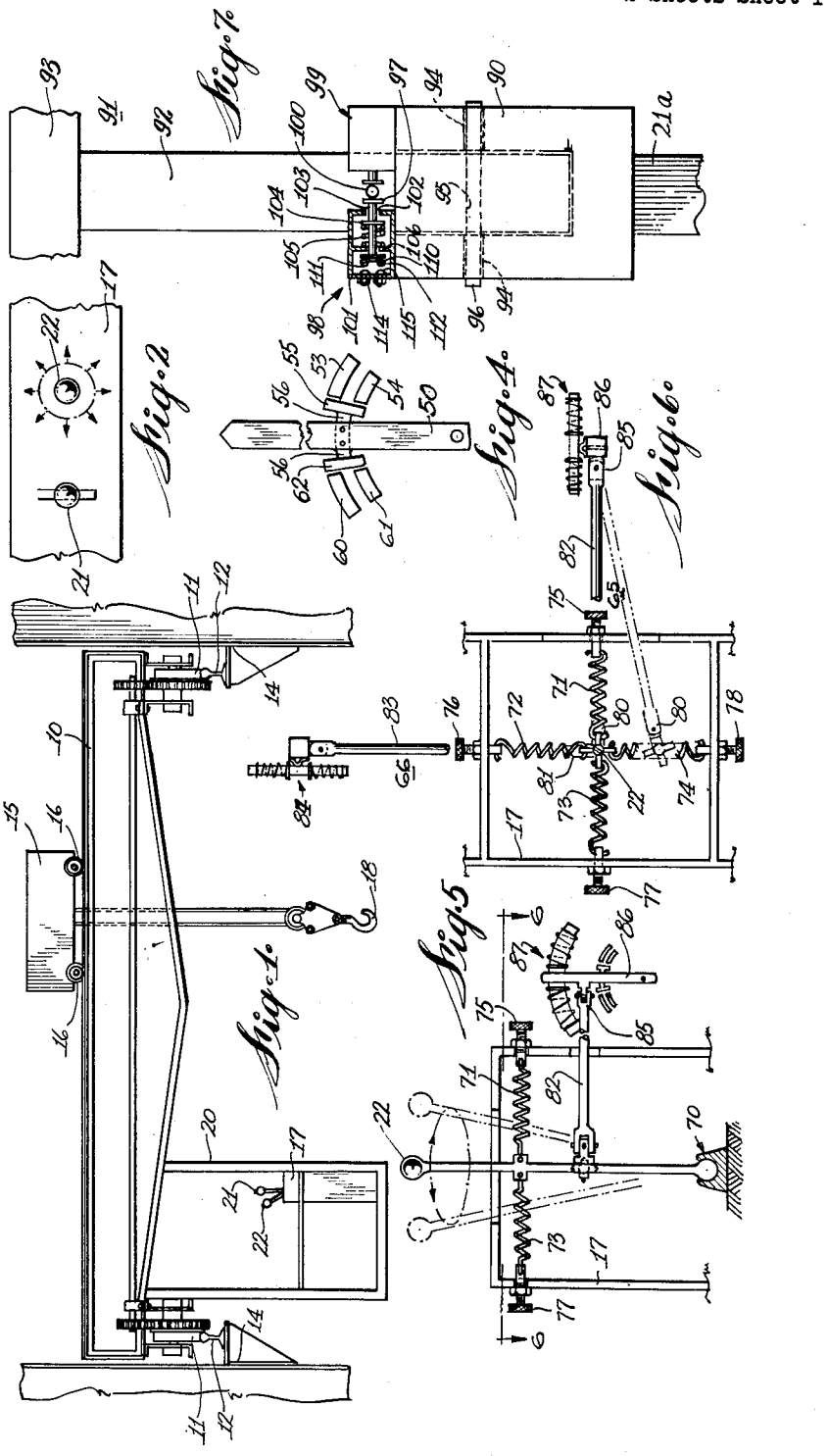
April 9, 1963 R. B. McKINNON 3,084,805

CONTROL DEVICE FOR CRANES

Filed Aug. 24, 1961 2 Sheets-Sheet 1



April 9, 1963 R. B. McKINNON 3,084,805

CONTROL DEVICE FOR CRANES

Filed Aug. 24, 1961 2 Sheets-Sheet 2

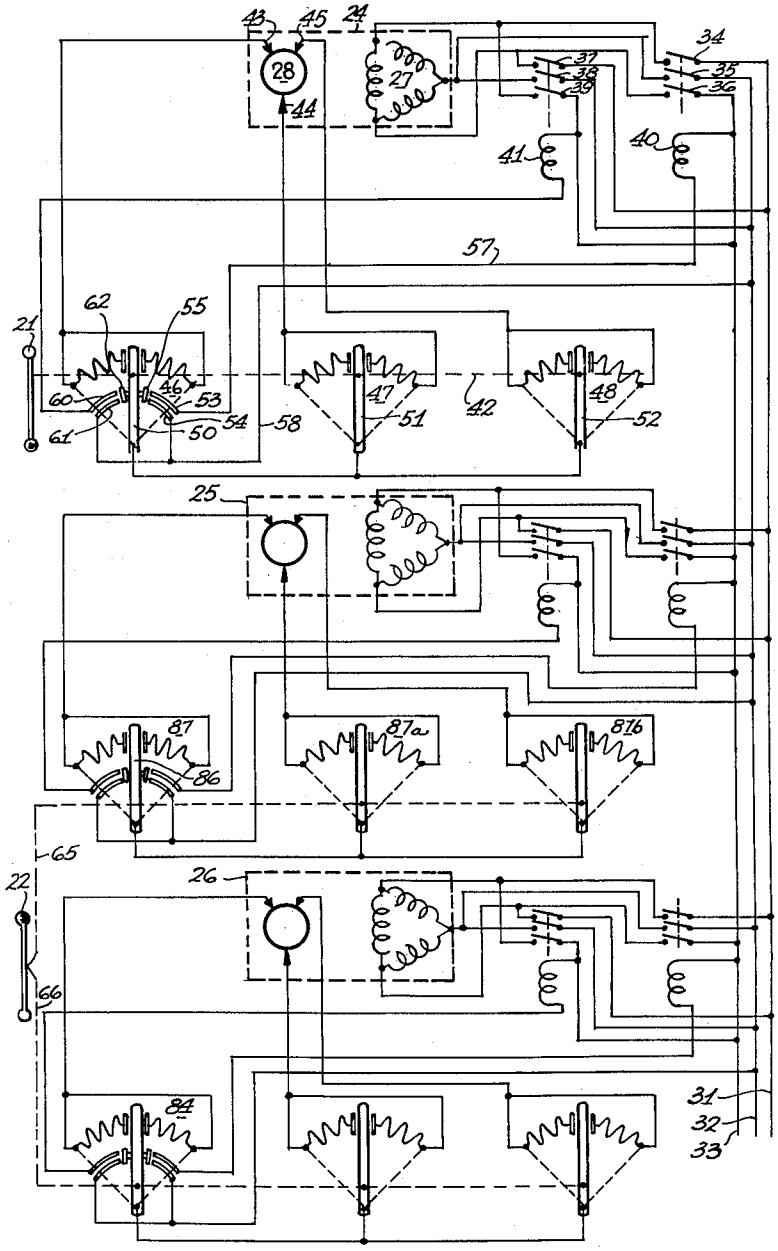


Fig. 3.

United States Patent Office 3,084,805 Patented Apr. 9, 1963

3,084,805

CONTROL DEVICE FOR CRANES

Robert B. McKinnon, R.R. 1, P.O. Box 26, Hannon, Ontario, Canada

Filed Aug. 24, 1961, Ser. No. 133,654
10 Claims. (Cl. 212—21)

This invention relates to a control system for cranes, and in particular it relates to a simplified control for a crane using two control levers to cause three, four or more different crane operations.

In the past it has been customary to provide the operator of a large crane with a panel having three, four or more operating levers. For example, in an overhead crane, a first lever may be moved forwards and backwards to raise and lower a crane hook, a second lever may be moved forwards and backwards to cause travel of a carriage or trolley forwards and backwards along a bridge, and a third lever may be moved forwards and backwards to cause the bridge to travel left and right along side rails. These are the fundamental operations or movements of an overhead crane, but additional operations are frequently required which necessitates further control levers. Thus, there may be an additional lever to switch current on and off to an electromagnet provided to carry loads of magnetic material, there may be an additional lever to cause rotation of the load for aligning the load in a particular direction or directions, and there may be an additional lever to raise or lower an auxiliary crane hook.

