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G. COZZO

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SAFETY DEVICE FOR ROLLER LEVELERS

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Fig. 1

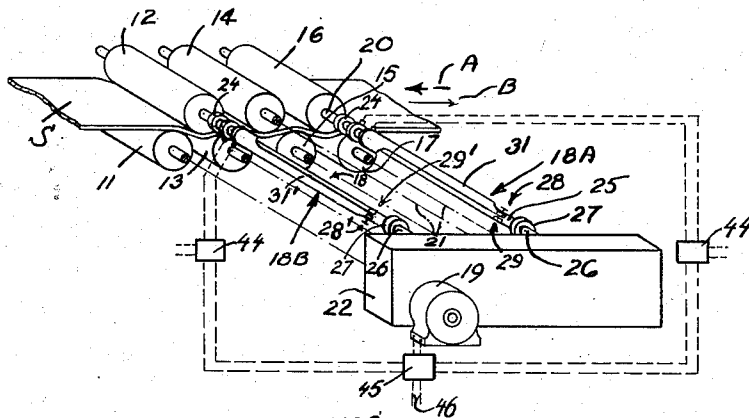


Fig. 2

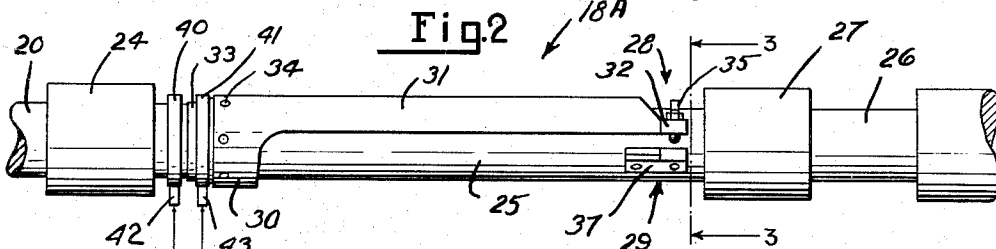
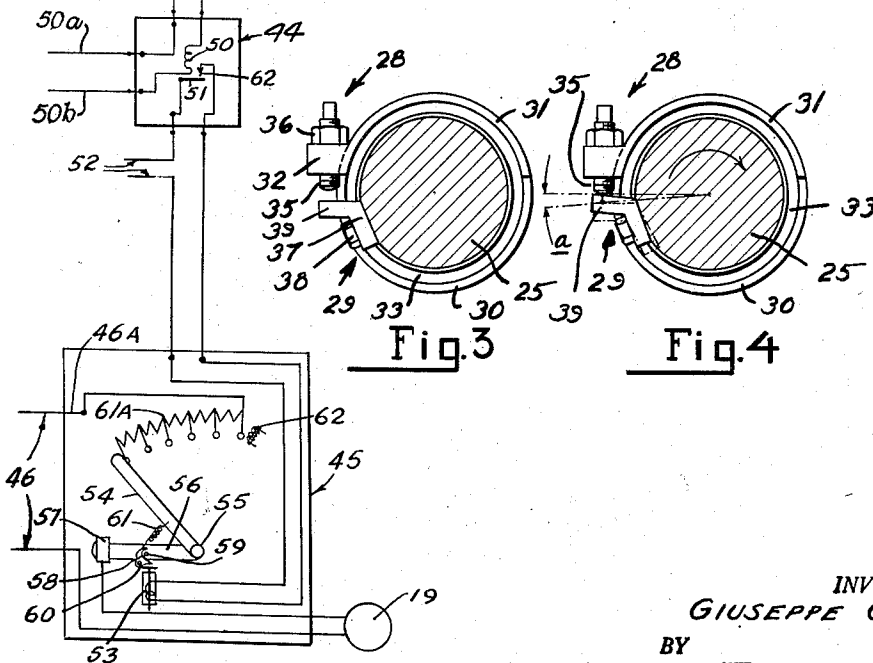


Fig. 3

Fig. 4



INVENTOR.
GIUSEPPE COZZO

BY

Pollard and Johnston

ATTORNEYS

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SAFETY DEVICE FOR ROLLER LEVELERS

Giuseppe Cozzo, Yonkers, N. Y., assignor to Hydropress, Incorporated, New York, N. Y., a corporation of Delaware

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The present invention relates generally to roller levelers, and is particularly directed to safety devices for preventing overloading of such machines.

