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[54] **MATERIAL MISFEED DETECTOR FOR POWER PRESS**

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[51] **Int. Cl.** **B26d 7/24,** B65h 25/08, B65h 25/32

[58] **Field of Search** 83/63, 61; 408/7, 408/12; 192/128; 340/259

[56] **References Cited**

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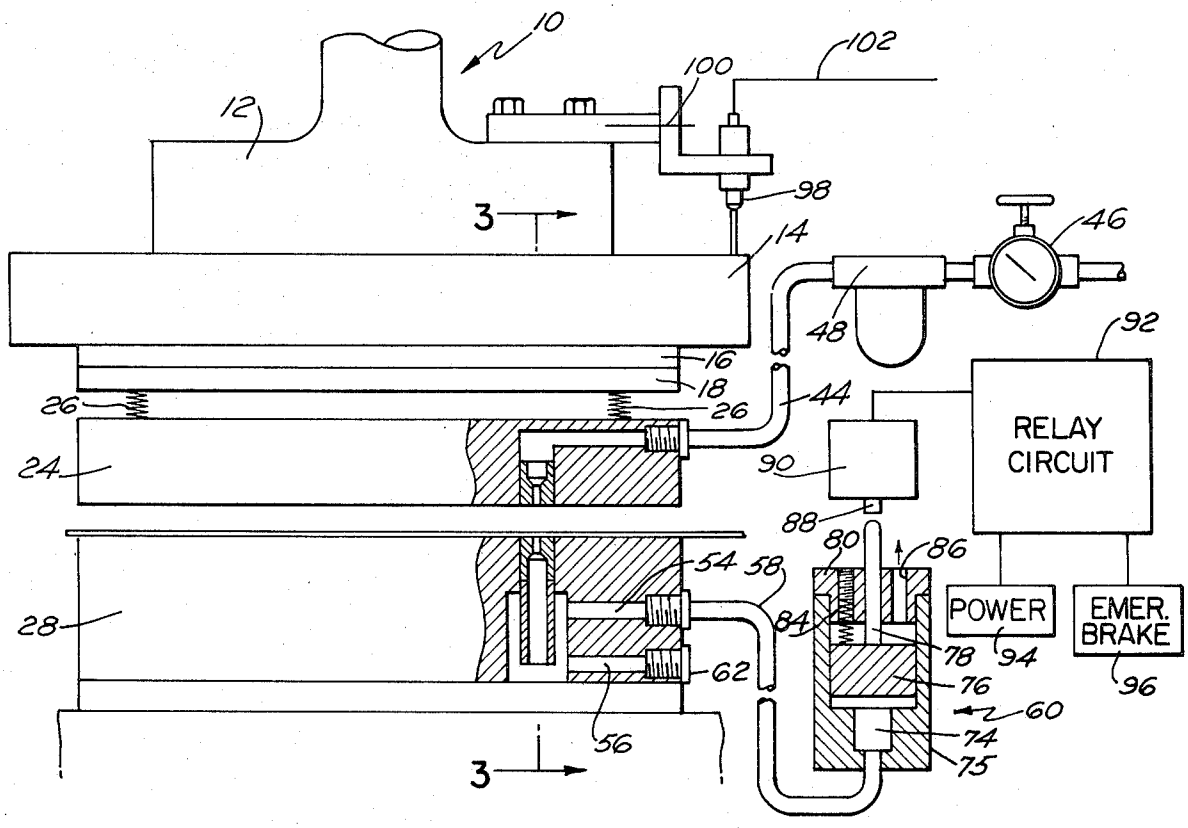
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Attorney—Elliot A. Salter et al.

[57] **ABSTRACT**

A material misfeed detector for a power press for discontinuing the operation of the power press on the upstroke thereof when a misfeed of the material is detected, the detecting device including a nozzle for directing a jet of air to a preformed opening formed in the material and a receiver located on the other side of the material in alignment with the nozzle and receiving the air therein, wherein the receiver directs the air to a pressure switch that is responsive to a predetermined pressure thereon to continue the operation of the power press.

