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SWITCH APPARATUS FOR DETECTING DELIVERY OF PARTS

Filed Nov. 20, 1959

Fig. 1

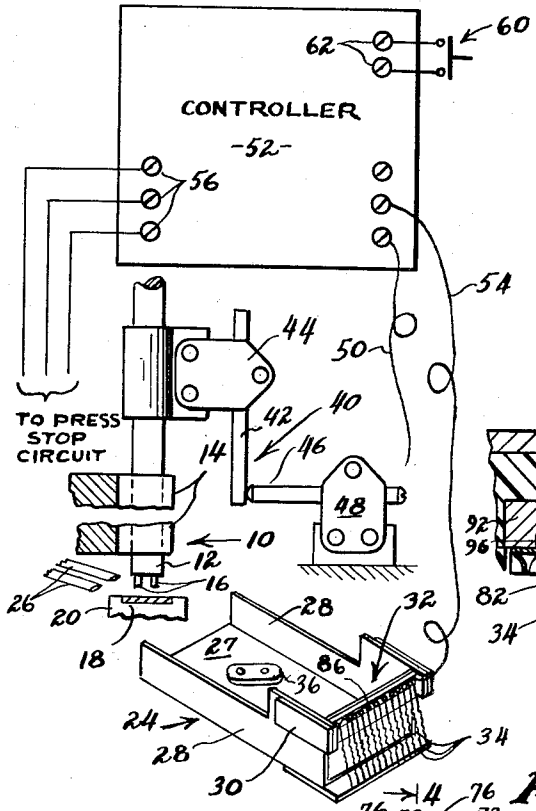


Fig. 4

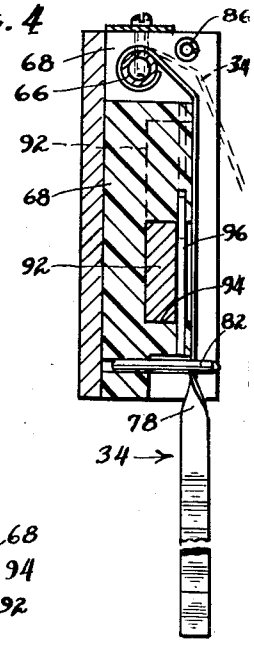


Fig. 3

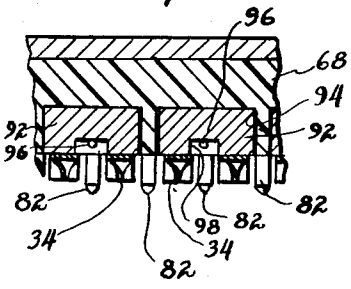
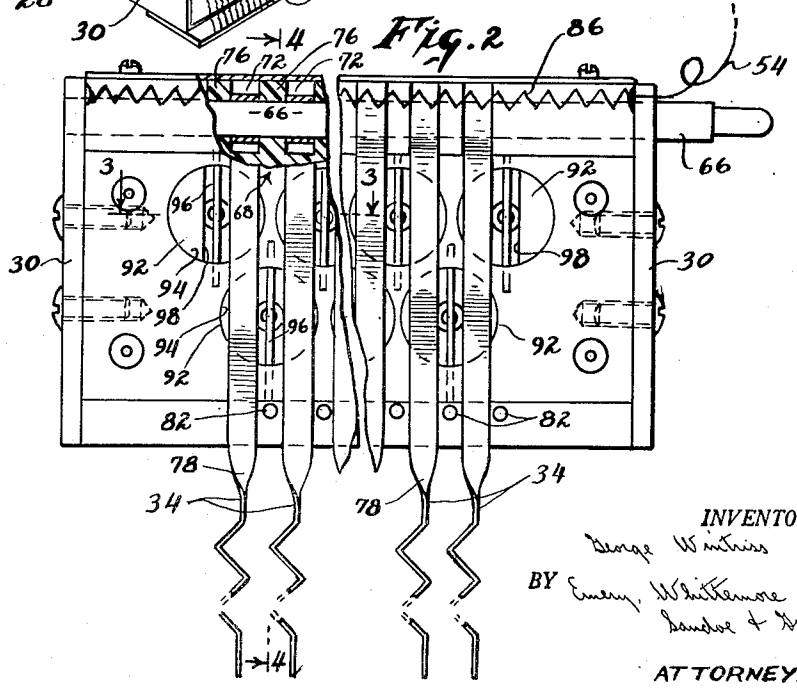


Fig. 2



INVENTOR.
George Wintriss
BY Emery, Whittemore
Sandoe & Graham
ATTORNEYS

United States Patent Office

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SWITCH APPARATUS FOR DETECTING DELIVERY OF PARTS

George Wintriss, Carversville, Pa.