Other types of crane such as a gantry crane also have control panels with three, four or more control levers.

It will be apparent that a crane operator cannot have more than two such control levers under constant control, and it is necessary for the operator to move his hands from lever to lever in any sequence of operations normally required of him. It will also be apparent that the control levers do not necessarily have a relation between their movement and that of the crane hook. Consequently it has been necessary for an operator to have a long training period to develop skill and experience necessary for accurate and rapid performance.

Because it is necessary for an operator to move his hands from lever to lever in the aforementioned control system, it is not usual to provide a so called "dead man control," that is, the levers normally remain in the position in which they were placed. It is of course, desirable to have a "dead man control" which returns to a neutral or off position when the operator's hand is taken from the control lever.

Another prior art crane control was devised to overcome some of the disadvantages of the aforementioned control. This other type uses only a single control lever to control the three basic crane operations. The single lever may be moved forwards and backwards, left and right, and up and down to cause the crane hook to move in like directions. This control relates control lever movement to crane hook movement, but the control is complex and expensive. The mechanism used is such that the movement of the control lever in a given direction depressed one, two or three push-button type switches depending on the degree of movement of the lever. The push-button switches provide speed control in three discrete steps. While three steps of speed control, or even fewer, may be sufficient for some auxiliary crane operations, it is desirable to have a greater degree of speed control at least for the three basic or fundamental crane operations. Because of the complex nature of this prior art control it is difficult to increase the number of steps of speed control in the three operations.

The present invention seeks to overcome disadvantages of prior crane controls by an improved two lever crane control.

It is an object of this invention to provide a relatively simple and inexpensive crane control which controls crane operations by two control levers.

It is another object of this invention to provide an improved crane control system where the operator is not required to remove his hands from the two control levers during crane operation.

It is yet another object of this invention to provide a crane control wherein a fine control of speed in the main crane operations may be achieved.

Other objects and advantages of the invention will be apparent from consideration of the following description taken in conjunction with the drawings in which:

FIGURE 1 is a side elevation showing very generally a three motor overhead crane embodying the present invention,

FIGURE 2 is a partial top view showing the two control levers used in the control system according to the invention,

FIGURE 3 is a schematic wiring diagram of the motor control circuits of a crane adapted to the present control system,

FIGURE 4 is a partial view of a contact member shown in FIGURE 3 on an enlarged scale,

FIGURE 5 is a side elevation, partly in section, of one of the control levers used in the present invention and showing some adjacent apparatus,

FIGURE 6 is a partial view of the control lever of FIGURE 5 taken along line 6—6 of FIGURE 5, and

FIGURE 7 is a side elevation, partly in section, of a modification of one of the control levers used in the present invention.

Briefly, the present invention is a control system for controlling at least three basic crane operations or movements with two control levers. Three sets of switch contacts control the directions of rotation of the three motors, and three rheostats control the speed of rotation. A first control lever is pivotally mounted to move in opposite directions from a neutral position to engage first switch contacts and vary the resistance of a first rheostat. A second control lever is movable in any planar direction from a neutral position, and has means to engage second switch contacts and vary the resistance of a second rheostat upon movement in a first direction from a first line extending through the neutral position and in a direction opposite thereto. The second lever also has means to engage third switch contacts and vary the resistance of a third rheostat upon movement in a second direction from a second line extending through the neutral position at right angles to said first line and in a direction opposite said second direction. Additional control devices may be added to the first lever to perform auxiliary operations.

Referring now to FIGURE 1, a well known type of overhead crane is shown generally, having a bridge **10** equipped with wheels **11** which are supported by rails **12** for movement of the bridge transversely to the length of the bridge. The rails **12** are fixed to walls **14** or other convenient supporting structure. A wheeled carriage or trolley **15** is provided with wheels **16** which are supported by the bridge **10** for movement along the length of the bridge. A hoisting mechanism is carried by trolley **15** for raising and lowering a crane hook **18**.

