employs a locating nest **20** in which the workpiece is placed by the operator, but the nest **20** is attached to the nest feed unit **11**, rather than to the lower die **14***a* as is done in conventional manual feeding. The nest **20** is similar in construction to the nests used in manual feeding, and as shown for illustrative purposes in FIGS. **1** and **6**, the nest **20** is made of a flat piece of metal with a cut out portion therein generally conforming to the outline of the workpiece. Other nest configurations may be appropriately employed, and examples of these alternative configurations will be subsequently described.

Referring to FIG. **2**, the nest feed unit **11** has a frame **21** which has mounted on the upper side thereof two flat metal slide support plates **22***a* and **22***b* which together form a planar upper support surface **22** to provide upper support plate means for slidably supporting a workpiece placed on the nest feed unit. The slide plates **22***a* and **22***b* are fixedly attached to the frame **21** by screws **23** and are spaced a short distance apart to

define a longitudinal slot **24**. The slot **24** is preferably no greater than one-fourth inch in width to conform to OSHA safety regulations and general safety considerations. The frame **21**, which is preferably made of a strong, lightweight magnesium-aluminum alloy, rests on a spacer shim block **25** which is placed between the frame **21** and the stationary bed **14** of the press **13**, the frame being firmly attached to the bed **14** by bolts **26***a* which pass through appropriate holes **26** in the frame and threadingly attach to the bed. The purpose of the shim block **25** is to position the support surface **22** in substantially the same plane as the upper surface of the lower die **14***a*; thus the dimensions of the shim block **25** will be determined as necessary to achieve the proper spacing.

As shown in FIG. **2**, a nest carrier plate **27** is attached above the support surface **22** to a carrier bar **28***a* by bolts **29**. The carrier bar **28***a* extends up through the slot **24** and is attached below the support surface **22** to a carriage upper body **28***b* by bolts **30**, as shown in FIG. **4**. The carrier plate **27** is adapted to mount the particular nest configuration being used, and as illustratively shown in the drawings, the carrier plate **27** has a broadened front portion **27***a* which extends transverse to the slot **24** and has a number of holes **27***b* therein. The front portion **27***a* is preferably spaced a sufficient distance above the support surface **22** to allow the nest **20** to be attached to the underside of the carrier plate front portion **27***a* by screws passing through the holes **27***b*.

As best shown in FIGS. **3** and **4**, a main support bar **31** and a parallel side support bar **32** extend longitudinally parallel to and below the support surface **22** and are fixedly attached to the frame **24**. The bars **31** and **32** are preferably round and of uniform cross sectional diameter throughout their lengths. A precision main support bearing **33** is mounted on the main support bar **31** and a precision side support bearing **34** is mounted on the side support bar **32**. The bearings **33** and **34** are selected to ride on the bars **31** and **32** with little friction and with very low tolerances. The carriage upper body **28***b* fits over the bearings **33** and **34** and a carriage lower body **28***c* is fitted on the bearings from beneath and firmly attached to the carriage upper body **28***b* by screws **35**. The carriage lower body **28***c*, the carriage upper body **28***b*, the carrier bar **28***a* and the bearings **33** and **34** form a carriage **28** which is free to move in a longitudinal direction on the bars **31** and **32** between the front end **21***a* and the back end **21***b* of the frame **21**. The lateral spacing of the bars **31** and **32** and the low tolerances of the bearings **33** and **34** prevents any rotational or other non-longitudinal motion of the carriage **28** on the support bars **31** and **32**. The carriage **28** and the carrier plate **27** thus provide a means for supporting and carrying the locating nest **20** for precise longitudinal motion above and parallel to the support surface **22**.

As best seen in FIG. **3**, a pneumatic cylinder **36** is longitudinally attached to the frame **21** below the support surface **22**, and a piston **37** (not shown in FIG. **3**) is movably contained within the cylinder **36** to divide the cylinder into two substantially airtight compartments. Flexible cables **38***a* and **38***b* are respectively attached to the opposite sides of the piston **37** and extend out of the cylinder **36** through air tight seals, around pulleys **39***a* and **39***b* respectively which are mounted to the frame **21** at opposite ends of the cylinder and proximate to the frame, and are attached to the opposed sides of a bracket **40** which is mounted on the carriage **28**. Air or other suitable gas may be selectively supplied under pressure to pneumatic couplers **41***a* and **41***b* which communicate with the interior of the cylinder **36** at the respective ends thereof. Air or other gas introduced under pressure to one of the couplers with the other coupler at atmospheric pressure produces a differential pressure on the piston **37** which tends to move the piston away from the source of air pressure, and because the carriage **28** is connected to the piston through the cables **38***a* and **38***b*, the carriage also tends to move, but in a direction opposite to the direction of motion of the piston. The arrangement of the pneumatic cylinder **36**, piston **37** and cables **38***a* and **38***b* allows the carriage **28** to move over its full longitudinal travel between a first position wherein the carriage is abutting the back end **21***b* of the frame **21**, and a second position wherein the carriage is abutting the front end **21***a* of the frame. The cylinder and the pulleys **39***a* and **39***b* require no more longitudinal space than that required to accommodate the carriage **28** between the extremes of its travel.

