

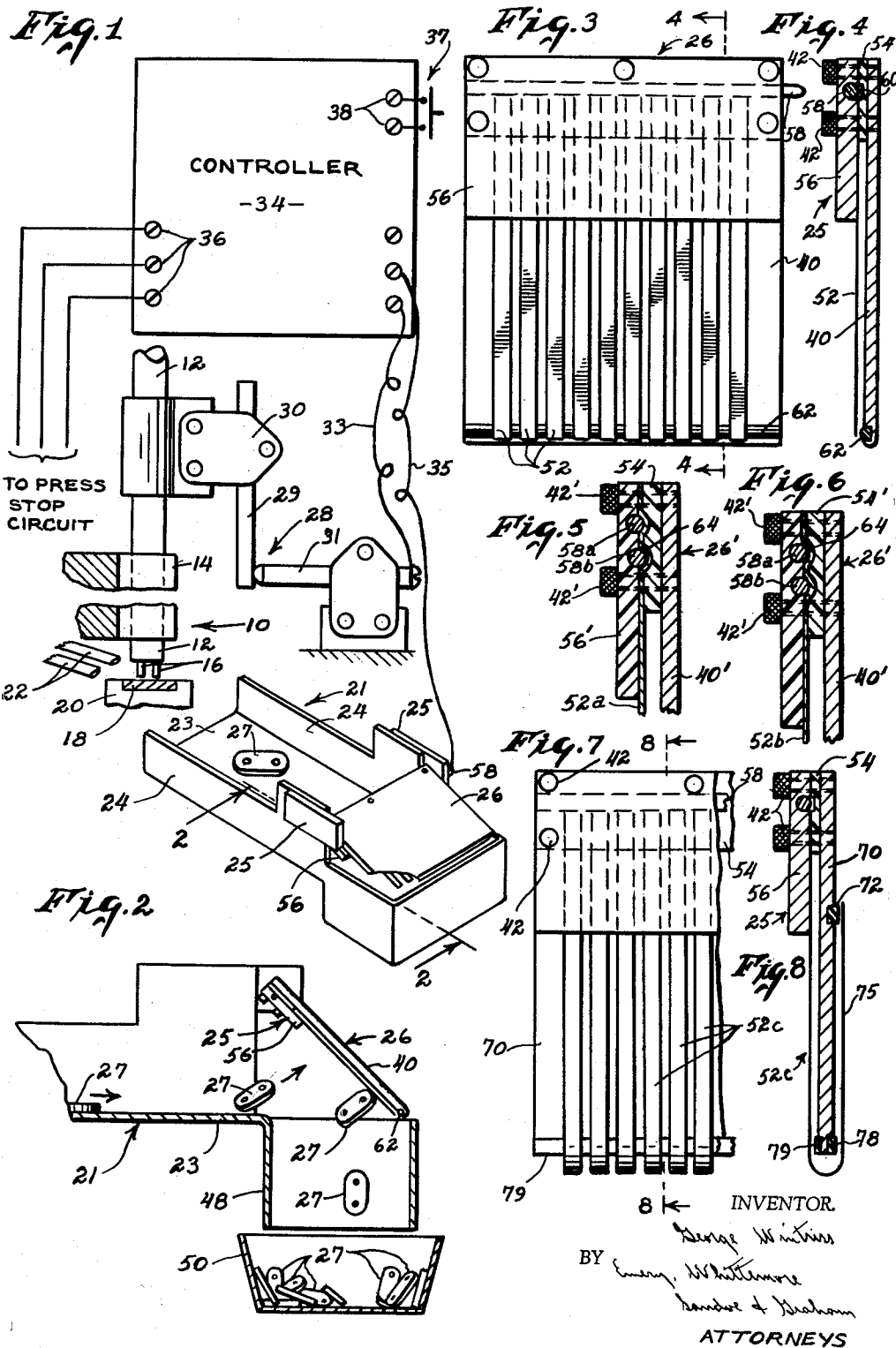
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MISSING PARTS DETECTOR

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MISSING PARTS DETECTOR
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This invention relates to apparatus for detecting variations in the operation of automatic machines from which work pieces are delivered in succession with each cycle of the machine. The invention relates more particularly to a detector which supplies a signal when a work piece is delivered from the machine; and there is automatic control equipment for stopping the machines if no piece is delivered at the time in the cycle when it should be delivered.