Three electric driving motors (not shown in FIGURE 1) drive the crane. A first driving motor drives the hoisting mechanism to raise and lower the crane hook **18**; a second motor drives the trolley **15** back and forth along the bridge **10**; and a third motor drives the bridge transversely to and fro. This is well known in the art. The controls for controlling the motors and operating the

crane are generally located in an operator's cab 20 suspended beneath bridge 10 towards one end. According to the present invention two control levers 21 and 22 mounted in casing 17 are used to control the three driving motors. In FIGURE 1 the lever 21 is shown in its neutral or "off" position whereas lever 22 is shown moved to one side of its neutral position so that levers 21 and 22 can be seen separately.

The levers 21 and 22 as mounted in casing 17 are shown in a top view in FIGURE 2. Here the levers 21 and 22 are both shown in their neutral positions. The lever 21 is pivotally mounted at its lower end for movement in opposite directions from its neutral position. The lever 22 is mounted so that it is movable in any planar direction from its neutral position, that is, the control knob at the upper end of lever 22 may move in any planar direction as indicated by the arrows. Lever 22 is restrained from vertical movement by its mounting. The mounting means for lever 22 is shown in more detail in FIGURES 5 and 6 and will be described in connection with these figures hereinafter. It is desirable to relate crane hook movement to control movement where possible. A preferred control uses lever 21 to control the hoisting motor while lever 22 controls the movement of the trolley and bridge. Thus, the right hand control lever 22 may have its movement related to the direction of movement of the trolley and bridge.

Referring now to FIGURE 3 which shows the schematic wiring diagram of the control circuit, the three driving motors are indicated at 24, 25 and 26. These motors are indicated as three phase, wound rotor, induction motors with the rotor winding brought out to slip rings. It will, however, be apparent that single phase induction motors or direct current motors could be used as driving motors for the crane. The motors 24, 25 and 26 drive the hoisting mechanism, trolley and bridge respectively, however the circuitry associated with each motor is similar. Consequently, it is believed that a description of the circuitry of motor 24 is sufficient for an understanding of FIGURE 3.

Motor 24 comprises a stator 27 and a rotor 28. The stator may be connected in a delta connection as shown or a Y connection to a three phase power source 31, 32, 33 through either the contacts of switches 34, 35, 36 or 37, 38, 39 whichever are closed. The normally open switches 34, 35, 36 are operated to a closed condition when a solenoid 40 is energized, and switches 37, 38, 39 are operated to a closed condition when a solenoid 41 is energized. These two sets of switches constitute a reversing switch for motor 24 as is well known.

The windings of rotor 28 are brought out to three slip rings indicated at 43, 44, 45 which are connected through rheostats 46, 47, 48 to a common point such as ground. The rheostats 46, 47, 48 are connected to insert resistance in the rotor circuit of motor 24 to reduce the speed of rotation of the rotor. The rheostats 46, 47, 48 have movable contact members or arms 50, 51, 52 respectively which are mechanically connected one to the other and to control lever 21 by a linkage 42. The rheostats 46, 47, 48 may constitute parts of a multiple section rheostat positioned adjacent lever 21 with a short linkage extending between lever 21 and the multiple rheostat. As the lever 21 is moved away from its neutral position in either direction, the arms 50, 51, 52 move accordingly away from their neutral position. As the arms 50, 51, 52 move over the resistance of the rheostats 46, 47, 48 in a direction away from their center position, the resistance added to the rotor circuit by the rheostats is decreased. Thus, as lever 21 is moved away from its neutral position, the speed of rotation of motor 24 is increased. This is so regardless of the direction in which lever 21 is moved away from neutral. This type of speed control of motors is known in the art and further detail is believed unnecessary. Because of the use of rheostats in the speed control it is possible to achieve a fine control of speed.

In order to have control of the direction of rotation of motor 24, the solenoid 40 should be energized when lever 21 is moved in one direction from its neutral position and solenoid 41 when the lever is moved in the opposite direction. This will close either switches 34, 35, 36 or switches 37, 38, 39. The solenoids can be energized in the aforementioned manner by many switch means known in the art. FIGURE 4 shows one means comprising contact strips 53 and 54 extending to one side of arm 50 when arm 50 is in its center position as shown. A bridging member 55 is carried by arm 50 and insulated therefrom by an insulating arm 56. The member 55 does not bridge the contact strips 53 and 54 when arm 50 is in its center or neutral position, but does so as soon as arm 50 moves from its center position in the direction of the contact strips. When bridging member 55 connects strips 53 and 54, a circuit is completed through solenoid 40. The circuit is from power source conductor 33, through solenoid 40, through conductor 57 to contact strip 53, across bridging member 55 to contact strip 54 and thence by conductor 58 to the power source conductor 32.