A normally open front limit switch **42** and a normally open back limit switch **43** are attached to the frame **21** near the front end **21***a* and the back end **21***b* respectively, as shown in FIG. **3**. A front limit switch trip **44** and a back limit switch trip **45** are adjustably attached to the carriage **28** in position to trip respectively the switch **42** or the switch **43** when the carriage is at the extremes of its travel. Conducting wires **46** electrically connect the limit switch **42** to a socket **48**, and similar conducting wires **47** connect the limit switch **43** to the socket **48** which extends through the frame **21** and allows electrical connections to be made to the limit switches **42** and **43** from outside the nest feed unit **11**.

A metal base plate **49** is attached to the bottom of the frame **21** to prevent the intrusion of any foreign object into the interior of the nest feed unit **11** from below, and to protect the operator from the internal moving parts of the nest feed unit.

As shown in FIG. **1**, an electrical control line **50** connects the control unit **12** to the socket **48** on the nest feed unit **11**. Pneumatic lines **51***a* and **51***b* run from the control unit **12** to the couplers **41***a* and **41***b*, respectively, on the nest feed unit. A pneumatic supply line **52** supplies air under pressure from a shop compressor or other standard source of air pressure to the control unit **12**. The press control box **17** is connected to the control unit **12** by an electrical control line **53**.

In addition to the basic nest feed unit **11** and the control unit **12**, my sliding nest feeding apparatus has a normally open limit switch **54** mounted on the press **13** near the end of the press crankshaft **19** that extends from the press body. A cam **55** is mounted on the end of the crankshaft **19**, and is positioned to contact and close the limit switch **54** as the slide **15** and upper die **15***a* are ascending toward their upper position and the work cycle of the press **13** is being completed. A connecting line **56** electrically connects the limit switch **54** to the control unit **12**. The limit switch **54** is preferably closed before the slide **15** reaches its upper position to insure that the slide will not be stopped before the limit switch is closed.

As shown in FIG. **5** the control unit **12** has a housing **57** which surrounds and protects the controls contained therein. A three-position selector switch assem-

bly **58** is mounted on one side of the housing **57** and is used to select the mode in which the sliding nest feed will be operating. The three modes selectable by the switch assembly **58** are the single cycle mode, the continuous mode, and the off mode wherein the sliding nest feed is disengaged. The operation of the sliding nest feeding apparatus in these three modes will be subsequently discussed. A selector dial **59** is mounted on the same side of the housing **57** as the selector switch assembly **58,** and is used to set the length of time that the nest **20** will dwell in the loading position as will be subsequently explained. An electrically actuated pneumatic control valve **60** distributes air under pressure, supplied by the air supply line **52,** to the pneumatic lines **51***a* or **51***b* as determined by the control unit **12.** Air coming into the control unit **12** under pressure from line **52** is preferably passed through an air filter **61,** an air pressure regulator **62,** and a mist oiler **63,** before passing through a line **64** to the pneumatic valve **60.** The mist oiler **63** introduces a fine oil mist into the compressed air which helps to lubricate the moving parts of the pneumatic valve **60** and the cylinder **36** and piston **37** in the nest feed unit **11.** The pneumatic control valve **60,** air filter **61,** air pressure regulator **62,** mist oiler **63,** cylinder **36** and piston **37,** and associated cables **38,** pulleys **39** and air lines **51** are all of known, conventional construction, and together provide a means for driving the carriage **28** over its longitudinal travel in response to an electrical signal.