9 Claims, 4 Drawing Figures



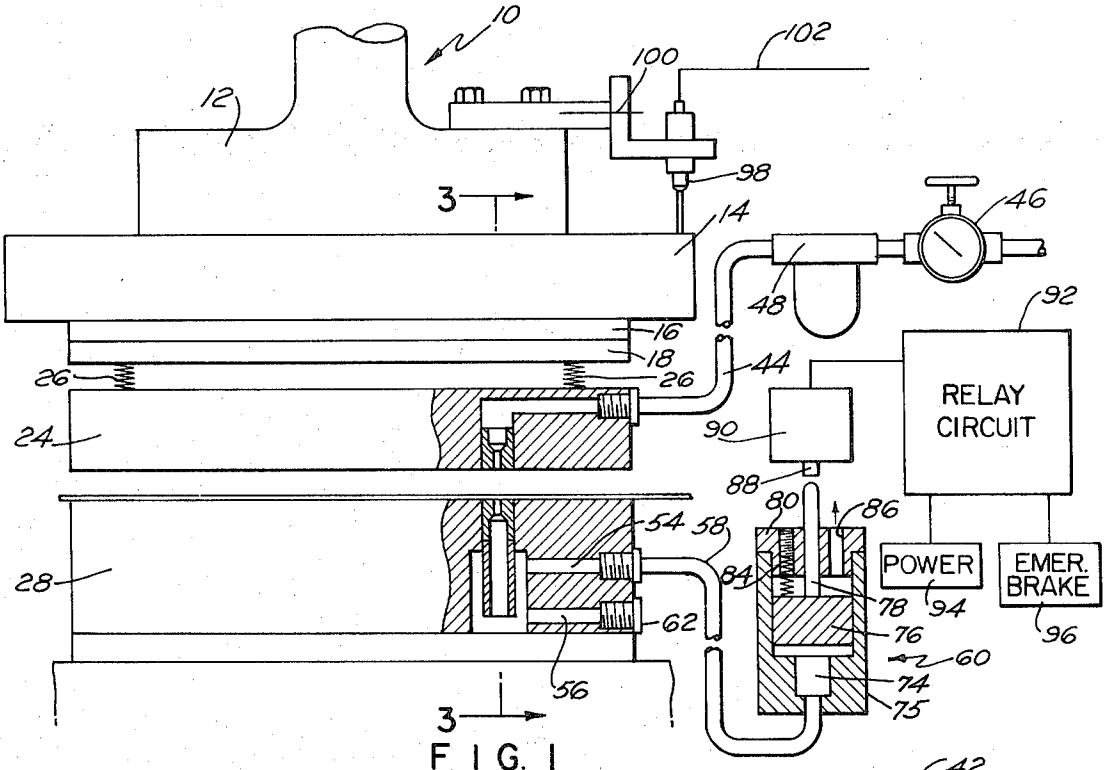


FIG. 1

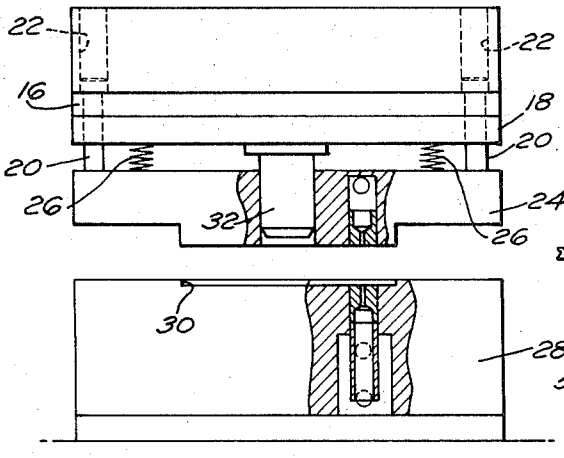


FIG. 2

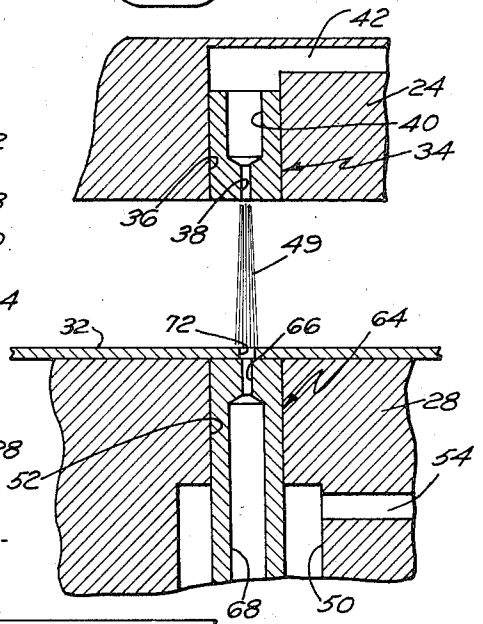


FIG. 3

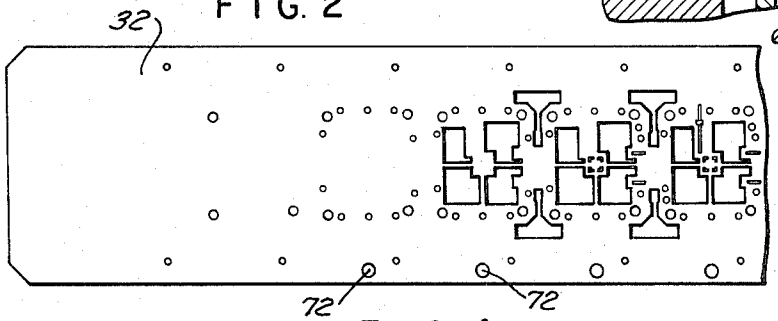


FIG. 4

MATERIAL MISFEED DETECTOR FOR POWER PRESS

BACKGROUND OF THE INVENTION

The apparatus as embodied herein is for use in a power press automatically auomatically performs a series of work operations on a work material such as strip stock that is progressively transferred through a work station in the apparatus, a work stool such as a punch being vertically movable relative to the work material to perform the series of preselected work operations thereon.

In operation of automatic punch presses the strip stock is progressively transferred to the work station and is progressively punched to produce a work piece of preselected design. Oftentimes the material will misfeed and unless the operator has noticed the misfeed, damage to the press tool can occur.

Prior to the instant invention, various kinds of safety devices have been proposed for detecting the improper feeding or misfeed of a work material to the work station of a punch press or the like. Generally, these prior known safety devices have included a mechanical detecting or sensing means such as a finger or the like which was supposed to sense the misalignment of the work material and actuate an appropriate device for discontinuing operation of the machine. Other devices for detecting misfeeding in punch presses have also been proposed and have incorporated fluid systems that included sensors for detecting changes in pressure thereto upon misfeed of a work material to the press work station; and although these devices in theory were operable to detect misfeeding, the fluid systems incorporated therein did not function in a practical sense to immediately detect misfeeding, and further such systems incorporated relatively complicated mechanical parts and electrical circuitry that prohibitively increased the cost of the device.

SUMMARY OF THE INVENTION