Similarly, contact strips 60 and 61 on the other side of arm 50, in conjunction with a bridging member 62, can complete a circuit through solenoid 41 when arm 50 is moved from its center position towards the strips 60 and 61. The lever 21 therefore has control over both direction and speed of rotation of motor 24.

The wiring for motors 25 and 26 is similar to that for motor 24. However, the control lever 22 is mechanically connected by linkages 65 and 66 to the rheostats and solenoid switches for controlling speed and direction of rotation of both motors 25 and 26. The linkages are better understood by reference to FIGURES 5 and 6.

In FIGURES 5 and 6 the control lever 22 is shown mounted at its lower end in a ball and socket type joint 70. Any type of joint which permits movement of the upper or handle end of lever 22 in all planar directions is suitable. Four springs 71, 72, 73 and 74 are connected between the four sides of lever 22 and casing 17. At the outer end the springs 71, 72, 73, 74 are fastened to an adjusting screw 75, 76, 77, 78 respectively so that the tension exerted by each spring may be adjusted. The screws 75, 76, 77, 78 threadedly engage casing 17 and are restrained from unwanted rotation by lock nuts. The springs 71, 72, 73, 74 exert sufficient force on lever 22 to cause it to return to its neutral position when the handle of lever 22 is released. This creates the so-called dead man control.

It will be apparent that only two springs would be required for pivotally mounted handle 21 in order to have it return to neutral when released. Thus, the spring return for lever 21 is similar to that of lever 22 for example in the plane shown in FIGURE 5. It is believed to be unnecessary to describe this in detail for lever 21.

The control lever 22 is provided with universal joints 80 and 81 on two sides at right angles to one another. Connecting members 82 and 83 extend from the universal joints 80 and 81 respectively. The connecting member 82 is provided with a universal joint connection 85 at its remote end for connection with a movable arm 86 of a rheostat 87. The universal joints 80 and 85 and the connecting member 82 comprise the linkage 65 of FIGURE 3. While only a single rheostat 87 is shown in FIGURE 5 for simplicity, it will be apparent that this may be a triple or multiple rheostat comprising, for example in combination parts 87, 87*a* and 87*b* of the schematic diagram of FIGURE 3.

In a like manner the connecting member 83 extends to a universal joint connection with the rheostats 84 for controlling motor 28. The member 83 is thus a part of the linkage 66 of FIGURE 3.

It will be apparent that the manner of linking control lever 22 to control both motors 25 and 26 as shown in FIGURES 5 and 6, will result in some degree of inter-

action between the controls. To illustrate this by way of example, if lever **22** were moved towards the bottom of the diagram as shown in FIGURE 6, the linkage **66** comprising member **83** will move the rheostat control **84** for motor **26**. Ideally, such a movement should not affect motor **25**. However, as lever **22** is moved it carries the universal joint **80** with it so that connecting member **82** is at an acute angle to member **83**. The arm **86** of rheostat **87** will be pulled by member **82** a short distance towards the control lever **22** which may cause motor **25** to rotate. This interaction may be negligible depending partly on the length of the linkages or the interaction may be permitted because the operator will become accustomed to it and counteract it automatically. There are, however, linkages known that will not cause any interaction between movements in two directions at right angles. While these linkages are of a more complex design they may be readily used in the present invention. An example of such a linkage can be found in United States Reissue Patent 22,785 to Clay dated September 3, 1946 and particularly in FIGURE 6 of this patent.

It will be seen from the description thus far that the invention provides a simple inexpensive crane control using two control levers for controlling three crane motors. The system may be readily adapted to the crane controls presently in use. The rheostat permits a fine control of motor speed for the three basic crane movements or operations.