In manufacturing metal sheets and strips of relatively wide and thin material, it is customary to straighten the sheets or strips by passing them through a machine, known as a roller leveler, which comprises a large number of upper and lower working rolls for imparting a series of bends to the material. So long as the sheets or strips to be straightened are of uniform thickness and pass through the roller leveler without incident, the spacing or clearance between the upper and lower rolls may be adjusted to accommodate the sheets or strips and no overload conditions need be encountered. However, in manufacturing metal sheets and strips, variations in the thickness thereof are unavoidable so that, from time to time, a sheet or strip portion of excessive thickness may be passed between the rolls of the roller leveler thereby causing excessive strains on the leveler structure and overloading the motor driving the rolls. Similar overloading of the roller leveler may result from the passage through the latter of a sheet or strip portion which is folded over or which jams between the working rolls for any reason whatsoever.

Accordingly, an object of the present invention is to provide a safety device in association with a roller leveler for halting the operation of the latter whenever an overload condition is encountered.

Another object is to provide a safety device associated with a roller leveler having working rolls driven, through intermediate drive shaft means, by an electric motor or other similar source of motive power, wherein safety device means, associated with one or more drive shafts of the drive shaft means, respond to the torsional load on its drive shaft to halt the motor, and thereby stop the rolls when the torsional load exceeds a predetermined safe value.

A further object is to provide a safety device associated with a roller leveler having working rolls driven, through intermediate drive shaft means, by an electric motor or other similar source of motive power, wherein the safety device responds to excessive torsional deflection of a drive shaft of the drive shaft means caused by torsional overloading of the shaft to automatically halt the motor and thereby stop rotation of the working rolls.

A still further object of the present invention is to provide a safety device of the described character which is simple in its operation and construction and is adapted to be associated with existing roller levelers or similar machines without requiring any substantial revision or alteration thereof.

In accordance with the present invention, the above and other objects, features and advantages appearing in the following detailed description are obtained by providing a safety device including two mutually engageable contacts fixed to the drive shaft of the roller leveler at axially spaced apart locations of the shaft and arranged to contact each other when the portion of the shaft between the axially spaced apart locations undergoes a predetermined torsional deflection corresponding to an overload condition in the roller leveler. The two contacts on the drive shaft are interposed in a suitable control circuit which is operative to halt the motor coupled to the drive shaft when the contacts engage each other.

In one aspect of the invention a safety device can be connected with the second roller contacting the sheet after the sheet enters the roller leveler. When the roller

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leveler is reversible, a safety device appropriately constructed can be connected in the drive to the second roller contacting the sheet when the machine is reversed.

An illustrative embodiment of the present invention will now be described in connection with the accompanying drawing forming a part hereof, and wherein:

Fig. 1 is a diagrammatic perspective view of a safety device embodying the present invention and shown in association with a roller leveler;

Fig. 2 is a side elevational view of the safety device of Fig. 1 with the electrical connections and equipment for controlling the operation of the roller leveler motor being shown diagrammatically;

Fig. 3 is a transverse sectional view taken along line 3—3 of Fig. 2 and showing the disposition of parts of the safety device during normal operation; and

Fig. 4 is a view similar to Fig. 3, but showing the disposition of parts of the safety device when the associated roller leveler has been overloaded.

Referring to the drawing in detail, and initially to Fig. 1 thereof, a series of working rolls 11, 12, 13, 14, 15, 16 and 17 form parts of a roller leveler of conventional construction, illustration of the remainder of the conventional leveler being avoided for the purpose of clarity.

Various numbers of upper and lower rolls can be used. The successive upper and lower working rolls 11 to 17, inclusive, are arranged so that a sheet or strip S of relatively thin metal or other material, when passed between the rolls in the direction of the arrow A in Fig. 1, has a series of alternately oppositely directed bends imparted thereto so that the sheet or strip is straightened in a well known manner upon emergence from the roller leveler. In order to effect movement of the sheet or strip S through the working rolls, the upper rolls and lower rolls are rotated in opposite directions through a gear box assembly generally indicated by the numeral 22, and shafts schematically indicated by dot-dash lines 21. The gear assembly is driven by an electric motor 19 or any other suitable source of motive power.

The second roll in contact with the sheet after it enters the leveler is the roll which may be overloaded due to the conditions mentioned previously so that a safety device is needed in its drive.

