June 14, 1966 G. WINTRISS 3,256,397

IMPACT SIGNAL DEVICE WITH MAGNETICALLY RESTRAINED INERTIA ELEMENT

Filed April 21, 1964

FIG. 1.

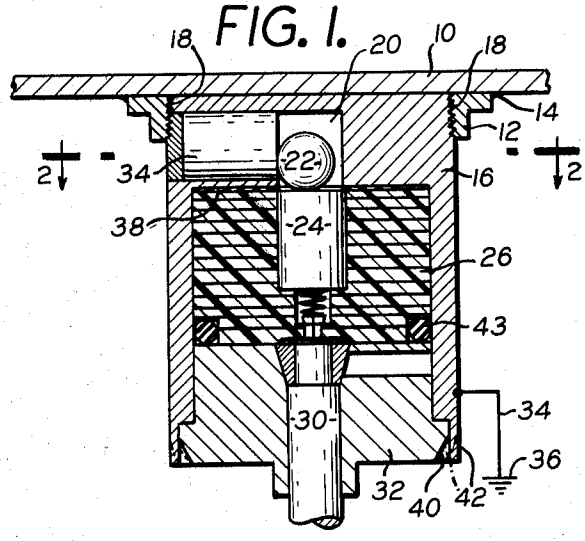


FIG. 2.

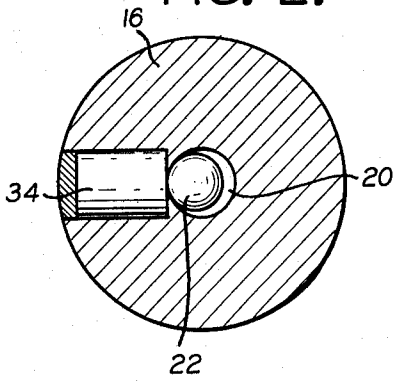
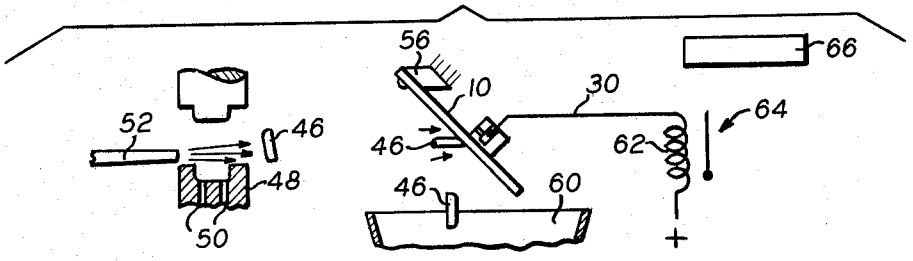


FIG. 3.



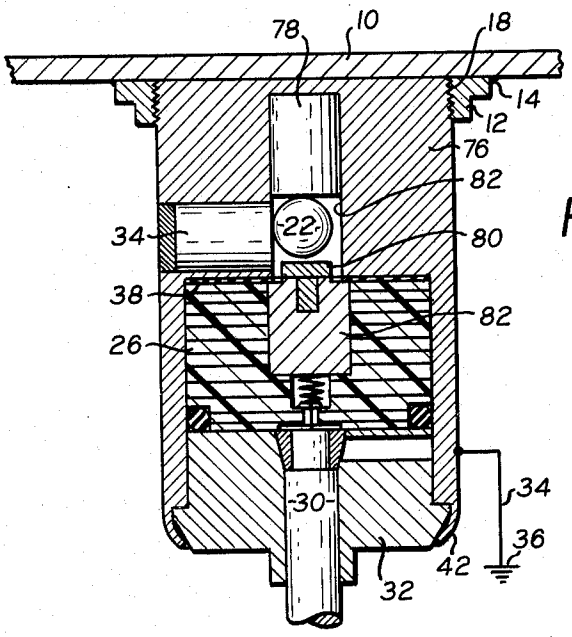


FIG. 4.

