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OPERATOR SAFETY DEVICE FOR ROTATING MACHINERY PARTS

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Fig. 1.

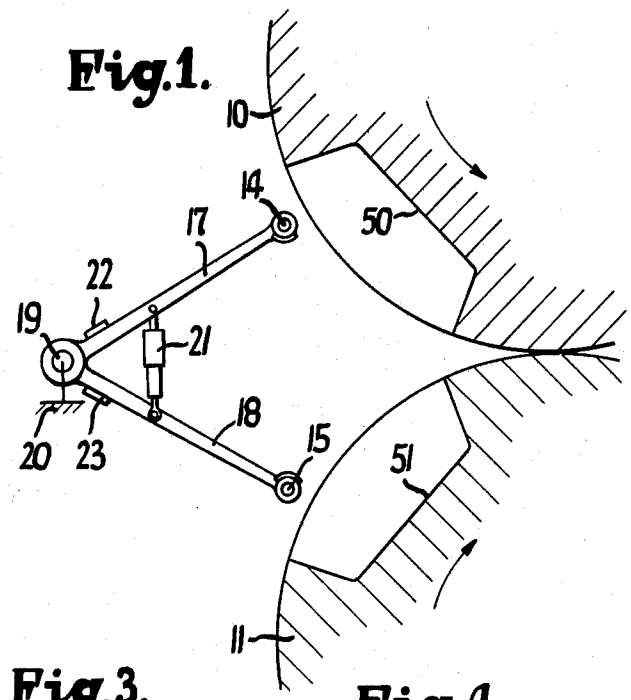


Fig. 2.

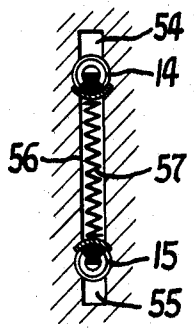


Fig. 3.

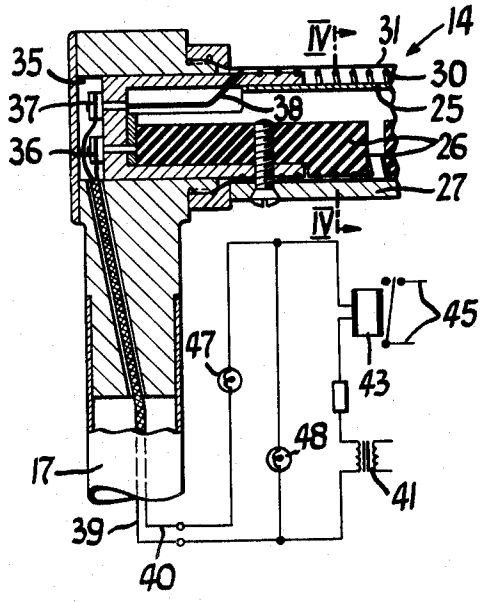
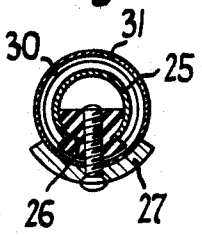


Fig. 4.



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OPERATOR SAFETY DEVICE FOR ROTATING MACHINERY PARTS

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4 Claims. (Cl. 200—52)

This invention relates to safety devices and emergency cut-offs for preventing accidentally catching or crushing the fingers or hands or clothing of an operator in rotating machinery parts, and more particularly, to highly responsive and virtually touch-sensitive cut-off devices for stopping the machinery if the operator's fingers or hands are inserted into a position where they might get caught by rotating members such as the nip between two mating counter-rotating rolls of printing presses, calenders, and like machinery.

Many types of heavy machinery include rotating members of large mass, such as two counter-rotating rolls or one such roll engaging or closely approaching a stationary member, forming nips in which the operator's fingers or hands or clothing may become accidentally caught or engaged with resultant serious injury to the operator or death. As will be understood, this situation may be particularly dangerous with the rotating rolls of rotary printing presses, calendering machines, paper machinery, and the like, where a web or sheet of paper or other material is being fed around or between the rolls and/or where manual adjustment or initial threading of material between the rolls may be necessary or attempted by the operator and where, because of the very design and use of the machine, permanent fences or like stationary obstructions are undesired or impracticable.

If it is attempted to provide a safety cut-off device, such as a bar across the danger zone and connected to a cut-off switch so that movement of the bar actuates the switch, difficulty may be experienced in providing a device of desired sensitivity or effectiveness. Thus, considering particularly printing presses or similar machinery of very substantial width, if such a switch-activating protective bar extends clear across the machine, it may not provide the desired sensitivity and uniformity of response if made of very light materials; whereas if constructed in a heavier manner, the weight or masses involved may make movement of the bar so difficult or troublesome that the operator will actually attempt to avoid the safety device installed for his own safety.