The present invention relates to a safety device for use in a punch press in which a series of preselected work operations are performed on a work material that is transferred through a work station in the punch press. The safety device is designed to detect a misfeed of the work material to the work station of the punch press, and thereafter is operable to discontinue the operation of the punch press ram so as to prevent damage to the work tool thereof in striking the misfed work material. The safety device includes a nozzle that is located on one side of the work material at the work station and that discharges a jet of compressed air toward a receiver that is located on the other side of the work piece at the work station. The receiver is vertically aligned with the nozzle and normally communicates directly with the nozzle through a preformed opening in the work material to receive a jet of air after feed of the work material to the work station of the punch press. A pressure responsive device communicates with the receiver and is operable in response to a predetermined pressure exerted thereon by the compressed air directed thereto from the receiver to close a switch that is located in circuit with the operating means for the punch press. Should a misfeed of the work material occur, the preformed opening in the work material becomes misaligned with the nozzle and receiver and the jet of compressed air from the nozzle is deflected in its path through the opening in the work material to the receiver, wherein the pressure to the pressure responsive device is decreased. Thereafter, the switch opens to interrupt the operation of the operating means of the punch press. It is significant that the operation of the operating means is interrupted on the upstroke of the punch press ram and the ram is thus prevented from returning on its downstroke, whereby the tool in the punch press is prevented from striking the misfed work material.

Accordingly, it is an object of the present invention to provide a safety device that senses the misfeed of a work material to a work station in a punch press.