Referring to FIG. **6,** the nest feed unit **11** is shown mounted next to the schematically illustrated lower die **14***a* of the press in horizontally spaced relation. The nest feed unit must usually be spaced horizontally from the lower die because of the shape of the die **14***a*, and to allow proper placement of the nest **20** over the working position of the die. To provide vertical support for the workpiece between the nest feed unit **11** and the lower die **14***a*, an extension slide support plate **65** is attached to the frame **21** by screws **66** and extends from the support surface **22** to the die **14***a*. The upper surface of the extension plate **65** is in the same plane as the upper surface of the lower die **14***a* and the support surface **22.**

The locating nest **20** is illustrated in FIG. **6** at the two extremes of its travel; the position of the nest **20** shown in solid lines is the fully retracted loading position of the nest above the support surface **22** wherein the carriage **28** supporting the nest is in its first position abutting the back end **21***b*, while the position of the nest shown in dashed lines is the working position of the nest above the lower die **14***a* wherein the carriage is in its second position abutting the front end **21***a*. The machine operator places the workpiece in the nest **20** at its loading position. Upon actuation of the sliding nest feeding apparatus **10** the nest pushes the workpiece inwardly toward the working position above the die **14***a*. The nest **20** prevents horizontal motion of the workpiece in a direction transverse to the longitudinal motion of the nest, and prevents any horizontal motion of the workpiece once the workpiece is in the working position. The precision construction of my invention has, in a commercial embodiment, allowed placement of the workpiece to within 2 mils (2/1000 inch) of its desired working position. Vertical support is provided to the workpiece over its travel from the loading position to the working position consecutively by the support surface **22,** the extension plate **65,** and the surface of the lower die **14***a*.

The means for controlling the operation of the press **13,** the feeding apparatus **10** and the functional interconnections between the press **13,** the control unit **12,** and the nest feed unit **11,** are illustrated by FIG. **7,** which is a simplified schematic view of the electrical and pneumatic portions of the sliding nest feeding apparatus and the press. The nest feed unit is shown generally at **11** within the broken line, the control unit is shown generally at **12** within the broken line, and the press is shown generally at **13** within the broken line.

When the selector switch assembly **58** is in its first position or off mode, as shown in FIG. **7,** the feeding apparatus **10** is completely disengaged electrically from the press **13** since a direct connection is made between the conductors **53***a* and **53***b*, and between the conductors **53***c* and **53***d*. This allows the press **13** to operate as it originally did before addition of the feeding apparatus **10.** The press circuitry shown at **13** within the broken line is for illustrative purposes only, and the basic functional units of the press circuitry are shown in block form, and are representative of the circuitry used in presses, which is well known in the art. However, my sliding nest feeding apparatus **10** is designed to function, with minor modifications if necessary, with any press which is activated by electrical circuitry, and it is understood that my invention does not depend on the particular circuitry utilized by the press.

The clutch of the press **13** is operated magnetically by a slide actuator solenoid **67** which forms a part of the mechanical power means of the press **13.** As long as electrical power is supplied to the solenoid **67** the clutch will be engaged and the slide **15** and the upper die **15***a* will reciprocate. Removal of electrical power from the solenoid **67** allows the clutch to automatically disengage and the upper die to cease its motion. Electrical power is supplied to the press **13** by a.c. power lines **18***a* and **18***b* where, for descriptive purposes, the conductor **18***a* will be considered the high or incoming line and the conductor **18***b* the ground or return line. The conductor **18***a* is connected by a conductor **68** to the push button switches **16** (or alternatively to foot switch **16***a* as shown in FIG. **1**) wherein circuitry internal to the push button switches requires that the two push buttons be depressed at approximately the same time in order to allow a completed circuit through the switches **16.** Current flowing through the closed push button switches **16** is passed to the anti-repeat circuitry **69,** shown generally as a block in FIG. **7,** by the conductors **53***d* and **53***c*, and thence to the clutch solenoid **67** by the conductors **53***b* and **53***a*, and back to the return line **18***b* by a conductor **70.** The anti-repeat circuitry **69** is well known and is required by OSHA regulations to be included in the slide actuator circuitry in all two-hand control presses wherein the slide is intended to make a single stroke upon actuation of the press. The anti-repeat circuitry **69** allows current to flow from the push buttons **16** to the clutch solenoid **67** only long enough for a single stroke of the slide **15** to be completed. Thereafter the anti-repeat circuitry **69** will not allow current to flow to the solenoid **67** until the push buttons **16** are released and again depressed. Thus when the push buttons **16** are closed, the slide **15** will make one stroke and return to its upper position to allow reloading of a workpiece on the lower die **14***a*.