Similarly, with any such protective mechanism which must be moved by the operator in order to activate mechanically a remote cut-off switch, there is a virtually inevitable time delay between touching the bar and activating the cut-off switch, which delay may be sufficient to produce an accident with the operator's fingers, particularly where the rotating rolls or other members are sufficiently large to have substantial momentum to continue turning after the cut-off switch is activated. If any such safety device requires manually resetting the switch or replacing the activating bar into protecting position, such resetting or replacing operation may itself provide an additional hazard to the operator, and necessarily interjects discontinuity into the protection offered. This latter difficulty may also be aggravated if the protective device is of such size or positioning as to interfere with access to the danger area, as may be necessary from time to time for inspection or adjustment, without deactivating the protective device or removing it from a protecting position.

According to this invention, however, there is provided a safety device or emergency cut-off for mounting in such

danger zones as the entrance nip between two counter-rotating rollers and including relatively rigid members extending entirely across the danger zone and forming substantially along the entire length thereof highly responsive or touch-sensitive switch contact means for substantially instantaneously stopping the machinery if the safety device is touched at any point along its length across the machinery, so as to operate substantially without a time delay. As further features of the invention, such switch devices or touch-responsive safety members are mounted with respect to the rolls or nip or machine parts they are to protect at a position where the cut-off mechanism will be activated by the touch of an object at a point so that even the inertia or momentum-induced motion of the machine will have stopped before on object such as the operator's fingers will have moved from a position activating the cut-off device to a position where damage or injury may result; and, further, the cut-off switch members are, preferably, resiliently and movably mounted within the danger zone in a manner so that the cut-off switch will be actuated by a force less than the force necessary to move the resiliently mounted members through the danger zone or out of protective position should such movement be necessary for safety or inspection or adjustment, and provide for continuous uninterrupted protection at all times.

With the foregoing and other objects in view, this invention will now be more particularly described, and other objects and advantages thereof will be apparent from the following description, the accompanying drawing, and the appended claims.

In the drawing:

FIG. 1 is a partial vertical section through two counter-rotating and mating rolls of a rotary printing press having applied thereto a safety device embodying and for practicing this invention;

FIG. 2 is a detail view partly in section showing an embodiment of a resilient mounting for a safety device in accordance herewith and different from the mounting indicated in FIG. 1;

FIG. 3 is a partial axial section through a portion of a safety device embodying this invention and at one extreme end thereof and indicating a diagram of an emergency cut-off control circuit in accordance herewith;

FIG. 4 is a section along the line IV—IV of FIG. 3.

Referring to the drawing, in which like characters of reference refer to like parts throughout the several views thereof, a safety device in accordance herewith is shown as applied to the nip between two counter-rotating rolls of a rotary printing press, although, as will be understood, such application to a printing press is purely illustrative, and this invention is adapted for use with a variety of other machinery having counter-rotating rolls or other parts or a nip-like danger zone between a rotating member and a stationary member. Thus, two counter-rotating rolls **10** and **11** are indicated in FIG. 1 in a manner to form a danger zone in the entrance nip therebetween in which an operator might accidentally catch his finger or clothing, and particularly in instances where it was necessary for him to inspect or adjust either the mating engagement of rolls **10** and **11** or the threading or passing of a web of paper or other material (not shown) therearound or therebetween.

Two switch bars **14** and **15** are shown, each extending substantially across the entire width of the printing press (i.e., along substantially the entire length of rolls **10** and **11**). Switch bars **14** and **15** are shown as carried by swingable arms **17** and **18**, respectively, which are, in turn, pivotally mounted at **19** on a portion of the printing press frame **20**, so that arms **17** and **18** are pivotally movable about **19** toward and away from each other. A compres-

sion spring arrangement is indicated at **21** for resiliently urging arms **17** and **18** apart into the position shown in FIG. 1, where further movement is arrested as by stops **22** and **23** mounted, in known manner, on main frame **20**. As will be understood, the arms **17** and **18** as shown in FIG. 1 are mounted at the side of the printing press furthest from the viewer of the drawing and adjacent the far end of rolls **10** and **11**, whereas a similar structure of arms **17** and **18**, etc., is duplicated at the opposite side of the printing press for supporting opposite ends of switch bars **14** and **15**, which, as noted above, extend across substantially the entire width of the printing press and/or along substantially the entire length of the danger zone between rolls **10** and **11**.