Another object of the invention is to provide a material misfeed detector in a punch press that includes an air nozzle that directs a stream of compressed air through a preformed opening in a work material to a receiver, wherein the pressure of the air as received by the receiver is operative to actuate a pressure responsive device to continue the operation of the punch press; and upon misfeed of a work material to the work station, the air stream to the receiver is deflected to reduce the pressure to the pressure responsive device that is then operative to discontinue the operation of the punch press.

Still another object is to provide a safety device for use in a punch press for detecting the misfeed of a work material to the work station thereof, the safety device incorporating an air nozzle and receiver that are located on opposite sides of the work material and that are operative to detect a misfeed of the material to the work station, provision being further made for continued operation of the machine during normal feeding of the work material to the work station and when communication between the nozzle and receiver is interrupted.

Other objects, features and advantages of the invention shall become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is an elevational view with parts shown in section and in diagrammatic form of the safety device embodied herein as employed in a punch press;

FIG. 2 is an elevational view with parts shown in section of the punch press and the safety device incorporated therein and as seen at right angles with respect to the view illustrated in FIG. 1;

FIG. 3 is an enlarged sectional view taken along 3—3 in FIG. 1; and

FIG. 4 is a top plan view of an example of a work material that is fed into the punch press and showing progressive steps in the formation of an article by successive punching operations.

DESCRIPTION OF THE INVENTION

Referring now to the drawings and particularly to FIG. 1, a portion of the punch press as embodied in the present invention is illustrated, and for purposes of the subject invention, the punch press which is generally indicated at 10 is shown for use with a safety device, to be described. The invention has particular application in apparatus for automatically performing a prese-

lected work operation on a work material such as strip stock that is progressively transferred through a work station of the punch press **10.** It is understood that the concept of the invention may be incorporated in other machines that perform a similar work operation and to which a work material is directed. However, since the safety device of the present invention is particularly useful with a punch press that is automatically operated and that progressively performs an operation on strip stock, the description as follows hereinafter will be directed to use of the punch press **10.**

The motor and operating structure for the punch press **10** is not illustrated in the drawings, although this is conventional structure and forms no part of the subject invention. It is understood that the operating mechanism of the punch press is interconnected to a ram **12** of conventional construction to which a sub-tool assembly is interconnected. The sub-tool assembly includes an upper punch block **14** with which the ram **12** engages during a punching operation. Secured to the upper punch block **14** is a backup plate **16** having a punch or tool holder **18** joined thereto. Interconnected to the upper punch block **14** through shoulder screws **20** that ride in bores **22** in the upper punch block, is a floating pressure pad **24,** spring **26** being interposed between the pressure pad **24** and the tool holder **18.** A base **28** is mounted on a support and is fixed in position with respect to the movable sub-tool assembly. The base **28** is shaped to cut in any particular manner to accommodate a work material; and as shown in FIG. **2,** a channel **30** is formed in the base for receiving a work material that in the present invention is in the form of an elongated metal strip **12.** It is understood in the operation of the punch press **10,** that the ram **12** is moved downwardly in a cyclical operation to engage the upper punch block **14** thereby producing downward vertical movement of the pressure pad **24** toward the base **28.** A tool **32** carried by the tool holder **18** extends through an opening in the pressure pad **24** and is brought into engagement with the work material **32** as the ram is moved in its downward stroke toward the base **28.** As previously described, the operation of the punch press **10** is conventional and the parts of the punch press illustrated and described in FIGS. **1** and **2** are also of conventional design and form no part of the present invention.

The punch press **10** progressively performs a series of punching operations on the work material **32;** and after each operation, the work material is advanced so that as it is progressively transferred through the work station, a series of work operations are performed thereon so as to produce a specific configured article. As illustrated in FIG. **4,** the work strip **32** is shown in blank form at the left thereof; and as the strip work material **32** is advanced along the base **28,** a particular operation is performed at the various stations therein until an article, such as for example, for use in an electrical circuit is produced. It is understood that a final punching operation will be performed on the strip to cut out the article as produced by the progressive operations of the punch press.