The nest feed unit is shown schematically at **11** within the broken line in FIG. **7**. Motion of the piston **37** within the cylinder **36** results in motion of the carriage **28** because of the cables **38***a* and **38***b* connecting the piston and carriage. When the carriage **28** is at the extremes of its travel it depresses and closes either limit switch **42** or limit switch **43**, depending on whether the carriage is stopped at its second position at the front end **21***a*, or at its first position at the back end **21***b* of the frame, respectively. The switch **42** and the switch **43** are electrically connected to the control unit by the conductors **50***a* and **50***b* and the conductors **50***c* and **50***d*, respectively.

Referring to FIG. **7**, the commercially available pneumatic valve within the control unit **12** is shown schematically at **60** within the broken line for illustrative purposes. The pneumatic control valve **60** has an air valve assembly **71** which is composed of a valve body **71***a* and a center spool **71**b which rides within the valve body. The spool **71***b* will be stable in one of two positions: either supplying air under pressure to pneumatic line **51***a*, or to pneumatic line **51***b*, with the other line being open to atmospheric pressure. A forward travel actuator solenoid **72**, when activated, attracts the spool **71***b* to the illustrated position where air under pressure from supply line **52** is being directed to the pneumatic line **51***a*. A return travel actuator solenoid **73**, when activated, will attract the spool **71***b* to the alternate position where air under pressure from the supply line **52** is being directed to the pneumatic line **51***b*. A conductor **74** electrically connects one side of the solenoid **73** to the switch **58***f* of the selector switch assembly **58**, while the other side of the solenoid **73** is connected to the conductor **56***a* which comes from the limit switch **54**. A time delay circuit **75** is electrically connected to one side of the solenoid **72** while the other side of the solenoid is connected to the conductor **50***c* coming from the limit switch **43**. The commercially available time delay circuit **75** acts essentially as an open switch for a period of time after voltage is impressed across it and then becomes a closed switch for as long as current continues to be supplied to it. A variable resistor **75***a* within the circuit **75** allows the period of time that the time delay circuit **75** is non-conducting to be varied. The resistance of the resistor **75***a* is adjusted by use of the selector dial **59** shown in FIG. **5** mounted on the exterior of the control unit housing **57**. The time delay circuit **75** is connected by the conductor **76** to the conductor **74**.

The control unit **12** also contains a relay **77** which consists of a normally open switch **77***a* and an electromagnet **77***b* which closes the switch **77***a* when activated. A conductor **78** connects one side of the switch **77***a* and the electromagnet **77***b* to the conductor **50***b*. The other side of the electromagnet is connected by a conductor **79** to the conductor **76**. A conductor **80** connects the other side of the switch **77***a* to the switch **58***g* of the selector switch assembly **58**. The switch **58***g* is connected by a conductor **81** to the conductor **50**d.

The switch assembly **58** is a seven pole ganged switch having three positions corresponding to the three modes of the sliding nest feed. With the selector switch assembly **58** in the off mode, position one, the conductor **53***b* is connected to the conductor **53***a* through the switches **58***a* and **58***b*; and the conductor **53***d* is connected to the conductor **53***c* through the switches **58***d* and **58***c*. The other switches are open. With the selector switch assembly **58** in the single cycle mode, position two, the conductor **53***a* is connected through the switch **58***a* to the conductor **50***b*; the conductor **53***b* is connected through the switch **58***b* to the conductor **50***d*; the conductor **53***c* is connected through the switch **58***c* and the switch **58***d* to the conductor **53***d*; the conductor **53***e* is connected through the switch **58***e* to the conductor **56***b*; the conductor **53***f* is connected through the switch **58***f* to the conductor **74**; and the conductor **80** is connected through the switch **58***g* to the conductor **81**. With the selector switch assembly **58** in the continuous mode, position three, the conductor **53***a* is connected through the switch **58***a* and the switch **58***b* to the conductor **53***b*; the conductor **53***c* is connected through the switch **58***c* to the conductor **50***b*; the conductor **53***d* is connected through the switch **58***d* to the conductor **50***d*; the conductor **53***e* is connected through the switch **58***e* to the conductor **56***b*, the conductor **53***f* is connected through the switch **58***f* to the conductor **74**; and the switch **58***c* is an open circuit so no connection is made between the conductors **80** and **81**.

As previously described, the operation of the press **13** is not affected by the presence of my sliding nest feeding apparatus **10** when the selector switch assembly **58** is in the off position, or off mode. The operation of the feeding apparatus when in the single cycle and continuous modes will now be described with reference to FIGS. **6** and **7**.