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This invention relates to control apparatus for protecting machines and more especially machines having punches and dies, or similar elements, for making parts. More particularly, the invention is concerned with systems for stopping further operation of a machine if a part is not delivered at the time when it should be. By detecting such missing parts, the invention is made responsive to irregularities in the operation of the machine regardless of where the trouble may exist. For example, the invention will be responsive to a failure of an automatic feed as well as to jamming of a part in a die, since the failure of the machine to deliver a part at the proper time in the cycle is a definite indication of improper operation of some part of the system.

It is an object of the invention to provide an improved safety control for machines, and with the safety control responsive to the operation of a missing-part detector. The invention includes a control system in which the operation of the missing-part detector is co-ordinated with the operation of the elements of the machine so that the missing-part detector is conditioned again for every cycle of operation of the machine.

Another object of the invention is to provide an improved detector in the path of delivery of work pieces from a machine, and with feelers constructed and spaced so that parts delivered from the machine will operate one or more of the feelers, even though the parts are small and movable along courses which vary considerably from one side to the other of a conveyor, delivery chute, or other discharge means on the delivery side of the machine.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views:

FIGURE 1 is a diagrammatic view of a missing-parts detector system, made in accordance with this invention, and connected with elements of a machine which is to be protected;

FIGURE 2 is a greatly enlarged, front view of the missing-parts detector shown in FIGURE 1;

FIGURES 3 and 4 are enlarged sectional views taken on the lines 3—3 and 4—4, respectively, of FIGURE 2;

In FIGURE 1, a punch press 10 is shown diagrammatically. This press includes a ram 12 which moves up and down in a bearing 14 and which has punches 16 in position to operate on a strip 18 carried by a die 20. Parts punched from the strip 18, and stripped in the usual way, are blown into a delivery chute 24 by compressed air from blast nozzles 26.

The delivery chute 24 has a bottom 27 and side walls 28. At the discharge end of the delivery chute 24, there is a bracket 30 attached to the upper portions of the sides 28. This bracket 30 supports a missing-part detector 32 having feelers 34 extending downwardly to the bottom 27 of the delivery chute.

In the construction shown, the feelers 34 are located at the end edge of the bottom 27 and they extend slightly below the top surface of the chute bottom 27.

The feelers 34 are pivotally supported at their upper ends so that they are free to swing outwardly away from the end of the delivery chute; and they do swing outwardly when struck by a part 36 as the part is blown down the delivery chute 24 by compressed air from the blast nozzles 26.

The number of feelers 34 which are displaced by the part 36 depends upon the transverse dimension of the part at the particular orientation which the part may have at the time it strikes the feelers 34. The spacing of the feelers 34 from one another is less than the minimum width of any part which may be delivered from the machine which the invention is designed to protect.

The missing-part detector 32 will operate with parts traveling along the chute bottom 27, and equally well with parts blown through the air out of contact with the bottom or other surfaces of a delivery chute. The missing-part detector will also operate in co-operation with a conveyor belt and the feelers 34 may be at the end of the belt or they may be disposed above the belt with their lower ends hanging down close to the conveyor surface along which the parts travel, and in any event, at a distance from the conveyor surface less than the height of the parts which move the feelers when the machine is operating satisfactorily and parts are being delivered in accordance with the time cycle of the machine.

There is a switch 40 responsive to the movement of the punches 16 with respect to the stationary die 20. This switch includes a movable contact 42 attached to the ram 12 by a bracket 44; and includes also a relatively fixed contact 46 held in a bracket 48 attached rigidly to a fixed part of the frame of the machine. Thus, the contact 46 is in a fixed relation to the die 20.

The contacts 42 and 46 are adjusted so that they touch one another when the machine is operating during the part of its cycle when a part 36 should be discharged from the delivery chute 24.

In order to allow for reasonable variations in the operation, the switch 40 remains closed for a period starting some time before a part should reach the discharge end of the delivery chute and extending for some time after the part should be discharged from the chute.

The switch 40 is grounded on the machine and is connected at its other side, by a conductor 50, to a controller 52. The missing-part detector 32 is connected with the controller 52 by a conductor 54.

The controller 52 has terminals 56 with conductors leading to a circuit that stops the operation of the machine. With punch presses, the circuit from the terminals 56 operates the clutch so as to prevent the application of power from the flywheel to the ram 12 for the next cycle of the machine if the controller has not received an impulse from the detector 32 during the time that the switch 40 was closed during any successive cycle.

