ABSTRACT: Pairs of conductor strips are positioned adjacent a moving conveyor belt for carrying materials. The flexible conductor strips of each pair are spaced to form a plurality of normally open switches in an electric circuit adapted to produce an electric signal. The strips are adjustably positioned for engagement by a protrusion in the conveyor belt whereby one of the flexible conductors of a pair is deflected into engagement with the other to close the electric circuit and produce the electric signal.
BELT FAULT DETECTION DEVICE

BACKGROUND OF INVENTION

This invention relates to a detector in a material-handling system and, more particularly, a belt failure detection device in a material-handling system using conveyor belts.

In a conventional material-handling system using conveyor belts in combination with a series of impact rollers, a worn, ripped or torn belt is a major problem. Early detection of a worn belt may prevent a tear in the belt, and early detection of a torn belt will prevent further tearing and will also avoid problems created by the product falling from the belt after it is torn. In installations where the conveyor may extend over a large area, quick and convenient determination of the exact location of the fault may be as important as detecting the fault itself.

SUMMARY OF INVENTION

A primary object of this invention is to provide an improved belt failure detection device particularly designed for use in a material-handling system and which can be economically produced and installed and yet be completely reliable in the detection and location of such belt failure.

The device proposed by this invention comprises two flexible conductor strips mounted adjacent a movable conveyor belt. The conductor strips form a normally open switch and are connected in an electric circuit having apparatus for producing a signal. The strips are arranged sufficiently close to the underside of the belt such that they are cleared under normal operating conditions but will be engaged by a protrusion resulting from a belt failure. Such engagement produces engagement of the switch with each other thereby closing the electric circuit and producing an electric signal. While this invention is discussed in terms of a conveyor belt it is appreciated that it could be used with other types of material conveying apparatus.

The electrically operated signal devices may be placed at convenient locations adjacent to or remote from the conveyor and will give a warning of a worn or torn conveyor belt without necessitating the presence of an operator at any particular location. Any number of signal devices may be used and it will be appreciated that the contact closure could also turn off the conveyor. In addition, a number of sets of strips could be arranged along the belt and in series circuit relation such that it would be necessary for a fault to close two or more sets in order to activate the alarm. This would prevent a purely transitory condition activating the alarm.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a conveyor belt system embodying the belt fault detection device of this invention; FIG. 2 is an elevation view taken generally along line 2-2 in FIG. 1 showing several of the conductor strips arranged along the width of a conveyor belt; FIG. 3 is a sectional view of the detection device proposed by this invention taken generally along line 3-3 in FIG. 2 and illustrating the condition immediately before a fault is detected; FIG. 4 is a partial view of one of the conductor strips; and FIG. 5 is a sectional view of the detection device similar to FIG. 3 but after a fault has been detected.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, FIG. 1 shows a part of a conventional material-handling system 10 using a conveyor belt 12 to carry a load on material 14. The belt is used in combination with a series of supporting impact rollers 20 fixed to frames 22 or any other convenient structure. Only a portion of the material-handling system 10 has been illustrated as the remainder of the same can be conventional and is not necessary to a thorough understanding of this invention.

FIGS. 1 and 2 show a detection device 24 connected in an electric circuit 26. The circuit can be connected to a convenient power source 25 and includes electric signal devices such as light 28 and/or bell 30.

The detection device 24 includes a plurality of pairs of conductor strips 34 and 36. Strips 34 are all connected on the common side of insulating support member 32 and strips 36 are all connected on the opposite side of support member 32. All of strips 34 are electrically common with each other as are strips 36. This can be accomplished by providing conductor plates 50 and 52 shown in FIGS. 3 and 5. Since each pair of conductor strips 34 and 36 are similar in construction and operation only one such pair will be described.

Flexible conductor strips 34 and 36 are laterally spaced in the direction of movement of belt 12. FIGS. 3 and 5 show belt 12 as having a material-handling surface 16 and an opposite surface 18 with load 14 carried on surface 16. Conductor strips 34 and 36 extend from support 32 to a point adjacent to face 18. More particularly, the strips are disposed immediately beneath surface 16 such that there is no engagement of conductor strips 34 and 36 with belt 12 so long as the belt is free of faults.

Preferably, conductor strips 34 and 36 are adjustable in order to provide enough spacing between the strip ends 35 and the conveyor belt 12 to accommodate the particular load being carried, it being recognized that different loads will cause different belt deflections during a normal operation. With particular reference to FIG. 4, this is accomplished by providing slots 38 in each of conductor strips 34 and 36 permitting the height of the conductor strips to be altered with respect to the belt. In the particular embodiment shown, the conductor strips are affixed to the insulated support member 32 by a bolt 40 and a nut 42 both made of a nonconductive material. It will be appreciated that this connection could be accomplished by several convenient alternatives.

FIG. 3 shows the detection device immediately prior to coming into contact with protrusion 44 while FIG. 5 shows the device after having come into contact with protrusion 44. This protrusion is indicative of a belt weakness which may ultimately result in a tear in the belt or it can actually be a tear. Preferably the front conductor strip 34 (front in the sense of the direction of movement of the conveyor belt as depicted by arrow 46) is comprised of a type of steel having a low modulus of elasticity so that it will bend upon deflection and take a set as shown in FIG. 5. The rear conductor strip 36 on the other hand is desirably made of a spring steel which will return to its normal shape after deflection. The lateral spacing of conductor strips 34 and 36, represented by the width of support member 32, can be preset depending upon various design criteria. For example, as the strips are moved closer together the detector will respond to smaller faults. As illustrated, support 32 is made in two sections, the spacing can be reduced by eliminating one or increased by the addition of one or more sections.