In the illustrated embodiment, the shaft of upper roll 16 has a safety device 18A therein, this roll being the second roll contacted by the sheet when the sheet is moving in the direction indicated by the arrow A. When the sheet is moving in the direction shown by the arrow B, roll 12 is the second roll contacted so that a safety device indicated generally by 18B is located in its drive shaft. The safety device 18A is specifically shown in Figs. 2, 3 and 4 and will be described hereinafter, safety device 18B being the reverse of device 18A. Shaft 20 of roll 16 is coupled, preferably by a conventional universal joint 24, to one end of a metal shaft section 25 which forms a part of the assembly 18A and is connected at its other end to the shaft 26 of gear box 22 by a suitable coupling 27. Operation of the motor 19 effects rotation of the roll 16 through the connected shafts 26, 25 and 20. Upper rolls 12 and 16 are rotated in a direction corresponding to movement of the sheet S, such being in one direction when the sheet is moving as indicated by the arrow A and in the opposite direction when the sheet moves as indicated by the arrow B. Other arrangements of drive can be used and safety devices employed and located as required by the particular arrangement of rolls involved. For example, there may be two more rolls on the upper level making five rolls on top and four rolls on the bottom. In such a case, the second roll to be contacted will be the roll at either end of the bottom group of rolls according to the direction of movement of the sheet. The safety devices then would be located in the drives of said lower end rolls.

So long as the sheet or strip S is of uniform thickness, the spacing or clearance between the upper rolls 12, 14 and 16 and the corresponding lower rolls 11, 13, 15 and 17 may be adjusted to accommodate such thickness so that the sheet or strip may pass between the rolls and be straightened without overloading or excessively straining the structure of the roller leveler or the driving motor. However, when the thickness of the sheet or strip is non-

uniform and excessive in certain places, a condition that cannot always be avoided in its manufacture, so that the sheet or strip jams between the rolls, or when such jamming occurs for any other reason, for example, because the sheet or strip is folded over, the structure of the leveler and the driving motor will be overloaded and damage to the machine will result unless its operation is immediately halted.

In order to effect the automatic cessation of operation of the roller leveler when an overload condition is encountered, the present invention provides a safety device in association with the shaft section 25 and sensitive to excessive torsional deflection of the latter caused by torsional overloading of the shaft to operate a control circuit for interrupting or reversing the supply of electric current to the motor 19. The illustrated safety device embodying the present invention includes two confronting and normally spaced apart contacts, generally indicated by the numerals 28 and 29 (Fig. 2), which are fixed to shaft section 25 as axially spaced apart locations on the latter so that the contacts are brought together when the portion of shaft section 25 between these axially spaced locations is torsionally deflected through a predetermined angle α (Fig. 4).

As seen in Figs. 2, 3 and 4, contact 28 is mounted on a support assembly which includes a cylindrical collar 30 having a greater inner diameter than the diameter of shaft section 25 and an axially extending support member 31, preferably of semi-cylindrical configuration, formed integrally with collar 30 and having a lug 32 projecting radially from its free end portion adjacent a side edge thereof to carry contact 28. The collar 30 and support member 31 are formed of metal, preferably having good electric conducting characteristics, and collar 30 engages around shaft section 25 adjacent one end of the latter and is spaced from the shaft section by a sleeve 33 of suitable insulating material. Collar 30 is fixed to shaft section 25 by suitable fastenings 34 which are electrically insulated from either the shaft section or the collar so that the support assembly for contact 28 is electrically insulated from the shaft section with the support member 31 extending axially along the shaft section and spaced from the latter.

Contact 28 consists of a contact screw 35 threadedly extending through lug 32 for adjustment purposes and having a locking nut 36 thereon for retaining the contact screw in selected position relative to the lug.

The other contact 29 is formed by a metal plate 37 secured to shaft section 25 by suitable fastenings 38 at a location on the shaft section adjacent lug 32 of the support assembly for contact 28, plate 37 being in electrical contact with shaft section 25. A contact lug 39 extends laterally from plate 37 and confronts contact screw 35 of contact 28. It should be noted that the surface of contact lug 39 confronting contact screw 35 faces in the direction of rotation of shaft section 25, as indicated by the arrow of Fig. 4, so that torsional deflection of the shaft section, between the locations at which collar 30 and plate 37 are secured thereto and resulting from resistance of the rolls 16 and 17 to the rotation imparted by motor 19, causes the contact screw 35 and lug 39 to be relatively displaced towards each other. Adjustment of the contact screw 35 to vary the distance it projects through lug 32 towards contact lug 39 varies the angle α of torsional deflection of shaft section 25 necessary to bring the contact screw and contact lug into mutual engagement.

Contacts 28 and 29 constitute a normally open switch assembly rotating with the shaft section 25 and closing when an overload on the latter causes a predetermined torsional deflection thereof. In order to connect the switch assembly, constituted by contacts 28 and 29, into a control circuit, slip rings 40 and 41 are provided on shaft section 25 and are respectively engaged by stationary brushes 42 and 43. Slip ring 40 is in electrical contact with shaft section 25 and hence communicates electrically with contact 29, while ring 41 is insulated from shaft section 25, for example, by the sleeve 33, and is electrically connected to collar 30 for electrical communication with contact 28.