A reset switch 60 is connected with terminals 62 of the controller for operating the machine during times when no delivery of parts can be expected; as when initially threading a strip of stock into the machine.

FIGURES 2–4 show the construction of the missing-parts detector. Each of the feelers 34 is made of spring material and has a curved upper end which fits around an axle 66 extending for the full transverse width of the detector. This axle 66 is supported by a block 68 which is preferably made of hard plastic, or some other electrical insulating material. There are slots 72 in the top of the block 68 for exposing the portions of the axle 66 around which the upper ends of the individual feelers 34 extend. The portions of the block 68 between the slots 72 provide spacers 76 for holding the upper ends of the feelers 34 at the desired spacing from one another.

The flat sides of the spring material, of which the feelers 34 are made, extend around the axle 66; but at locations near the bottom of the block 68 there is a twist 78 in each of the feelers 34 so that the lower portions of the feelers have their narrow edges confronting the delivered parts which strike the feelers. This disposes the feelers 34 in positions having the greatest

strength for resisting bending as a result of the repeated blows of parts striking the detector.

In order to hold the feelers 34 in parallel relation, there are studs 82 extending from the face of the block 68, there being one stud 82 between every feeler 34 and its next adjacent feeler. These studs 82 are of substantially the same width as the spacing between the feelers 34; and they have tapered ends for guiding the feelers back into proper position as a feeler swings downwardly toward the block 68 after each displacement of the feeler. In the construction illustrated, the feelers 34 are of zig-zag shape below the twists 78 so as to eliminate the possibility of a flat and narrow part being blown between successive feelers. With larger parts having no narrow dimension, straight feelers are just as effective as those shown in the drawing.

There is a spring 86 stretched across the full transverse width of the detector at the upper end of the block 68 and outside of the curved upper ends of the feelers 34. Each of the feelers 34 moves into contact with the spring 86 when the feeler 34 swings outward, as shown in dotted lines in FIGURE 4.

The axle 66 is connected with one side of a circuit, and the spring 86 is connected with the other side of the circuit. The feelers 34, therefore, serve as switches for closing a circuit between the axle 66 and the spring 86 whenever the feelers 34 swing into contact with the spring 86. Either the axle 66 or the spring 86 can be connected to the conductor 54 of FIGURE 1. The other side of the detector is grounded.

Since the feelers 34 are of light weight, it is desirable to provide means for holding them in a vertical direction when they are not displaced by the delivery of a part from the machine. This is particularly true with installations where the parts are propelled toward the detector by a blast of compressed air. Without some means for holding the feelers in their downwardly hanging position, the blast of air could displace the feelers in a manner similar to the effect of a part delivered from the chute.

In the construction illustrated, the feelers 34 are held in their downwardly hanging positions by magnets 92 located in sockets 94 in the front face of the block 68. The magnets are relatively loose in the sockets 94 so that no accurate facing of the magnets and the insulating block 68 is required. Each magnet 92 is held in its socket 94 by a pin 96 extending through the block 68 above and below the magnet. There is a vertical groove 98 in the front face of each magnet 92 providing clearance for the pin 96.

The faces of the magnets 92 are preferably flush with the face of the block 68; but the pins 96 are located so as normally to leave some clearance for the magnets 92 to move outwardly into contact with the feelers 34 in the event that any feeler 34 touches the face of the block 68 before coming in contact with its magnet 92.

In the illustrated construction, there are two rows of magnets 92, with the magnets in the respective rows located in staggered relation to one another. This provides two magnets for holding each of the feelers 34. The diameter of each magnet is substantially equal to, or slightly greater than, the transverse width of two feelers 34 and the space between the feelers, as shown clearly in FIGURE 2.

The wiring of the detector can be modified so as to connect the magnet at one side of the detector circuit, and the magnet at the other end of the detector to the other side of the circuit. When so connected, the feelers 34, in contact with all of the magnets, provide a series circuit from one end magnet to the other, and the movement of any feeler out of contact with its magnet will break the circuit to provide an impulse for the controller.

It will be understood that the operation of the controller can be controlled by either making or breaking a circuit, since the breaking of a circuit can supply current when necessary through the de-energizing of a relay which closes another circuit when de-energized.

The invention has been described in connection with a delivery chute which is to be considered representative of conveyors, and the term "conveyor" is used herein to indicate any apparatus, either fixed or moving, along which a part is delivered from a machine. The preferred embodiment of the invention has been illustrated with multiple feelers 34, but it will be understood that a single feeler is sufficient for installations where the parts delivered are large, or always travel along an identical path as they come from the machine.

