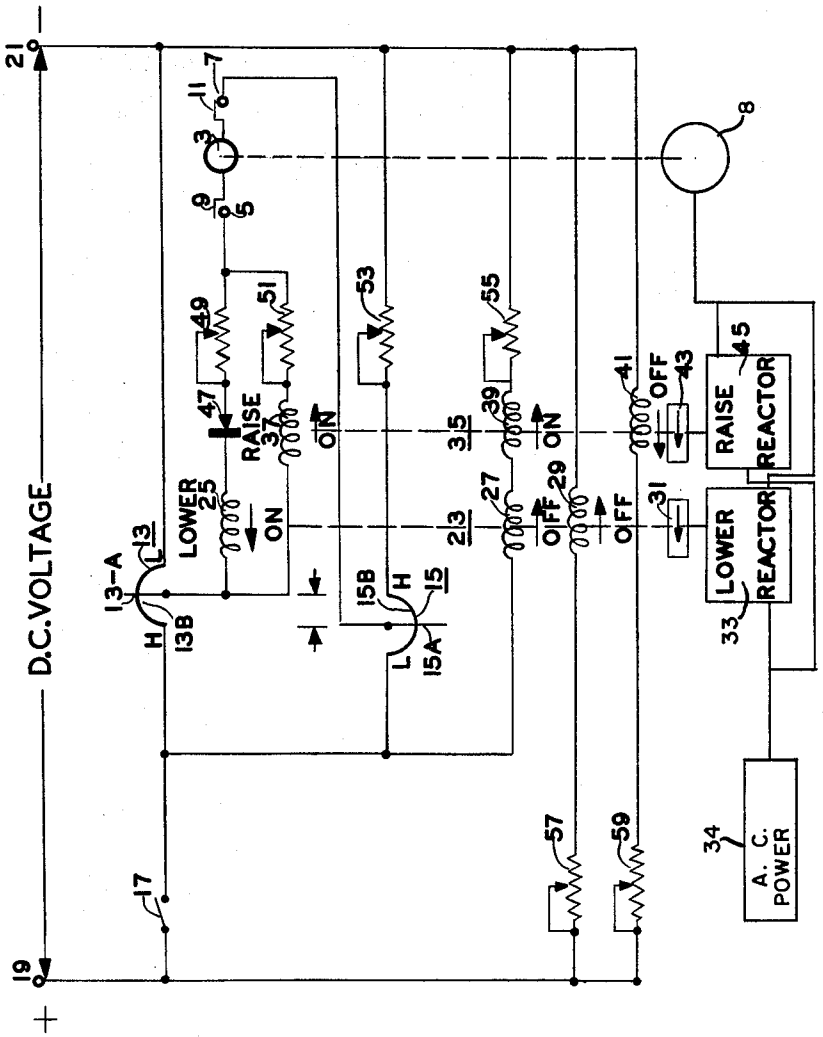
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FEEDBACK FAILURE PROTECTION FOR MOTOR IN CRANE CONTROL SYSTEM

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FEEDBACK FAILURE PROTECTION FOR MOTOR IN CRANE CONTROL SYSTEM

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This invention relates to a crane control and more particularly to a crane control for maintaining hoist torque on a hoist motor if the electrical connection between the tachometer measuring the speed of the hoist motor and the control circuit is broken.

The current to the hoist motor of a crane is controlled by a control circuit with the current dependent on the speed of the motor as measured by a tachometer. The hoist and hoist motor with the accompanying tachometer are usually movable while the control circuit remains stationary. To avoid trailing wires the tachometer is connected in the control circuit by collector shoes making contact with an electric rail.

The collector shoes at times become displaced from the electric rail breaking the electrical connection between the tachometer and the control circuit. Heretofore, with the electrical connection between the control circuit and the tachometer broken, the control circuit has not controlled the current to the hoist motor, no hoist torque has been maintained and the load has fallen.

Therefore, it is an object of this invention to provide a new and improved crane control for maintaining hoist torque on the hoist motor if the electrical connection between the tachometer measuring the speed of the hoist motor and the control circuit is broken.