Numerous devices have been developed for detecting malfunctioning of automatic machines so that the machine can be stopped when the operation becomes irregular and before damage has been done to the equipment. It is an object of this invention to provide improved means for detecting the delivery of work pieces which are supplied along a delivery chute, and to provide apparatus which does not give a false signal as the result of air blasts that are used for propelling the work piece along the chute.

The invention includes flexible fingers which bend in response to impact by a work piece, and features of the invention relate to constructions for bending the fingers over substantial portions of their length so as to obtain deflection by small and relatively light work pieces; and to constructions which are simple and rugged in construction for insuring reliable operation and freedom from maintenance expense.

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 an automatic machine with the detection and control apparatus of this invention;

FIGURE 2 is an enlarged, diagrammatic view taken on the plane 2—2 of FIGURE 1;

FIGURE 3 is a greatly enlarged front view of the detector shown in FIGURES 1 and 2;

FIGURE 4 is a sectional view taken on the line 4—4 of FIGURE 3;

FIGURE 5 is an enlarged fragmentary view, similar to FIGURE 4, but showing a modified form of the invention;

FIGURE 6 is a view similar to FIGURE 5 but taken through one of the alternate fingers of the modified construction illustrated in FIGURE 5;

FIGURE 7 is a fragmentary view, similar to FIGURE 3, but showing another modified form of the invention; and

FIGURE 8 is a sectional view taken on the line 8—8 of FIGURE 7.

FIGURE 1 shows a punch press 10 having a ram 12 which moves up and down in a bearing 14 and which carries punches 16 for operating on a strip 18 in a die 20. Work pieces punched from the strip 18, and stripped from the die in a conventional manner, are blown into a delivery chute 21 by compressed air from blast nozzles 22. This apparatus is representative of automatic machinery which delivers work pieces in accordance with a repetitive cycle of operation.

There is a bottom 23 of the delivery chute 21, and the chute has side walls 24. A bracket 25 at the discharge end of the delivery chute is attached to the upper por-

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tions of the chute sides 24. A missing parts detector 26 is attached to the bracket 25 and is located in position to be struck by work pieces or parts 27 that move along the delivery chute in response to the air blasts from the nozzles 22.

FIGURE 2 shows a number of parts 27 moving along the delivery chute 21 and into contact with the detector 26. It is a feature of the construction that the detector 26 responds to pieces 27 which slide along the bottom 23 or which are blown through the air.

In FIGURE 2 the part 27, which is furthest to the left, is shown sliding along the bottom; and its momentum is sufficient to cause it to be projected beyond the end of the bottom and into contact with the detector 26 in the same manner as the part 27 which is in contact with the detector 26 in FIGURE 2. The uppermost part 27, in FIGURE 1, is shown projected through the air and this part will also strike the detector 26, though at a higher level.

There is a switch 28, responsive to the movement of the punches 16 with respect to the stationary die. The switch 28 has a movable contact 29 which is attached to the ram 12 by a bracket 30. The switch 28 also includes a fixed contact 31 rigidly attached to a fixed part of the frame of the machine and located, therefore, at a constant position with respect to the die 20. It will be understood that the contacts 29 and 31 are adjustable, and they are set so as to touch one another, when the machine is operating in its intended manner, during that part of the cycle when a work piece or part 27 should be discharged against the detector 26.

In order to allow for reasonable variations in the operation of the apparatus, the switch 28 remains closed for a period of time which starts before a part should reach the detector 26 and which continues for a short period after the part should reach the detector 26. The switch 28 is grounded on the machine and is connected at its other side, by a conductor 33, to a controller 34. The detector 26 is connected with this controller 34 by a conductor 35. There are terminals 36 on the controller 34 with conductors leading to a circuit of automatic apparatus for stopping the operation of the machine. In the case of punch presses, the automatic stop usually disengages the clutch to prevent application of power from the flywheel to the ram, and in the apparatus illustrated, this prevents the ram 12 from operating through its next cycle if the controller 34 does not receive a signal from the detector 26 during the time that the switch 28 is closed for the preceding cycle.

A reset switch 37 is connected with terminals 38 of the controller 34 for operating the machine during times when no delivery of parts can be expected, such as when initially threading a strip of stock through the apparatus.

The detector 26 includes a plate 40 connected at its upper end to the bracket 25 by a rigid connection, such as screws 42.