Various changes and modifications can be made in the illustrated construction without departing from the invention as defined in the claims.

What is claimed is:

1. In a machine having a work station where an operation is performed on a work piece, an operation-performing element having relative movement toward and from the work piece at said work station, means for dislodging a work piece from the work station along a discharge path after each cycle of operation of the machine, first electric circuit make-and-break means that move in timed relation with said relative movement of the operation-performing element between a controlling and non-controlling position, a missing-parts detector located along said discharge path and including second electric circuit make-and-break means with a movable feeler extending into position to be struck by a part discharged along said path, and a controller that stops the operation-performing element when the feeler of the second electric circuit make-and-break means remains undisturbed while the first electric circuit made-and-break means is in said controlling position.

2. The combination described in claim 1 and in which there is a delivery chute along which successive parts are delivered from the machine and said chute constitutes the discharge path, and the missing-parts detector includes a plurality of feelers hanging down across the cross section of the chute and closely spaced from one another transversely of the chute.

3. The combination described in claim 2 and in which the lower portions of the feelers are of zig-zag contour in directions to increase the effective width of the feelers transversely of the chute.

4. The combination described in claim 2 and in which the end portions of the feelers constitute movable contacts of the second electric circuit make-and-break means.

5. The combination described in claim 4 and in which all of the portions of the feelers that are movable contacts of the second electric circuit make-and-break means are in parallel with one another.

6. The combination described in claim 2 and in which there are magnets in position to hold each of the feelers in its downwardly hanging position.

7. The combination with a machine having relatively movable elements, one of which operates through a cycle to make a part, of a first electric circuit make-and-break means having contacts that move toward and from one another in timed relation with movement of one of said elements, a missing-parts detector located in the path of movement of parts delivered from the machine, the missing-parts detector including second electric circuit make-and-break means and an operator for the second electric circuit make-and-break means consisting of a movable feeler extending into position to be struck by a part delivered from the machine, and a controller for the machine in the circuit with both the first and second electric circuit make-and-break means, and in which there is a delivery chute along which successive parts are delivered from the machine, and the missing-parts detector includes a plurality of feelers hanging down across the cross section of the chute and closely spaced from one another transversely of the chute, and there are magnets in position to hold each of the feelers in its down-

wardly-hanging position, and there is a block with a downwardly-extending face across which the feelers extend when in their downwardly-hanging positions, and the magnets for holding the feelers are mounted in sockets in the block and are loose in the sockets so as to provide accommodation of the magnets to the positions of the feelers across the locations where the sockets open through the downwardly-extending face of the block.

8. The combination described in claim 7 and in which there is a pin extending across a recess in the face of each of the magnets for preventing the magnets from coming out of the sockets in the block.

9. The combination described in claim 7 and in which there are two rows of magnets in staggered relation to one another and the magnets are of such widths that each of the feelers crosses the face of a portion of one magnet of an upper row and a portion of another magnet of the lower row.

10. The combination with a machine having relatively movable elements, one of which operates through a cycle to make a part, of a first electric circuit make-and-break means having contacts that move toward and from one another in timed relation with movement of one of said elements, a missing-parts detector located in the path of movement of parts delivered from the machine, the missing-parts detector including second electric circuit make-and-break means and an operator therefor consisting of a movable feeler extending into position to be struck by a part delivered from the machine, and a controller for the machine in the circuit with both the first and second electric circuit make-and-break means, and in which there is a delivery chute along which successive parts are delivered from the machine, and the missing-parts detector includes a plurality of feelers hanging down across the cross section of the chute and closely spaced from

one another transversely of the chute, and there are magnets in position to hold each of the feelers in its downwardly-hanging position, and each of the feelers is made of flat spring material and the wide face of the feeler is transverse of the direction of movement and extends downwardly from the upper end thereof for a substantial distance, and each feeler has a 90° twist in a position intermediate the upper and lower ends positioning the lower portions of the feelers, with which the parts contact, with narrow edges toward the direction from which the parts are projected against the feelers.

11. A missing-parts detector for location in the paths of movement of parts delivered from a machine, the detector including electric circuit make-and-break means having a plurality of feelers extending downwardly and across the paths of movement along which parts are delivered from the machine, and a make-and-break circuit controlled by said electric circuit make-and-break means and responsive to the displacement of one or more of the feelers by a part passing along said path, and in which the feelers extend downwardly across a face of a support, and there are magnets located in sockets in said face of the support in position to hold the feelers in their downwardly-extending positions in spite of air blasts delivered along the path which is to be followed by the parts.

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