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United States Patent Office 3,256,397
Patented June 14, 1966

3,256,397

IMPACT SIGNAL DEVICE WITH MAGNETICALLY RESTRAINED INERTIA ELEMENT

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Filed Apr. 21, 1964, Ser. No. 361,336
8 Claims. (Cl. 200—61.45)

This invention relates to apparatus for picking up a signal in response to the impact of an object against an abutment. It may be used on automatic machines by placing the abutment in the path of work pieces delivered from the machine, and it has many other uses.

It is an object of the invention to provide an improved pick-up responsive to impact, and more especially to provide a more rugged pick-up than those of the prior art, and which remains reliable indefinitely in contrast to prior impact signal pick-ups that are eventually damaged by the impacts.

Another object of the invention is to provide an electric switch containing an inertia element which is one of the contacts of the switch, the switch being constructed and arranged to open or close momentarily when the housing moves suddenly so as to shift a contact secured to the housing away from the inertia element which does not partake of the sudden movement.

In order to prevent bouncing and vibration of the inertia element in the housing, the inertia element is given a bias toward or away from the contact that is held in the housing; and in one embodiment of the invention, the contact that is held in the housing is a magnet and the inertia element is made of ferrous metal so that the attraction of the magnet for the inertia element provides the bias for the inertia element toward the other contact. In another embodiment of the invention, a magnet which is not part of the circuit biases the inertia element away from a contact held in the housing.

The preferred construction has a ball as the inertia element and has a second magnet that contacts with the ball at the same time as the first magnet when the circuit through the switch is closed. The invention includes an abutment plate to which the switch housing is connected and the housing may be a part of the electric circuit and may be at the frame potential of the machine with which the pick-up is used. The other side of the circuit can be connected with the actuator of a control switch of the automatic 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 sectional view through an abutment and switch made in accordance with this invention;

FIGURE 2 is a sectional view taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a diagrammatic view showing the combination of the pick-up apparatus of this invention with an automatic machine; and

FIGURE 4 is a view similar to FIGURE 1, but showing a modified construction in which an impact closes a circuit instead of opening it as in the case in the construction shown in FIGURE 1.

FIGURE 1 shows an abutment **10** consisting of a plate which is made of stiffly flexible material preferably metal. This plate **10** is constructed so that it is not flexed beyond its elastic limit by the impact of the work pieces or other objects with which it is intended to be used.

On the back of the abutment plate **10** there is a fastening element **12** which is secured to the plate in any suitable way as by welding **14**. A switch housing **16** is attached to the fastening element **12** by screw threads **18**.

Within the switch housing **16**, there is a chamber **20** which encloses an inertia element **22**. In the construction illustrated, the inertia element **22** is a steel ball.

At the bottom of the chamber **20** there is a contact **24** imbedded in an insulating cup **26** which prevents the contact **24** from touching the switch housing **16**. This insulating cup **26** can be made of plastic or any other suitable electrical insulating material. The cup **26** preferably fits with a press fit into the lower end of the chamber **20** and the contact **24** preferably fits with a press fit into the cup **26**.

The contact **24**, which is fixed with respect to the switch housing **16** by being secured in the bottom of the switch housing, is preferably a permanent magnet so that it attracts the steel ball **22** and thus provides a bias holding the ball **22** normally in contact with the upper pole face of the contact magnet **24**.

The contact magnet **24** is connected with a conductor **30** extending through an insulating sleeve **32** in the switch housing **16** and constituting part of an external circuit. In the preferred construction, the switch housing **16** is a part of the electric circuit and is grounded by a conductor **34** on a frame **36** of the machine or other equipment with which the invention is used. The circuit through the steel ball **22** is at ground potential when the switch is closed.

The chamber **20** is cylindrical with its longitudinal axis extending toward the plate **10**. The upper pole face of the contact magnet **24** extends across the entire area of the part of the chamber **20** in which the ball **22** is contained; but the contact magnet **24** may be of smaller cross section. In any event it is large enough so that the space between the circumference of the pole face and the cylindrical side wall of the chamber **20** is less than the radius of the inertia element or ball **22**. Thus the ball **22** always touches the pole face of the contact magnet **24** when the ball is at rest, and even though the ball is up against some part of the cylindrical side wall of the chamber **20**.