The actual construction of bars **14** and **15** and the mounting thereof on arms **17** and **18** are indicated in more detail with reference to FIGS. 3 and 4, which indicate details of the internal construction of switch bar **14** and arm **17**, as typical and substantial duplicates of switch bar **15** and arm **18**, as will be understood. Thus, switch bar **14** includes a metal tube **25**, mounted as indicated in FIG. 4 on a member **26** of electrical insulating material, which is, in turn, carried by a rigid supporting rail **27**. Around and outside of tube **25** is provided a helically wound and uninsulated wire coil **30**, having an internal diameter somewhat larger than the outside diameter of tube **25** and spaced therefrom, as indicated in FIGS. 3 and 4, by the configuration of insulating member **26**. A flexible but electrically insulating outer covering or sleeve **31** encloses helical coil **30** and forms the outer surface of switch bar **14**.

As indicated in FIG. 3, a socket **35** is provided at one end of arm **17** for receiving the end of the switch bar **14** assembly, with the end of metal tube **25** extending into socket **35** and contacting an electrical terminal **36**. Another terminal **37** is connected, as by wire **38**, to helical coil **30**. Wires, indicated as at **39** and **40**, are connected, respectively, to terminals **37** and **36**, and lead through arm **17** to a low voltage control circuit diagrammed in FIG. 3.

Thus, as will be apparent from the foregoing, touching outer covering **31** of switch bar **14** at virtually any point along the length thereof depresses helical coil **30** against metal tube **25**, thereby establishing electrical connection therebetween and, hence, electrically connecting wires **39** and **40**. Such connection activates the low voltage control circuit, supplied as by a transformer indicated at **41**. Thus, closing the electrical contact between coil **30** and tube **25**, as by touching switch bar **14**, activates the control circuit and causes relay **43** to open or disconnect the main power circuit, indicated at **45**, to shut off the main power line and stop the printing press or other machine in known manner. Preferably, the control circuit includes an audible alarm indicated at **47** and a visible signal such as lamp **48** to indicate why the machine has stopped and, if desired, which one of a plurality of safety or protective devices caused the stoppage.

As will be understood from the foregoing, switch bar members **14** and **15** can thus be provided with as suitably heavy construction as may be necessary to maintain them properly and rigidly positioned across the machine no matter whether it is a very wide or narrow machine, and the switch bars are further rigidified by supporting rails **27**, yet all without sacrificing the desired responsiveness or sensitivity of the device. That is, it is not necessary in accordance with this invention for the protective or safety device itself to be moved in order to actuate the cut-off circuit, since merely a touch sufficient to depress helical coil **30** to touch metal tube **25** is enough to actuate the control circuit and stop the entire machine. Since outer sleeve **31** serves merely as a covering for the low voltage helical coil **30**, it and the coil can be satisfactorily provided with such flexibility as to form a virtually touch-sensitive switch mechanism. As will be understood, it is preferred that relay **43** be of the well known type which

will remain open once the low voltage control circuit has been even momentarily actauted, and that a reset mechanism is provided, in known manner, for again closing relay **43** and starting the machine at a point remote from the danger zone to provide continuous protection from switch bars **14** and **15** at all times when the machinery is running or capable of being started.

Particularly where one or both of rolls **10** and **11** may have recesses such as indicated at **50** and **51** (as is frequently the case with printing press rolls having plate clamping and other adjusting mechanism in recesses in the surface thereof), some extra danger may occur if the power is shut off with the rolls in the particular position indicated in FIG. 1, in that the continued movement of the rolls through momentum might pinch or catch the operator's fingers between the edge of recess **50** or **51** and switch bars **14** and **15**, at least temporarily until the rolls actually come to a stop.

To avoid this situation and as an extra assurance of protection in accordance herewith, switch bars **14** and **15** are mounted, as above noted, on swingable arms **17** and **18**, which are normally maintained in the position shown in FIG. 1 by the action of compression spring **21**, the force of which can be readily overcome without danger to the operator. Thus, if the operator accidentally puts his fingers on switch bar **14**, the power would be shut off. If roll **10** continued to rotate under momentum, however, pinching of the operator's fingers between the edge of recess **50** and switch bar **14** is avoided by being able to depress arm **17** sufficiently for the operator to withdraw his fingers, it being understood that the roll **10** is slowing down or stopping at that time, since any force on switch bar **14** sufficient to move arm **17** would also be more than enough to actuate the switch mechanism and stop the machine.

A further embodiment of construction for mounting switch bars **14** and **15** and to provide the additional assurance just mentioned is indicated in FIG. 2 as including slide blocks **54** and **55** carrying opposite ends of switch bars **14** and **15** and mounted for vertical sliding movement in a guide race **56** with compression spring **57** resiliently urging apart blocks **54** and **55** and switch bars **14** and **15** carried thereby to the position shown in FIG. 2 and for accomplishing substantially the same functioning and advantages as described with regard to the pivoted swinging arms **17** and **18**.