In the feeding of the work material **32** to the work station in the punch press **10,** the work material must be precisely located within the feed channel **30** of the base **28** so that as the tool **32** is driven into the work material, a precisely formed operation is achieved. Further, if the work piece is not in proper alignment, it is possible to damage the tool **32.** Unless the operator is closely observing the punching operation, any misalignment of the work material **32** will not be timely detected; and consequently, it is desirable to provide a safety device for promptly detecting the misfeed or misalignment of the work material and for discontinuing operation of the press before the tool is damaged. For this purpose the present invention incorporates a safety device in the punch press to immediately detect the misfeed of the work material **32;** and as illustrated in FIGS. **1, 2** and **3,** the safety device includes a nozzle generally indicated at **34** that is mounted in a bore **36** formed in the pressure pad **24** of the sub-tool assembly.

As shown in FIG. **3,** the nozzle **34** has a reduced passage **38** formed therein that communicates with an enlarged passage **40,** the enlarged passage **40** having communication with an interior conduit **42** that, in turn, communicates with an exterior conduit or pipe **44.** The pipe **44** is interconnected to a source of fluid under pressure, such as compressed air that is directed thereto through a regulator **46** and an air filter **48.** It is seen that the compressed air is introduced into the interior conduit **42** and then into the passage **40** and the reduced passage **38** for ejection in a jet stream **49** downwardly toward the base **28.**

Formed in the base **28** directly below the nozzle **34** is an interior chamber **50** that communicates with a bore **52** located in coaxial relation therewith. Parallel passages **54** and **56** also communicate with the interior chamber **50,** the passage **54** having access to an exterior pipe **58** which is connected to a pressure responsive device generally indicated at **60.** The passage **56** which is enclosed by a cap **62** is used to bleed the chamber **50** as required.

Slidably mounted in the bore **52** and extending inwardly into the chamber **50** is an air receiver generally indicated at **64.** The air receiver **64** is formed with a reduced passage **66** that communicates with an enlarged passage **68,** the enlarged passage **68** having direct communication with the interior chamber **50** at the bottom thereof. As illustrated in FIG. **1,** the receiver **64** is of such a length as to extend for a substantial portion of the chamber **50;** and as air from the nozzle **34** is directed into the receiver **64** and the interior chamber **50,** the back pressure exerted on the receiver **64** from the chamber **50** will retain the receiver **64** in the uppermost position thereof within the bore **52.** The passage **66** in the receiver **64** is located in direct vertical alignment with the passage **38** of the nozzle **34.** It is seen that the nozzle **34** sprays the stream of compressed air **49** downwardly toward the passage **66** of the receiver **64;** and if the strip material **32** is properly aligned in the channel **30,** the air will be fully directed into the passages **66** and **68,** chamber **50** and then outwardly of the base **28** by way of the passage **54.**

In the normal operation of the punch press, the work material **32** is punched at the first or second work station to form a pilot opening **72.** The pilot openings **72** are spaced along the strip material and may be used in aligning the strip during the punching operation. For purposes of operation of the present invention the pilot openings **72** are aligned at a selected station with the nozzle **34** and receiver **64** and are used to detect a misfeed of the work material. During the progressive feeding of the work material **32,** the pilot openings **72** in the strip material are progressively aligned with the nozzle **34** and receiver **64** as indicated in FIG. **3;** and the air

under pressure is directed from the nozzle **34** through the aligned opening **72** and into the receiver **64.** In normal operation and with a pilot opening **72** located in alignment with the nozzle **34** and receiver **64,** a predetermined pressure is exerted on the pressure responsive device **60** that is operable to effect continued operation of the power press **10.** For this purpose the pressure responsive device **60** includes a housing **75** in which an interior chamber **74** is formed that communicates with the conduit **58.** Slidably located in the chamber **74** is a piston **76** to which a rod **78** is connected. A cap **80** is friction fitted into the end of the housing **75** and is formed with a bore in which a spring **82** and an adjustment screw **84** are located. The adjustment screw **84** exerts pressure on the spring **82** to adjust the pressure that is necessary to move the piston **76** outwardly. A passage **86** is formed in the cap **80** for exhausting air that leaks between the housing walls and the piston **76.** It is seen that when a predetermined amount of pressure is exerted on the piston **76** by compressed air directed into the chamber **74** from the pipe **58,** the rod **78** is forced outwardly and into engagement with a contact **88** of a switch **90.** The switch **90** is located in a relay circuit **92** that is electrically interconnected to a power supply **94** and an emergency brake circuit **96.** When the piston **76** is moved outwardly by a predetermined amount of pressure as exerted by the air received from the nozzle **34,** the switch **90** is actuated to locate the power supply **94** in circuit therewith. The operating mechanism of the ram **12** is located in circuit with the power supply **94** and is thus operable to produce the operation of the device by cyclical movement of the ram in a vertical direction to perform the punching operations.