The switch can be made so that the contact of the ball **22** with the side wall of the switch housing **16** provides one side of the circuit while the contact of the ball with the contact magnet **24** provides the other side of the circuit of the switch.

When an object strikes on the abutment plate **10**, the impact causes the abutment plate **10** and the switch housing **16** to move downward very suddenly and because of the inertia of the ball **22**, the contact magnet **24** moves away from the ball **22** momentarily and breaks the circuit through the switch provided by the ball and contact **24** until the ball **22** has time to again move into contact with the contact magnet **24** under the influence of gravity and the pull of the magnet **24**.

The switch of this invention can be used in any orientation and it will be evident that a greater impact will be required to open the switch when it is in the position shown in FIGURE 1 than when it is in a position upside down with respect to FIGURE 1 or various other positions in which the attraction of gravity and the pull of the magnet **24** are not both in the same direction.

It is a feature of the construction, that the chamber **20** is of short axial extent as compared with the diameter of the ball **22** so that when the switch housing is in any orientation, the magnet **24** will always pull the inertia element or ball **22** back into contact with the pole face of the magnet **24** regardless of the position to which the ball **22** may be shifted with respect to the housing by impact of objects with the abutment plate **10**.

In the preferred construction of the invention, a second magnet **34** is used in the curved wall of the chamber **20**. This second magnet **34** is shown with one pole face flush

with the curved wall of the chamber **20** but it can extend slightly beyond the wall of the chamber when necessary to center the ball **22** over the contact magnet **24** while the ball is in contact with the second magnet **34**.

The magnet **34** preferably fits with a press fit into an opening in the side of the chamber **20** and it is located close enough to the level of the upper end of the contact magnet **24** so that at least a part of the inner pole face of the second magnet **34** is not further from the level of the pole face of the magnet **24** than a distance equal to the radius of the ball **22**. Thus the ball **22** touches both of the magnets **24** and **34** when in its normal undisturbed position as shown in FIGURE 1.

When the switch housing **16** is made of metal and constitutes a part of the electric circuit, it will be evident that the circuit is closed with the ball **22** in contact with any part of the side wall of the chamber **20** so long as the ball **22** is at the same time touching the pole face of the contact magnet **24**. However, the magnet **34** provides the important advantage of insuring a firmer contact between the ball **22** and the circuit which passes through the metal of the housing **16**. The second magnet **34** also has the additional advantage of making it unnecessary to construct the switch housing **16** out of electrically conductive material and the switch housing can be made of plastic or other electrically insulating material if the second magnet **34** is connected directly to the conductor **34** by which the circuit is grounded.

The switch has less resistance and operates more effectively without danger of corrosion if the magnets **24** and **34**, and the ball **22**, are plated with metal which constitutes a good conductor, such as silver. In the preferred construction the ball **22** is plated with silver or other material of good electrical conducting characteristics, and at least the pole faces and preferably the entire surface of the magnets **24** and **34** are similarly coated. One of the advantages of using the ball **22** as the inertia element is that the ball rolls and does not have the same area contact with the magnets **24** and **34** on subsequent closings of the switch. Thus the ball **22** provides a self-cleaning contact for the switch and the movement of the ball on the faces of the magnets tends to keep the faces of the magnets clean.

Within the broader aspects of the invention, the inertia element **22** can be made of various shapes and can be supported in different ways, and the chamber **20** can have other shapes including a shape where the magnets would pull the inertia element into a corner of the chamber.

In the construction illustrated, there is a washer **38** in the housing **16** between the end of the cup **26** and the broad shoulder at the level of the upper pole of the magnet **24**. This washer **38** has a center opening which is of substantially the same diameter as the portion of the chamber **20** in which the ball **22** is located. The diameter of the magnet **24** is somewhat larger than the center opening of the washer **38**, and thus the washer **38** provides insulation for preventing the outer edge portion of the upper pole face of the magnet **24** from contacting the metal around the shoulder of the chamber **20**.