The control circuit for motor 19 is shown schematically and includes relays 44 of conventional construction which are connected to brushes 42 and 43 so that the relays are energized when contacts 28 and 29 engage. Relays 44 are arranged to control a conventional motor starter assembly 45 so that the supply of current from

the lines 46 to motor 19 is interrupted when the relays 44 are energized by closing of the contacts 28 and 29. After the operation of the motor has been halted by closing of contacts 28 and 29 to stop rotation of the working rolls, the operation of the roller leveler can only be resumed by manual actuation of the starting switch, not shown, included in the motor starter assembly. Merely by way of example, relay arrangement 44 may have a solenoid 50 which will be energized from leads 50a and 50b by closing contacts 35 and 39. Upon energization switch blade 51 will be closed to furnish power from leads 52 to solenoid 53. Starter assembly 45 may take the form, for example, of an arrangement having blade 54 pivoted at 55 with a secondary pivot blade 56. Blade 56 is shown engaged with contact 57. Blade 56 is held in the position illustrated by engagement of the latch 58 with pin 59 thereon, latch 58 being pivoted at its corner 60. Spring 61 tends to urge blades 54 and 56 together. Lines 46 furnish power to motor 19. Line 46A is connected through the resistance 61A to the motor. There is a conventional holding magnet 62 for holding the blade 54 in running position after it is manually moved to the right. Solenoid 53 has a plunger arranged so that when the solenoid is energized the plunger will pivot latch 58 counter clockwise so as to release blade 56. When this is done, spring 61 will pull the blade 56 upwardly and break the circuit to motor 19. Solenoid 53 is energized when switch blade 51 is pulled against contact 62 upon energization of solenoid 50.

The safety device 18B is generally similar to safety device 18A with the exception that it is arranged to operate in the reverse direction because roll 12 turns in a direction reverse to that just described when sheet S moves in the direction of the arrow B. Operation of device 18B in this reverse direction is achieved by reversely arranging the elements 28', 29' and 31' thereof relative to the corresponding elements of safety device 18A.

From the above description of an illustrative embodiment, it is apparent that the present invention provides a safety device in association with a roller leveler which acts in response to an overload condition, as indicated by a predetermined torsional deflection of the drive shaft, to halt the operation of the leveler so that damage to the latter will be prevented in the event that material being passed through the roller leveler causes jamming or excessive resistance to rotation of the working rolls. Since the contacts 28 and 29 are merely applied to a section of the shaft driving the rolls of the roller leveler, it is apparent that safety devices embodying the present invention may be applied to existing roller levelers without requiring substantial revision or alteration of the latter.

While an illustrative embodiment of the invention has been set forth in detail in the foregoing description and in the accompanying drawing, it is to be understood that the invention is not limited to that precise embodiment, and that changes and modifications, apparent to one skilled in the art, may be effected therein without departing from the scope of the invention.

What is claimed is:

1. In combination with a roller leveler having working rolls, a drive shaft operatively connected to at least one of said rolls and means for rotating said drive shaft; a safety device comprising two confronting and normally spaced apart contacts on said drive shaft for movement towards each other in response to torsional deflection of said shaft, and electrical means operatively connected to said contacts and controlled by the latter to render said shaft rotating means inoperative when said contacts are mutually engaged.

2. In combination with a roller leveler for straightening sheets of thin material and including working rolls, a drive shaft operatively connected to at least one of said rolls and an electric motor for rotating said drive shaft; a safety device comprising two confronting and normally spaced apart contacts on said drive shaft for movement towards each other in response to torsional deflection of said shaft, and electrical means operatively connected to said contacts and controlled by the latter to render said motor inoperative when said contacts are brought together by a predetermined torsional deflection of said shaft caused by overloading of said roller leveler.

3. In combination with a roller leveler for straightening sheets of thin material and including working rolls,

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a drive shaft operatively connected to at least one of said rolls, an electric motor for rotating said drive shaft, and means for controlling the supply of electric current to said motor; a safety device comprising two confronting and normally spaced apart contacts, means mounting said contacts on said drive shaft at axially spaced apart locations on the latter so that said contacts move towards each other in response to torsional deflection of the portion of said shaft between said locations, and electrical means controlled by said contacts and operatively connected to said current supply controlling means to interrupt the supply of current to said motor when said contacts are brought together by a predetermined torsional deflection of said portion of the drive shaft caused by overloading of said roller leveler.