The plate 40 is preferably set at an angle of approximately 45° to the direction in which the work pieces or parts 27 are delivered from the machine. Such an orientation is illustrated in FIGURE 2, and there is a downwardly-extending chute 48 below the detector 26 for guiding the parts 27 to a tote box 50 or other receiver, below the chute 48. In the construction illustrated, the parts 27 fall into the tote box 50 but they can be made to drop on a conveyor, or can be taken away in other ways.

There are a plurality of flexible fingers 52 extending downwardly from the bracket 25 and across the lower portion of the plate 40. The upper ends of these fingers 52 are clamped between the bracket 25 and a block 54 of electrical insulating material. The portion of the bracket

25 which clamps against the fingers 52 is a plate 56 which is also made of electrical insulating material.

Electric power is supplied to the fingers 52 by a conductor 58 extending across substantially the full width of the plate 40. This conductor 58 fits into a groove in the plate 56 and extends beyond the open end of the groove just far enough to contact with the fingers 52 and to depress them slightly into a groove 60 in the insulation block 54.

The fingers 52 extend substantially parallel to the face of the plate 40, as shown in FIGURE 4; and in this position they are insulated from the plate.

In order to prevent closing of a circuit between the fingers 52 and the plate 40, as a result of an air blast against the fingers 52, there is a bumper 62 made of electrical insulating material and projecting from the lower end of the plate 40 just above the lower ends of the fingers 52. Thus a blast of air, which is intended to project a work piece or part against the detector, may blow the fingers 52 into contact with the bumper 62, but this does not close the circuit between the fingers 52 and the plate 40.

When a part is delivered from the machine and impinges against one or more of the fingers 52, the finger is bent toward the plate 40 and strikes against the bumper 62; but the weight of the part is sufficient to deform the finger 52 so that a portion of the finger immediately behind the part is bent into contact with the plate 40. This contact closes a circuit between the fingers 52 and the plate 40 and thus supplies a signal through the conductor 35 (FIGURE 1) to indicate delivery of a part and proper functioning of the machine.

The detector 26 has a plurality of fingers 52 which are preferably located in parallel relation to one another. In the preferred construction, the fingers 52 are spaced from one another by distances less than the width of the fingers; and the fingers 52 are made narrow enough so that they have the flexibility required for deflection into contact with the plate 40 when struck by a work piece. The same detector 26 is suitable for use with work pieces of different size and weight. While it is true that a larger work piece may strike several of the fingers 52 simultaneously, the necessary deflection is obtained because the larger work pieces have more momentum and are, therefore, capable of deflecting several fingers. The spacing between successive fingers 52 must be small enough so that a work piece can not strike the plate 40 between two fingers; that is, the spaces between fingers are narrower than the work pieces or parts with which the detector 26 is used.

FIGURES 5 and 6 show a modified form of the detector 26. The detector having this modified construction is designated by the reference character 26', and other corresponding parts are indicated by the same reference characters as in FIGURES 3 and 4 but with a prime appended. The essential difference between the detector 26', and the construction shown in FIGURES 3 and 4, is that the detector 26' has two conductors 58a and 58b, located in grooves in the plate 56'. A finger 52a is in electrical contact with the conductor 58a, but it is insulated from the conductor 58b by a layer of insulation 64. Alternate fingers 52b (FIGURE 6), located between each of the fingers 58a, have electrical contact with the conductor 58b, but are insulated from the conductor 58a by a layer of insulation 64.

In this construction shown in FIGURES 5 and 6, the plate 40' is not a part of the electrical circuit; and this detector can be used only with work pieces or parts which are made of metal or other electrically conductive material. It must also be used with parts having a width equal to at least the width of one of the fingers 52a or 52b, plus the spacing between the fingers. With parts of such size, each part striking the detector 26' will touch at least two of the fingers and thus complete a circuit from a finger 52a to a finger 52b. This puts the conductors 58a and 58b in a closed circuit through the fingers

and the work piece or part to supply an electrical impulse to the controller.

While, in FIGURES 5 and 6, the plate 40' is not in the electrical circuit, as previously explained, it has been found to be essential to the successful operation of the detector 26'. The purpose of the plate 40' in FIGURES 5 and 6 is to limit the deflection of the fingers 52a and 52b so that they can operate repetitively over extensive periods of time without deterioration resulting from excessive flexing at the upper portions of the fingers where they are clamped between the plates 54' and 56'.