The insulating sleeve **32** has a tapered face **40**. An end portion **42** of the housing **16** is crimped over the tapered face **40** as indicated in dotted lines in the drawing, after the insulating sleeve **32** has been inserted into the housing **16**. There is a sealing ring **43** in the housing **16** for preventing entrance of moisture into the interior of the housing.

One application of the invention to an automatic machine is illustrated diagrammatically in FIGURE 3. Work pieces **46** which are ejected from a die **48** by ejector pins **50**, are blown clear of the die by an airstream from a blast pipe **52**; and these work pieces **46** are blown against the abutment plate **10** which is supported at its upper end from a fixed support **56** constituting a part of the frame of the automatic machine. The abutment plate **10** is placed at an angle so as to deflect work pieces **46** downwardly into a tote box **60**.

The switch housing **16** is located on the back of the abutment plate, as previously explained, and the conductor **30** leads to an actuator coil **62** of a switch **64** which controls the stopping of the automatic machine. This switch **64** is connected with a controller **66** of the machine and unless the switch in the housing **16** breaks the circuit of the switch **64** once in each cycle of the machine to indicate that the work piece has been delivered from the die **48**, the control **66** stops the operation of the machine since the failure to deliver the work piece may indicate that there is a work piece stuck in the die or some other malfunction which will cause damage to the apparatus if the operation is allowed to continue.

FIGURE 4 shows a modified form of the invention in which the switch is normally open and the circuit through the switch is closed when there is impact against the plate **10**. Parts of the switch shown in FIGURE 4, which are identical with those shown in FIGURE 1, are indicated by the same reference character.

The essential difference in construction between the switch of FIGURE 4 and that of FIGURE 1 is that the FIGURE 4 construction is made with a longer housing **76** and a magnet **78** is located on the side of the inertia element or ball **22** which is nearer to the plate **10** rather than on the opposite side as in FIGURE 1. This magnet **78** of FIGURE 4 holds the ball **22** normally spaced away from a contact **80** in the lower end of a chamber **82**.

The contact **80** is carried by a conductor block **82** which connects with the conductor **30** in the same way as in the construction shown in FIGURE 1. The magnet **34** is the same as in FIGURE 1, and so is the washer **38**. The conductor block **82** takes the place of magnet **24** of FIGURE 1 so that the same cup **26** can be used for both constructions.

An impact against the plate **10** in FIGURE 4 causes the housing **76** to move and causes the inertia element or ball **22** to make the same movement since it is in contact with the magnet **78**. However, when the housing **76** has moved to the limit of travel imposed by the impact, the inertia of the ball **22** causes it to continue movement until it strikes against the contact **80**. This closes the circuit to the switch and produces the signal corresponding to the impact. Thus the switches shown in FIGURES 1 and 4 are both operated by impact but one closes a circuit in response to impact whereas the other opens a circuit.

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. An impact pick-up device for opening and closing an electric circuit to supply a signal in response to impact of an object against an abutment including in combination an abutment in position to be struck, a housing connected with the abutment and movable with the abutment in response to impact of an object against said abutment, an inertia element in the housing and movable with respect to the housing in response to said impact, first electrical contact means in a fixed position in the housing and including a magnet that gives the inertia element a bias toward a normal position in which the inertia element touches the first electric contact means to close a circuit, a support on which the inertia element rests including a conductor in an electrical circuit with the inertia element, said inertia element constituting a second contact and constituting with the first electric contact means a switch for opening and closing the electric circuit in response to impacts to product a signal in said electric circuit, and abutments confining the inertia element to a limited range of movement, the magnet constituting one of the abutments, and the inertia element contacting with the magnet at one end of the range of movement and the inertia ele-

ment being movable toward and from the magnet in the direction of the longitudinal axis of the magnet, the abutments remote from the magnet being in position to confine the inertia element to a location from which it is pulled back into contact with the magnet by the attraction of said magnet even when the housing is oriented with the inertia element below the magnet.