When a fault occurs such as a belt weakness as indicated in FIGS. 3 and 5, the load 14 causes a protrusion 44. It will be appreciated that an actual tear may cause a protrusion with or without a load. Upon passing over detection device 24, protrusion 44 will deflect front conductor strip 34 moving it into contact with back conductor strip 36. This will complete electric circuit 26 as shown in FIG. 1. As conductor strips 34 and 36 comprise, in effect, a switch. Upon completion of electric circuit 26 signal devices 28 and 30 will be activated, these can be activated simultaneously as shown or selectively by manipulating switches 31 and 33.

Bell 30 will give an audible signal. Light 28 can be located on a remote panel. In either case they provide a positive signal indicating the need for belt inspection. It is also contemplated that the electric circuit could be arranged to operate a relay 35 when the switch provided by conductor strips 34 and 36 are closed. In this latter case, it is desirable to locate light 28 in the vicinity of the detector to aid the operator in locating the area of the belt having the fault. Again, a switch 37 provides for selecting
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operation of relay 35. Upon repair of the system, front conductor strip 34 is then reset to its normal sensing position as shown in FIG. 3.

It will be appreciated that front conductor strip 34, instead of comprising a type of steel that will bend and take a set, could comprise the same spring steel as conductor strip 36 so that the conductor strips form a momentary switch. In this case a holding relay 48 is included in electric circuit 26, simply upon conductor strips 34 and 36 coming into contact, the relay activates the electric signal or signals and relay 35, whereupon the passage of protrusion 44 allows conductor strips 34 and 36 to return to their normal detecting position as shown in FIG. 3 thereby negating the need to reset strip 34.

As alluded to briefly above, detecting device 24 can include a number of pairs of conductor strips adjacent each other and spaced along the entire width of conveyor belt 12 thereby increasing the preciseness of detection as shown in FIG. 2. Likewise, a number of detecting devices 24 could be wired in series so that one or more set of conductor strips have to be closed to activate the relay circuit. In other words, two or more sets of sensors could be located at various points along the conveyor belt so that it would be necessary for the protrusion 44 to close several pairs of sensing contacts for the circuit to be activated. It is also contemplated that where multiple detecting devices are used, they can be connected in parallel or independently of each other with at least a circuit including a relay 35 and light 28 so that activation of any one detecting device will produce the necessary signal. It is also suggested that the detection device, or devices, be positioned near an impact roller assembly 20 so that the belt height (outline) will be more constant.

It will be appreciated that the structure incorporating this invention affords a wide range of sizes using the same basic elements. With this invention a simple, inexpensively produced detection device is provided which utilized a minimum of component parts and yet is highly effective in detecting any protrusion in a conveyor belt caused by a tear, rip or weakening thereof.

I claim:
1. In combination a movable member for handling materials having oppositely facing first and second surfaces, said first surface carrying a material; electrical circuit means; signal means connected in said circuit means to be activated when said electrical circuit is completed; and detecting means connected in said electrical circuit means and operative to detect protrusions in said second surface indicating a defect in said movable member, said detecting means comprising first conductor means spaced apart to normally maintain said electrical circuit open, said first conductor member constructed from a material having a low modulus of elasticity and arranged so as to remain in a deflected position after the application of a deflecting force thereto, support means holding said conductor members adjacent said second surface for engagement by a protrusion in said second surface as said movable member passes said conductor members to that protrusion deflects said first conductor member into contact with said second conductor member thereby activating said signal means through said first and second members, said first conductor member remaining in a deflected position after said protrusion passes said conductor members.
2. The combination according to claim 1 wherein said first conductor member according to claim 1 wherein said first conductor member is arranged in front of said second conductor member with respect to the direction of movement of said movable member.
3. The combination according to claim 2 wherein said conductor members extend from said support means towards said second surface and the extended ends of both first and second conductor members are engaged by said protrusion.
4. The combination according to claim 3 including means for adjusting the position of said conductor members relative to said second surface.
5. The combination according to claim 4 wherein said second conductor member is resilient.
6. The combination according to claim 5 including a plurality of said detecting means spaced along said width of said movable member and connected in said electrical circuit means so that the engagement of said first and second conductor members of any one of said detecting means activates said signal means.
7. The combination according to claim 5 including at least two of said detecting means spaced and substantially aligned along an axis parallel to the direction of travel of said movable member and connected in said electrical circuit means so that said first and second conductor members of more than one of said detecting means so aligned must be engaged before said signal means is activated.
8. The combination according to claim 6 wherein said movable member is a conveyor belt supported on a plurality of rollers and said detecting means is located in the vicinity of at least one of said rollers.
9. The combination according to claim 7 wherein said movable member is a conveyor belt supported on a plurality of rollers and said detecting means is located in the vicinity of at least one of said rollers.
10. In combination a movable member for handling materials, and electrical means for responding to abnormal protrusions from said movable member, said electrical means including detecting means and said detecting means comprising a first conductor member constructed from a material having a low modulus of elasticity, a second conductor member, and means supporting said first conductor member in the vicinity of said movable member for engagement by said abnormal protrusions, said support means also supporting said first conductor member in a normal position relative to said second conductor member and so that engagement of said first conductor member by said abnormal protrusion deflects and moves said first conductor member relative to said second conductor member to change the electrical state of said electrical means and thereby indicate the presence of said abnormal protrusion, said first conductor member remaining in a deflected position after engagement by said abnormal protrusion.