4. In combination with a roller leveler for straightening sheets of thin material and including working rolls, a drive shaft operatively connected to at least one of said rolls, and means for rotating said drive shaft; a safety device comprising two confronting contacts, means supporting said contacts on said drive shaft for movement relative to each other in the direction circumferentially of said shaft, said supporting means including means securing said contacts to said shaft at axially spaced apart locations on the latter so that said contacts rotate with said shaft and move circumferentially relative to each other in response to torsional deflection of the portion of the shaft between said spaced apart locations, and electrical means including a circuit having said contacts interposed therein for rendering said shaft rotating means inoperative in response to a predetermined torsional deflection of said portion of the drive shaft caused by overloading of said roller leveler.

5. In combination with a roller leveler for straightening sheets of thin material and including working rolls, a drive shaft operatively connected to at least one of said rolls, and means for rotating said drive shaft; a safety device comprising two contacts, a first support fixed to said drive shaft and supporting one of said contacts adjacent the periphery of said shaft, a second support fixed to said drive shaft at a point spaced axially from the point on said shaft at which said first support is fixed to the latter, said second support extending axially along said shaft toward said one contact and supporting the other of said contacts adjacent the periphery of said shaft and in a position confronting said one contact so that said contacts are displaced circumferentially relative to each other in response to torsional deflection of the portion of the drive shaft between the points at which said first and second supports are fixed thereto, and electrical means including a circuit having said contacts interposed therein for rendering said shaft rotating means inoperative in response to a predetermined torsional deflection of said portion of the drive shaft caused by overloading of said roller leveler.

6. In combination with a roller leveler for straightening sheets of thin material and including working rolls, a drive shaft assembly operatively connected to at least one of said rolls and having an elongated shaft section, and means for rotating said drive shaft assembly; a safety device comprising first and second contacts, first support means fixed to said shaft section adjacent one end of the latter and supporting said first contact adjacent the periphery of said shaft section, second support means fixed to said shaft section adjacent the other end of the latter and supporting said second contact adjacent the periphery of said shaft section and in a location axially of said shaft section confronting said first contact so that said first and second contacts rotate with said shaft section and are displaced circumferentially relative to each other in response to torsional deflection of said shaft section, first and second slip rings on said shaft section and electrically connected to said first and second contacts, respectively, and electrical means including brushes engaging said slip rings and a circuit having said

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brushes connected therein for rendering said shaft rotating means inoperative in response to a predetermined torsional deflection of said shaft section caused by excessive resistance to rotation of said working rolls.

7. In combination with a roller leveler for straightening sheets of thin material and including working rolls between which the sheets are passed, a drive shaft assembly operatively connected to at least one of said rolls and having an elongated shaft section of electrically conducting material, and means for rotating said shaft assembly; a safety device comprising first and second contacts, first support means fixed to said shaft section adjacent one end of the latter and in electrical contact therewith, said first support means supporting said first contact adjacent the periphery of said shaft section, second support means fixed to said shaft section adjacent the other end of the latter and extending axially of said shaft section to support said second contact adjacent the periphery of said shaft section and in a position confronting and normally spaced circumferentially from said first contact so that torsional deflection of said shaft section causes relative movement of said first and second contacts toward each other, said second support means being formed of an electrically conducting material, insulating means electrically isolating said second support means from said shaft section, first and second slip rings on said shaft section electrically connected to said shaft section and to said second support means, respectively, insulating means electrically isolating said second slip ring from said shaft section, brushes respectively engaging said first and second slip rings, and electrical means including a circuit having said brushes interposed therein for rendering said shaft rotating means inoperative when said first and second contacts are brought together by torsional deflection of said shaft section caused by excessive resistance to rotation of said working rolls.

8. The combination as set forth in claim 7; wherein said second support means includes a support member having a cylindrical portion surrounding and spaced from said shaft and an axial extension integral with said cylindrical portion and formed with a radially projecting lug, and wherein said second contact includes a contact screw threadedly extending through said lug for adjustment toward and away from said first contact to thereby vary the torsional deflection of said shaft section required to bring together said first and second contacts.

9. In combination a drive shaft for rotating the working parts of a machine, a motor connected to said drive shaft for rotating the latter, two circumferentially confronting contacts carried by said shaft, support means fixing said contacts to said shaft at axially spaced apart locations on the latter so that said contacts are displaced circumferentially relative to each other in response to torsional deflection of the portion of the drive shaft between said locations on the latter, and electrical means connected to said motor including an electric circuit having said contacts interposed therein and effective to render said motor inoperative in response to a predetermined torsional deflection of said portion of the shaft caused by excessive resistance to rotation of the working parts of the machine.

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