The crane control device constructed in accordance with the principles of this invention controls the current to the hoist motor by controlling the impedance of two saturable reactors. The "lower" reactor controls the current to the hoist motor to lower the load while the "raise" reactor controls the current to the hoist motor to raise the load. A "lower" amplistat controls the impedance of the "lower" reactor and a "raise" amplistat controls the impedance of the "raise" reactor. A tachometer measures the speed of the hoist motor and produces a voltage proportional thereto. The tachometer is electrically connected to a turn-on control winding of the "lower" amplistat to lower the impedance of the "lower" reactor and cause the hoist motor to lower the load and the tachometer is electrically connected to a turn-on control winding of the "raise" amplistat to lower the impedance of the "raise" reactor and cause the hoist motor to raise the load. A turn-on control winding of the "raise" amplistat is always electrically connected to a voltage source to lower the impedance of the "raise" reactor.

When the electrical connection between the tachometer and the "lower" or "raise" amplistat is broken, the impedance of the "raise" reactor is lowered as one turn-on winding of the "raise" amplistat remains connected to a voltage source. Therefore, current flows to the hoist motor and hoist torque is maintained so the load does not fall.

The novel features of the invention are set forth with particularly in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by referring to the following description and the accompanying drawing.

In the drawing the figure is a schematic of a crane control constructed in accordance with the principles of this invention.

In the drawing tachometer **3** is connected to collectors **5** and **7** by collector shoes **9** and **11**. Tachometer **3** generates a voltage proportional to the speed of the hoist motor **8**. The crane itself with the hoist is not shown. The hoist with the hoist motor and tachometer rides on a trolley on rails as is common in the crane art. The controls are stationary to one side of the rails. Electrical connection to the motor and to the tachometer is by means of electrical rails with collector shoes making the electrical contact to the rails as the trolley moves. The master switch is composed of two switches **13** and **15**, each composed of a movable contact **13***a* and **15***a* respectively. The movable contacts **13***a* and **15***a* are connected together to the handle so that the contacts **13***a* and **15***a* are moved together. The handle of the master switch is moved so the contacts move toward the H or hoist side to cause the hoist motor to raise the load, and moved to the L or lower side to cause the hoist motor to lower the load. Switch **17** must be closed to operate the control. A D.-C. voltage is applied to contacts **19** and **21** of the control circuit. "Lower" amplistat **23** has a turn-on control winding **25**, a turn-off control winding **27**, a bias winding **29**, and a gate **31**. "Lower" amplistat **23** controls the impedance of the "lower" saturable reactor **33** to control the current from the A.-C. power source **34** to the hoist motor **8** to lower the load. Current flow in turn-on control winding **25** lowers the impedance of "lower" reactor **33** while current flow in turn-off control winding **27** raises the impedance of "lower" reactor **33**. "Raise" or "hoist" amplistat **35** has two turn-on control windings **37** and **39**, a bias winding **41** and a gate **43**. Current flowing in turn-on control windings **37** and **39** in a forward direction as shown by the arrows causes the impedance in "raise" reactor **45** to be decreased so that more current flows from the A.-C. power source **34** to the hoist motor **8** to raise the load. "Raise" amplistat **35** controls the impedance in "raise" saturable reactor **45** to control the current from the A.-C. power source **34** to the hoist motor **8** to raise the load. Diode **47** permits unidirectional flow. Resistors **49**, **51**, **53**, **55**, **57** and **59** are adjustable resistors.

The operation of the control circuit will now be explained with reference to the drawing. Switch **17** is closed to energize the control circuit. Current flows from the positive terminal **19** through closed switch **17** through turn-off control winding **27** and turn-on control winding **39**, resistor **55**, to the negative terminal **21**. The current flowing through turn-off control winding **27** is sufficient to keep the impedance in the "lower" saturable reactor **33** up and the current flowing through turn-on control winding **39** is sufficient to lower the impedance in the "raise" reactor **45** so that some current flows from the A.-C. power source **34** to the hoist motor **8** and the hoist motor **8** applies some hoist torque H_1.

The contacts **13***a* and **15***a* are normally in the exact center of the potentiometers **13***b* and **15***b* when the contact **17** is closed before the master switch is moved. Because of resistor **53** current flows from positive terminal **19**, through closed switch **17**, switch **15**, collector **7**, collector shoe **11**, tachometer **3**, collector shoe **9**, collector **5**, resistor **49**, diode **47**, turn-on control winding **25**, switch **13**, to negative terminal **21**. Some current also tends to flow in a backward direction through control winding **37** to keep the impedance in the "raise" reactor **45** up. The current through turn-on control winding **25** tends to turn "lower" amplistat **23** on. The current through turn-on control windings **25** and **37** therefore counterbalances the current through control windings **27** and **39**. Resistor **53** may be adjusted to partially overcome, balance or completely overcome the hoisting effect of the current through the turn-on control winding **39** of "raise" amplistat **35**.