If for any reason the work piece is improperly fed to the work station in the press **10,** the pilot hole **72** located between the nozzle **34** and receiver **64** will be misaligned therewith, and the jet stream **49** will be deflected from the receiver **64,** and only a portion of the stream will enter the receiver **64.** As a result, the pressure of air as received in the chamber **74** of the pressure responsive device **60** will be reduced; and the piston **76** will not be moved outwardly sufficiently to close the switch **90.** Accordingly, the circuit to the power supply **94** will be broken to discontinue operation of the operating means for the ram **12,** and in addition the emergency brake circuit **96** will be energized to brake the operating mechanism for the ram **12** prior to the downstroke thereof.

It is understood that as the work piece **32** is fed through the work station of the press **10,** the individual pilot openings **72** will be aligned with the nozzle **34** and and receiver **64;** and although the nozzle and receiver can be located at any desired station in the press, they are preferably located at the second work station in the press.

In the operation of the punch press, and following a punching operation, the cyclical operation of the ram produces an upward movement thereof. As the pressure pad **24** lifts from engagement with the work material and the tool **32** is moved upwardly, the feed mechanism for the press (not shown) is operated to move the work material **32** in a feeding movement. Normally it is required that the jet of air from the nozzle **34** be received in the receiver **64** at the required pressure in order to retain the press in operation. However, since there is a period of movement of the work material in which the air jet is located between the openings **72** as the strip material is fed to the next station, the jet of air will not be received in the receiver **64,** and it is necessary to provide a parallel circuit to maintain the press in operation until the feeding operation is completed. For this purpose, a probe **98** is provided and is mounted on the ram **12** through a bracket **100.** The probe **98** defines a contact that is interconnected to an electrical lead **102** that is also located in circuit with the power supply **94.** As the ram **12** is moved downwardly, the probe **98** engages the punch block **14** to establish a ground connection therewith and to locate the power supply **94** in circuit with the means for operating the ram **12.** Since contact of the probe **98** with the punch block **14** occurs on the downward stroke of the ram, alignment of a pilot hole **27** in the work material **32** at the appropriate station and between the nozzle **34** and receiver **64** has already occurred. After the punching operation, and as the pressure pad **24** lifts off the work material **32,** the feed operaton begins; and since the receiver **64** is blocked from the nozzle **34,** contact of the probe **98** with the punch block **14** completes the circuit to the power supply **94** and movement of the ram **12** in an upward direction and feeding of the work material continues. As the ram **12** moves to an upward position, the probe **98** disengages from the punch block **14** and operation of the press **10** will continue only if the work material **32** has been moved properly and an opening **72** is in alignment with the nozzle **34** and receiver **64.** If for any reason the work material **32** has been moved improperly or has become misaligned after the upward movement of the ram **12,** the jet **70** will be deflected by the misaligned opening in the work material, and the predetermined pressure that is required for movement of the piston **76** outwardly will not be exerted thereon, and the switch **90** will remain open, whereby relay circuit **92** cannot be energized to connect the power supply to the operating mechanism for the ram **14.** Since the ram **14** has not yet reached the upper position thereof when misfeeding occurs, it will be prevented from moving in a downstroke; and further, the emergency brake **96** will be energized to stop the operating mechanism just short of movement to the position that begins the downward stroke of the ram **14.** Accordingly, the ram **14** will be stopped on the upstroke and movement thereof downwardly cannot occur so long as the work piece **32** is misaligned or misfed. A reset ciruit is incorporated in the circuit and after the misfeed of the work material **32** has been corrected, a reset button is depressed and the operation of the apparatus continues as hereinabove described.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described.