As will be understood by those skilled in this art, resilient hydraulic or pneumatic means may readily and satisfactorily be used instead of compression spring **57** or **21** for urging switch bars **14** and **15** into the normally protecting positions shown, provided that the outward urging of such means can only be overcome by a force greater than the force necessary to close the switching contacts of switch bars **14** and **15** so that the switch bars cannot be moved out of protecting position in the danger zone, intentionally or otherwise, without actuating the safety cut-off mechanism and stopping the machine.

Similarly, instead of the low voltage control circuit illustrated in FIG. 3, the safety device in accordance herewith may be satisfactorily connected, as will be understood and arranged as a short circuit switch in the main drive motor circuit so that contact between helical coil **30** and metal tube **25** directly shorts out the main drive motor. Furthermore, the flexible covering sleeve **31** around helical coil **30** may be filled, as well understood, with insulating oil or similar fluid to avoid sparking upon making or breaking electrical contact between any portion of helical coil **30** and metal tube **25**. Also, the ultimate sensitivity of switch bars **14** and **15** to the force necessary to depress helical coil **30** against metal tube **25** is readily varied, not only by selecting the degree of flexibility or rigidity of covering sleeve **31** and helical coil **30**, but also by filling the space within covering sleeve **31** with an inert or sufficiently dielectric gas under pressure.

Similarly, satisfactory results are also achieved in accordance herewith by utilizing a metallic or conductive mesh or fabric in switch bars **14** or **15** instead of the helically coiled wire **30** and depending upon such well understood considerations as the size and responsiveness and sensitivity desired, and other similar considerations. As also will be apparent from the foregoing, whether one or two or more switch bars such as **14** are provided in any particular installation and in accordance herewith will be in large measure controlled by the danger zone to be protected and the type and frequency of necessary access thereto, etc.

Accordingly, there is provided in accordance herewith a relatively small and light weight safety device of simple construction and installation for protecting operators of machinery from accidental injury, and yet without obstructing or obscuring unnecessarily the protected area from intended observation or adjustment. Additionally, such devices in accordance herewith may be provided with virtually touch-sensitive responsiveness, and without heavy construction or large masses which must be moved to operate the safety device. Emergency cut-off is provided with such devices substantially instantaneously and without time delay incident to mechanically operated or lever-type switches, and there is no necessity for repositioning or resetting the emergency device after use or for intentionally moving the device out of protecting position to accomplish some necessary adjustment or observation of the machine while running, all of which provide in accordance herewith an absolute and unavoidable continuity of protection at all times when the machine is either running or capable of being started or restarted, yet the devices embodying and for practicing this invention are of relatively simple mechanical and electrical construction and can be readily applied to or incorporated in new or existing machinery with mechanical and electrical simplicity.

While the apparatus and devices herein described constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to these precise apparatus and devices and that changes may be made therein without departing from the scope of this invention, which is defined in the appended claims.

What is claimed is:

1. In a safety emergency cut-off device for installation in machines having moving parts causing a danger zone in which injury may result to an operator if his hand is inserted while the machine is running, the combination which comprises a switch bar extending through said danger zone adjacent said moving parts, a rigid electrical contact member extending substantially throughout the length of said switch bar, a flexible and depressable electrical contact member extending along said rigid contact member and normally spaced therefrom such that depressing said flexible contact member against said rigid contact member at substantially any point therealong closes an electrical switch contact in said bar, an electrical control circuit connected to said switch contact for cutting off driving power to said moving parts, means for mounting said switch bar and said rigid and flexible contact member with respect to said danger zone and said moving parts so as to require touching and depressing said flexible contact against said rigid contact by an operator before injury results from said moving parts, and said mounting means including movable members providing movement of said switch bar into and out of protecting position and resilient means urging said switch bar into protecting position by a force which cannot be overcome by an opposite force less than that necessary to depress said flexible contact member against said rigid contact member closing said switch contact for cutting off said driving power to said moving parts.

2. A safety device as recited in claim **1** in which said movable members in said mounting means are pivoted arms providing arcuate movement of said switch bar through said danger zone.

3. A safety device as recited in claim **1** in which said movable members in said mounting means are elements at opposite ends of said switch bar, and which also includes stationary mounting members adjacent each end of said switch bar, and elongated slots in said stationary members for engaging and slidably carrying said elements for movement of said switch bar into and out of protecting position.

4. A safety device as described in claim **1** which includes a flexible insulating covering for said rigid and flexible contact members, and fluid means disposed within said flexible insulating covering and around said rigid and flexible contact members for pressure adjusting and controlling the force necessary to depress said flexible contact against said rigid contact, and for insulating said contact members for preventing sparking therebetween.

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