With the sliding nest feeding apparatus **10** in the single cycle mode, the machine operator manually places a workpiece in the locating nest **20** when the nest is in the fully retracted loading position illustrated by solid lines in FIG. **6**. The operator then depresses and closes the push button switches **16** (or the foot switch **16***a*). This completes a first circuit from the power line **18***a* to the limit switch **43** which is closed by the carriage **28** when the nest **20** is in the loading position and from the limit switch **43** to the return power line **18***b* through the air valve solenoid **72** and the time delay circuit **75**. The time delay circuit **75** is set to conduct after a short period of time, which then allows the control signal current to pass through the forward travel actuator solenoid **72** and thereby causes the valve **71** to direct air under pressure to the line **51***a*. Since the line **51***b* is open to the atmosphere, this causes a differential pressure to exist across the piston **37**. The piston **37** is thereby forced toward the other end of the cylinder **36**, and the carriage **28** correspondingly moves the attached nest **20** toward its working position illustrated by broken lines in FIG. **6**. The movement of the carriage is stopped by the frame front end **21***a*, and at that point the limit switch **42** is closed by the carriage. This completes a second circuit from the power line **18***a* through the push button switches **16**, the anti-repeat circuitry **69**, the switch **42**, the solenoid **67** and back to the return line **18***b*. The slide actuator clutch solenoid **67** is thereby activated by the control signal current and the slide **15** and upper die **15***a* begin their previously described reciprocation cycle. The relay electromagnet **77***b* is also activated and the switch **77***a* is closed. This condition of the relay **77** remains in effect as long as the push button switches **16** remain closed, and insures that electrical power will be provided through the switch **77***a* to the solenoid **67** even if the switch **42** is opened before the work cycle is completed.

After the die 15*a* has engaged and withdrawn from the workpiece and the ascending slide 15 nears its uppermost position, the limit switch 54 is closed by the cam 55 and a third circuit is completed from the power line 18*a* through the switch 54 to the return travel actuator solenoid 73 and back to the return line 18*b*. Activation of the solenoid 73 by the control signal current causes the valve 71 to direct air under pressure to the line 51*b* to move the carriage 28 rearwardly. The carriage 28 eventually stops against the frame back end 21*b* with the nest 20 in its loading position, and the switch 43 is again closed. However, the air valve solenoid 72 is not activated because the anti-repeat circuitry has become an open circuit and remains open until the push button switches 16 are opened. When the slide 15 reaches a point proximate to its upper position the anti-repeat circuitry 69 becomes an open circuit which deactivates the clutch solenoid 67 to thereby disengage the clutch and stop the motion of the slide. Opening of the push button switches 16 causes the anti-repeat circuitry to close and thus enable the press 13 and the sliding nest feeding apparatus 10 to begin a new cycle when the push button switches are again closed.

With the sliding nest feeding apparatus 10 in the continuous mode, the nest 20 is repeatedly moved between the loading position and the working position as long as the Run switch means are depressed by the machine operator. In this mode, a single push button or a foot switch 16*a* would be employed to activate the press and feeding apparatus. The nest 20 is set to dwell for a desired period of time in the loading position to allow the operator or an automatic loading device to load a workpiece in the nest.

In the continuous mode, power is continuously supplied to the conductors 50*d* and 56*b*. When the nest 20 reaches its loading position the switch 43 is closed by the carriage 28. This activates the forward travel actuator solenoid 72 after a dwell period determined by the time delay circuit 75 to initiate movement of the nest 20 toward its working position. When the nest 20 reaches the working position the switch 42 is closed by the carriage 28 to activate the clutch solenoid 67 and cause the press slide 15 and upper die 15*a* to reciprocate. As the slide 15 and upper die 15 return to their upper position the limit switch 54 is closed by the cam 55 to activate the return travel actuator solenoid 73 and thus cause the nest 20 to move back to its loading position. Current to the anti-repeat circuitry 69 is cut off as soon as the switch 42 is opened by the rearward movement of the carriage 28, since in the continuous mode the connection between the conductors 80 and 81 is broken by the switch 58*g* and there is no bypass circuit through the relay switch 77*a* around the switch 42 to supply the anti-repeat circuit. The anti-repeat circuit 69 is thus ready to conduct current to the solenoid 67 as soon as current is supplied to it. The cycle repeats when the nest reaches the loading position and the switch 43 is again closed by carriage 28.

Ejection of the finished workpiece from the nest 20 may be performed automatically by means associated with the punch press, or manually by the operator in both the single stroke or continuous modes. If the machine ejects automatically, the workpiece is ejected from the die area and the operator simply inserts another workpiece into the nest 20 on the next cycle. Otherwise the finished workpiece returns to the loading position with the nest 20, where the operator must remove it before inserting another workpiece into the nest.