2. The impact pick-up described in claim 1 characterized by the inertia element being a free ferrous body in the housing.

3. The impact pick-up device described in claim 2 characterized by the magnet constituting the contact of the first electrical contact means.

4. An impact pick-up device for opening and closing an electric circuit to supply a signal in response to impact of an object against an abutment including in combination an abutment in position to be struck, a housing connected with the abutment and movable with the abutment in response to impact of an object against said abutment, an inertia element in the housing and movable with respect to the housing in response to said impact, a first electrical contact in a fixed position in the housing and toward and from which the inertia element is movable, a magnet on a different side of the inertia element from the first contact to hold its electric circuit open, abutments in the housing confining the inertia element to a limited range of movement, the magnet constituting one of the abutments and the inertia element contacting with the magnet when at one end of the range of movement of the inertia element, and said inertia element being movable toward and from the magnet in the direction of the longitudinal axis of the magnet, and the abutments in the housing most remote from the magnet being in position to confine the inertia element within a pulling range of the magnet so that the magnet pulls the inertia element away from the first contact whenever the pick-up device is stationary and even when the pick-up device is oriented with the inertia element below the magnet, a conductor with which the inertia element is in contact both when touching and when away from the first electrical contact, the inertia element constituting a second electrical contact for making and breaking the electric circuit between said conductor and first electrical contact.

5. An impact pick-up device for opening and closing an electric circuit to supply a signal in response to impact of an object against an abutment including in combination an abutment in position to be struck, a housing connected with the abutment and movable with the abutment in response to impact of an object against said abutment, an inertia element in the housing and movable with respect to the housing in response to said impact, a first electrical contact in a fixed position in the housing, the inertia element having a bias urging it into a normal position with respect to the first electrical contact, a conductor in an electrical circuit with the inertia element, said inertia element constituting a second contact and constituting with the first contact a switch for opening and closing the electric circuit in response to impacts to produce a signal in said electric circuit the inertia element being a ball and the conductor in an electric circuit with the inertia element being a second magnet that attracts the ball, the magnets being located close together with their pole faces in differing planes where the ball can contact with both magnets at the same time.

6. The impact pick-up device described in claim 5 characterized by one of the magnets being insulated from the housing and connected with the external circuit, the other magnet being in electrical contact with the housing, and constituting said first contact and the housing being made of electrical conducting material and constituting part of the electric circuit.

7. The impact pick-up device described in claim 6 characterized by the abutment being a plate of stiffly flexible material that flexes within its elastic limit in response to impact of an object, the housing having a chamber therein open at one end of the housing, the chamber being cylindrical with a diameter greater than the diameter of the ball and the longitudinal axis of the cylinder extending toward the open end of the cylinder, fastening means connecting the housing at the open end of the chamber to the back of the plate and closing said open end of the chamber, the first magnet being imbedded in the end of the housing opposite the open end of the chamber with one pole of the magnet constituting a part of the end of the housing, electrical insulation spacing the first magnet from contact with the rest of the housing, the first magnet having the outer limits of its pole face spaced from said walls of the cylindrical chamber by a distance less than the radius of the ball, an electrical conductor leading from the first magnet to the external circuit, the second magnet being embedded in a curved side wall of the chamber and having at least a portion of its pole face spaced above the level of the pole face of the first magnet by a distance less than the radius of the ball so that the ball touches the pole faces of both magnets at the same time, an electrically conductive plating on the surface of the ball and on the pole faces of both of the magnets.

8. The impact pick-up device described in claim 2 characterized by the abutment plate being in position to be struck by work pieces discharged from an automatic machine, a switch for controlling the operation of the machine, an actuator for the switch, the electrical circuit being connected at one side with the switch actuator and on the other side being grounded on a frame of the automatic machine.

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