What is claimed is:

1. A material misfeed detector for a power press, wherein the material is progressively transferred through a work station in said power press, comprising a base located at said work station and over which said work material is progressively transferred, a work tool located above said base and vertically movable relative thereto to perform the preselected work operation on

said work material, operating means for producing the vertical movement of said work tool, and a safety device for detecting a misfeed of said work material and being operable to discontinue operation of said operating means so as to prevent damage to said work tool in striking the misfed work material, said safety device including a fluid discharge member located on one side of said work material at said work station and normally discharging a stream of compressed air therefrom through a preformed opening in said work material, a pressure responsive device responsive to a variation in pressure of the compressed air discharged from said fluid discharge member and when a misfeed of said work material occurs at said work station for discontinuing operation of said operating means, a contact located in circuit with said operating means and in parallel relation with said pressure responsive device, means for completing a circuit to said contact upon normal downward movement of the work tool during a work operation, said contact providing for feeding operation of said work material during upward movement of said work tool after a work operation.

2. A material misfeed detector as set forth in claim 1, a receiver located on the other side of said work material at said work station and in vertical alignment with said fluid discharge member, said receiver communicating directly with said fluid discharge member upon normal feed of said work material to said work station through the preformed opening in said work material for receiving the jet of compressed air therefrom, the pressure responsive device communicating with said receiver and being actuated in response to a predetermined pressure exerted thereon by the compressed air directed to said receiver for effecting operation of said operating means.

3. Apparatus as set forth in claim 2, said nozzle being located above said work material in a holder for said work tool and vertically movable therewith, said receiver being located in said base in vertical alignment with said nozzle.

4. Apparatus as set forth in claim 3, said base having a bore formed therein for receiving said receiver in sliding and floating relation, a chamber formed in said base and communicating with said bore, said receiver extending through said bore into the chamber located interiorly of said base and having a passage formed therein that communicates with said chamber and that is aligned with said nozzle for receiving the compressed air ejected therefrom, wherein the compressed air as directed into said passage is received in said chamber and retains said receiver in sliding and floating relation in said bore, and a conduit communicating with said chamber and directing the compressed air received from said passage to said pressure responsive device.

5. Apparatus as set forth in claim 4, said passage as formed in said receiver including an upper reduced portion that communicates with said nozzle, a lower enlarged portion that communicates with the chamber in said base, the reduced portion of the passage being confined within the bore in said base and the enlarged portion extending inwardly for a substantial portion of the interior chamber in said base.

6. Apparatus for automatically performing a preselected work operation on a work material that is progressively transferred through a work station in said apparatus, a base located at said work station and over which said work material is progressively transferred, a work tool located above said base and vertically movable relative thereto to perform the preselected work operation on said work material, and operating means for producing the vertical movement of said work tool, the improvement comprising a safety device for detecting a misfeed of said work material to said work station and being operable to discontinue operation of said operating means so as to prevent damage to said work tool in striking the misfed work material, said safety device including a nozzle located on one side of said work material at said work station and discharging a jet of compressed air therefrom, a receiver located on the other side of said work material at said work station and in vertical alignment with said nozzle, said receiver communicating directly with said nozzle upon normal feed of said work material to said work station through a preformed opening in said work material for receiving the jet of compressed air therein, a pressure responsive device communicating with said receiver and being actuated in response to a predetermined pressure exerted thereon by the compressed air directed to said receiver for effecting operation of said operating means, said pressure responsive device being responsive to a decrease in pressure when the jet of compressed air from said nozzle is deflected in its path through said work material to the receiver due to misfeed of said work material to interrupt the operation of said operating means, said nozzle being located above said work material in a holder for said work tool and vertically movable therewith, said receiver being located in said base in vertical alignment with said nozzle, a contact located in circuit with said operating means and in parallel relation with said pressure responsive device, and means for completing a circuit to said contact upon normal downward movement of the holder for said work tool during a work operation, said contact providing for feeding operation of said work material during upward movement of said work tool after a work operation.

7. Apparatus as set forth in claim 6, said contact being defined by an elongated probe that is adjustable in position relative to an electrical ground.

8. Apparatus as set forth in claim 3, said pressure responsive device being located in a relay circuit that is electrically interconnected to a circuit for an emergency brake, wherein said emergency brake is energized to discontinue operation of said operating means when said pressure responsive device is not moved sufficiently due to a decrease in pressure to said receiver.

9. A material misfeed detector as set forth in claim 1, said contact being defined by an elongated probe that is adjustable in position relative to an electrical ground.

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