FIGURES 7 and 8 show another modified form of the invention. The purpose of the construction shown in FIGURES 7 and 8 is to obtain greater flexibility of fingers 52c. These fingers are clamped between the plate 56' of the bracket 25 and the block 54, as already explained in the description of FIGURES 3 and 4. In place of the plate 40, however, there is a plate 70, and the fingers 52c extend downwardly, from the bracket 25, and under the plate 70, then upwardly on the other side of the plate. There is a bumper 72 for preventing the free end of any finger 52c from striking against the plate 70. The detector shown in FIGURES 7 and 8 is turned in the opposite direction from that shown in the other figures. In other words, the detector is turned so that the plate 56' is on the side away from the work pieces or parts, and the parts contact with the upwardly-extending portions 75 of the fingers 52c. There is a bumper 78 at the lower end of the plate 70 for preventing each finger 52c from being blown into contact with the plate 70 by the pressure from the air blast when no part is delivered by the machine. There is also a bumper 79, on the other side of the plate 70, for preventing each finger 52c from striking the plate 70 during any recoil of the finger 52c from a deflected position.

The advantage of the construction shown in FIGURES 7 and 8, as compared with that shown in FIGURES 3 and 4, is that the fingers 52c have a greater length along which they can bend; and this greater length is obtained without increasing the height of the detector. This reverse bend construction of the fingers 52c permits the use of fingers which are stiff enough to prevent distortion by the air blast, and at the same time to obtain a greater flexibility for use with very light parts.

The preferred embodiments of the invention have been illustrated and described, but changes and modifications can be made and some features can be used in different combinations without departing from the invention as defined in the claims.

What is claimed is:

1. A detector for supplying an electric impulse for an automatic machine including a plate having a substantial front area for location extending transversely across a path along which a work piece is delivered from the machine for each cycle of operation of said machine, flexible fingers having exposed portions extending across said front area of the plate and in position to be struck by the work piece, the fingers being spaced from one another by distances less than the width of the work pieces with which the detector is intended to be used, means at one end of each of the fingers securing the fingers to the plate, said means including electrical insulation between the fingers and the plate, and an electrical conductor connected with the secured ends of the fingers.

2. A detector for supplying an electric impulse for an automatic machine including a plate for location in a path along which a work piece is delivered from the machine for each cycle of operation of said machine, flexible fingers extending across the front of the plate, the fingers being spaced from one another by distances less than the width of the work pieces with which the detector is intended to be used, means at one end of each of the fingers securing the fingers to the plate, said means including electrical insulation between the fingers and the plate, and an electrical conductor connected with the secured ends of

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the fingers, the means securing the fingers being clamping elements on opposite sides of the fingers, and fastening means securing the clamping elements to the face of the plate near one end thereof, the clamping element on the plate side of the fingers being the electric insulation, and the electrical conductor being connected with the fingers by one of said clamping elements clamping the conductor.

3. The detector described in claim 2 and in which both of the clamping elements are made of electrical insulating material and there are screws clamping the clamping elements together and securing them to the plate, and there are grooves facing one another in the confronting faces of the clamping elements, and the electrical conductor is located in one of the grooves and slightly higher than the depth of the groove so that said conductor deflects the fingers to some extent into the groove in the other clamping element to increase the grip of the clamping elements on the fingers and to establish a firm contact between the fingers and the conductor.

4. The detector described in claim 3 and in which there are two pairs of grooves in the clamping elements and there is a different conductor in each of the grooves, and there is electrical insulation between one of the conductors and every other finger, and there is electrical insulation between the other of the conductors and the remaining fingers.

5. The detector described in claim 3 and in which the fingers extend from the clamping elements to the end of the plate most remote from the clamping elements, and the fingers curve around said end of the plate in spaced

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relation thereto and have free end portions extending across the opposite side of the plate and substantially parallel with and close to said opposite side in position to be deflected into contact with said opposite side when a work piece strikes against said free end portions.

6. The detector described in claim 2 and in which the clamping element that is farther from the plate than the other clamping element extends along and covers a substantial length of the fingers beyond the portions of the fingers that are between the clamping elements, the extending part of the clamping element being generally parallel to the plate.

7. The detector described in claim 6 and in which there is a bumper at the ends of the fingers remote from the clamping elements for holding the ends of the fingers out of contact with the plate whereby a finger must be deformed between the clamping elements and the bumper in order to bring it into contact with the plate.

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