To provide the maximum safety for the operator of the press 13, the entire work area of the press may be blocked off to the operator by guard barriers which meet OSHA safety standards. Such guards are shown in FIG. 1 attached to the press, and include a left side barrier 82*a* and a right side barrier 82b. A barrier 83 is placed between the loading position of the nest and the work area of the press 13 and is attached by bolts 84 to a bar 82*c* connecting the left and right side barriers 82*a* and 82*b*. The barrier 83, which is preferably made of transparent plexiglass to allow an unobstructed view of the work area, has a cut-out portion 83*a* which is shaped to allow the nest 20 with a workpiece therein to pass through, but is not large enough to allow the operator to place his hands in the work area between the upper and lower dies.

It is apparent that my sliding nest feed may be used with various nest configurations other than that shown in the drawings and described herein for illustrative purposes. For example, the nest could be composed of a stationary portion affixed to the lower die 14*a*, and a movable portion attached to the carriage 28 which pushes the workpiece from the loading position to the working position where the workpiece would be precisely located between the stationary and movable nest portions. The nest could also consist of stationary rails leading to the working position and a nest portion attached to the carriage 28 which pushes the workpiece between the rails to a stop mounted on the lower die 14*a*. Any nest configuration which transfers a workpiece from a loading position, and precisely locates the workpiece in a working position can be used with my invention.

It is understood that my invention is not confined to the particular construction and arrangement of parts herein illustrated and described, but embraces all such modified forms thereof as come within the scope of the following claims.

I claim:

1. Feeding appartus for engaging a locating nest which horizontally locates a workpiece in a working position within the work area of a press, and for transferring the locating nest between the working position and a loading position remote from said work area, said feeding apparatus comprising:

a. a frame attachable to said press;

b. support plate means attached to the upper side of said frame for slidably supporting a workpiece within said locating nest between said loading position and said work area, said support plate means having a longitudinal slot therein;

c. at least one longitudinally extending support member mounted to said frame beneath said support plate means;

d. a carriage having a lower portion located beneath said support plate means and slidably attached to said support member for longitudinal motion of said carriage, and having an upper portion extending through said slot and above said support plate means to engage and support said locating nest above said support plate means; and

e. drive means for driving said carriage between a first position wherein said locating nest is in said loading position, and a second position wherein said locating nest is in said working position.

2. The feeding apparatus specified in claim 1 wherein the width of said slot is no greater than one-fourth of an inch.

3. The feeding apparatus specified in claim 1 wherein a pair of longitudinally extending parallel bars are mounted to said frame beneath said support plate means, and wherein said carriage includes bearings slidably mounted on said parallel bars to permit longitudinal movement of said carriage and to substantially prevent non-longitudinal movement of said carriage.

4. The feeding apparatus specified in claim 1 wherein said drive means includes:

a. a pneumatic cylinder attached to said frame;

b. a piston movable within said cylinder;

c. means for connecting said piston to said carriage whereby movement of said piston will cause movement of said carriage; and

d. control valve means for supplying air under pressure to said cylinder, including forward travel actuator means for causing said control valve means to direct air under pressure to one end of said cylinder to cause said piston to drive said carriage from said first position to said second position when said forward travel actuator means is supplied with electrical power, said control valve means also including return travel actuator means for causing said control valve means to direct air under pressure to the other end of said cylinder to cause said piston to drive said carriage from said second position to said first position when electrical power is supplied to said return travel actuator means.

5. The feeding apparatus specified in claim 4 including electrical control means for directing electrical power to said forward travel actuator means to thereby move said locating nest from said loading position to said working position, for directing electrical power to said machine to initiate the work cycle of said machine when said locating nest is in said working position, and for directing electrical power to said return travel actuator means after said machine has performed its work on said workpiece to thereby move said locating nest back to said loading position.

6. The feeding apparatus specified in claim 1 wherein said drive means comprises:

a. a pneumatic cylinder;

b. a piston movable longitudinally within said cylinder;

c. means for connecting said piston to said carriage whereby movement of said piston will cause corresponding movement of said carriage; and

d. means for selectively adjusting the differential pressure across said piston to produce motion of said carrier means between said first position and said second position.

7. The feeding apparatus specified in claim 1 including means for controlling said drive means to cause movement of said carriage from said first position to said second position, and movement of said carriage back to said first position after work has been performed when said carriage is in said second position.

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