The movement of the master switch to move contacts 13*a* and 15*a* to the hoist side of potentiometers 13*b* and 15*b* causes current to flow from positive terminal 19, through closed contact 17, switch 13, turn-on control winding 37, resistor 51, tachometer 3, switch 15, resistor 53, to negative terminal 21.

No current flows through turn-on control winding 25 because of diode 47. The current flow through turn-on control winding 37 causes "raise" amplistat 35 to be turned on lowering the impedance in "raise" reactor 45 to apply current from the A.C. power source 34 to the hoist motor 8 to raise the load.

The movement of the master switch to move the contacts 13*a* and 15*a* to the lower side of potentiometers 13*b* and 15*b* causes current to flow in turn-on control winding 25 in a similar manner to cause the load on the hoist to be lowered.

If one of the collector shoes loses contact with the rail the load does not fall. The current through turn-on control winding 39 causes the hoist motor 8 to remain energized to maintain hoist torque.

Thus a crane control has been described which controls the hoist motor so that even when a collector shoe is displaced hoist torque is maintained and the load does not fall.

While this invention has been explained and described with the aid of a particular embodiment thereof, it will be understood that the invention is not limited thereby and that many modifications will occur to those skilled in the art. It is therefore contemplated by the appended claims to cover all such modifications as fall within the scope and spirit of the invention.

What is claimed is:

1. A crane control for controlling the current to a hoist motor by controlling the impedance of a lower and raise saturable reactor including a D.-C. voltage source, a lower amplistat having a turn-on control winding and a gate winding, the gate winding of said lower amplistat connected to the lower reactor, a raise amplistat having a first and a second turn-on winding and a gate winding, the gate winding of said raise amplistat connected to the raise reactor, a tachometer for producing a voltage proportional to the speed of the hoist motor, means connecting said tachometer to the first turn-on winding of said raise amplistat and to the turn-on control winding of said lower amplistat, a first potentiometer having a movable contact, means connecting the turn-on control winding of said lower amplistat and the first turn-on control winding of said raise amplistat to the movable control of said first potentiometer, a second potentiometer having a movable contact, means connecting said tachometer to the movable contact of said second potentiometer, means connecting said first and second potentiometers to said D.-C. voltage source, switching means for moving the movable contacts of said first and second potentiometers to lower the impedance in said lower and raise reactors to control the current to the hoist motor, and means for constantly connecting the second turn-on control winding of said raise amplistat to said D.-C. voltage source to lower the impedance of the raise reactor and allow current flow to the hoist motor.

2. A crane control for controlling the current to a hoist motor by controlling the impedance of a lower and raise saturable reactor including a D.-C. voltage source, a lower amplistat having a turn-on control winding and a gate winding, the gate winding of said lower amplistat connected to the lower reactor, a raise amplistat having a first and a second turn-on winding and a gate winding, the gate winding of said raise amplistat connected to the raise reactor, a tachometer for producing a voltage proportional to the speed of the hoist motor, means connecting said tachometer to the first turn-on winding of said raise amplistat and to the turn-on control winding of said lower amplistat, a first potentiometer having a movable contact, means connecting the turn-on control winding of said lower amplistat and the first turn-on control winding of said raise amplistat to the movable control of said first potentiometer, a second potentiometer having a movable contact, means connecting said tachometer to the movable contact of said second potentiometer, means connecting said first and second potentiometers to said D.-C. voltage source, switching means for moving the movable contacts of said first and second potentiometers to lower the impedance in said lower and raise reactors to control the current to the hoist motor, means for constantly connecting the second turn-on control winding of said raise amplistat to said D.-C. voltage source to lower the impedance of the raise reactor and allow current flow to the hoist motor, and an offset resistor connected between said D.-C. voltage source and the turn-on control winding of said lower amplistat to lower the impedance of the lower reactor to oppose the current flow through the raise reactor.

References Cited by the Examiner

UNITED STATES PATENTS

2,783,427	2/57	Bracutt	318—513 X
2,958,814	11/60	Foote	318—207
3,060,367	10/62	Richards	318—513

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