As was previously mentioned, it is frequently necessary to have auxiliary controls for a crane to enable an operator to control auxiliary operations. One such auxiliary operation is the rotating of the load carried by the crane to align the load in a given direction. Such a control is frequently required, for example, in a crane in a steel mill used to place ingots in a soaking pit. This rotating operation requires an additional electric motor and an additional control. The control can be added quite conveniently by a modification to the control lever **21** as best described with reference to FIGURE 7.

Referring to FIGURE 7, there is shown a partial side elevation of the left hand or pivotally mounted control lever which is designated **21***a*. A socket **90** is formed in the upper part of lever **21***a* to receive a T-shaped handle **91** having an upright **92** and a cross-portion **93**. Opposed slots **94** are provided in socket **90** extending laterally around socket **90** for a limited distance. The upright **92** is provided with a hole **95**, extending diametrically through the upright, to receive a pin **96**. The pin **96** extends from hole **95** through slots **94** to retain the upright **92** in socket **90** while permitting rotational movement of upright **92** within limits where the pin **96** strikes the ends of slots **94**.

Two similar switches **98** and **99** are mounted to socket **90**, one on each side of a projection **100** which projects from upright **92**. Switch **98**, which is shown in section, comprises a casing **101** of insulating material with an opening **102** at one end through which projects a rod-like or cylindrical operating member **103**. The operating member **103** is mounted for longitudinal inward and outward movement and has a bearing head **97** which bears against projection **100**. A spring **105** is compressed between a protrusion or ring **104** on operating member **103** and an inwardly projecting member **106** on casing **101**. The spring **105** biases the operating member outwardly against projection **100**. The longitudinal movement of member **103** is limited or restricted in an outward direction by ring **104** engaging the end of case **101** and in an inward direction by the contacts becoming engaged as will now be described. The inward end of operating member **103**, that is, the end remote from bearing head **97**, carries a bridging member **110** with two spaced contacts **111** and **112**. While bridging member **110** may be a rigid piece of conducting material with a contact **111** on one end and a contact **112** on the other, it is preferably a piece of resilient conductor having a slight curvature to provide a slight resilient mounting for contacts **111** and **112**. The contacts **111** and **112** are designed to engage contacts **114** and **115** when operating member **103** is depressed or moved in an inwardly direction. This would complete a circuit, for example, through contact **114**, contact **111**, bridging member **110**, contact **112** and contact **115** and the switch is then closed. The switch **99** is similarly constructed.

The operation of the control of FIGURE 7 is straightforward. The springs in switches **98** and **99** tend to bias the pin **100** to a central position. The springs have sufficient force to return the pin to this position and thereby return the handle **91** to its neutral position whenever the handle is released. A dead man type of control is thus provided. As the cross portion **93** of handle **91** is turned the upright **92** rotates causing pin **100** to depress the operating member of either switch **98** or **99**. This will close the contacts of the particular switch and cause power to be applied to a motor for rotating the crane load in a given direction. For example, the closing of the contacts may energize a solenoid which closes switches between a power source and the motor. Turning handle **91** in the opposite direction will close the contacts of the other switch and cause rotation in the other direction. It is, of course, desirable to have the rotation of the handle in one direction cause rotation of the load in the same direction.

Another auxiliary operation frequently required on a crane is the switching on and off of a current to energize and denergize an electromagnet for carrying loads of magnetic material. The operator's control switch for controlling this electromagnet current may be a simple on-off switch which energizes a solenoid operated switch to control the current. Such an operator's control switch can be easily added to lever **21**. It is convenient to use a snap-action type of push-button switch which switches to closed condition on one push and switches to an open condition on the next push. Such switches are well known and can be mounted on lever **21** for operation by the operator's thumb.

If it should be required an operator's push button control switch for an electromagnet could be mounted on a handle **91** of FIGURE 7 for example at one end of the cross piece **93** for actuation by the operator's thumb.

It will be apparent that other types of operations may be controlled by a crane operator by placing the added control on level **21**. The control system enables a crane operator to control the three basic crane movements or operations with certain additional operations from two control levers.

I claim:

1. A control system for controlling at least first, second and third driving motors in a crane, comprising first, second and third switch contacts for controlling the direction of rotation of said first, second and third motors respectively, a first, second and third variable resistance means for controlling the speed of rotation of said first, second and third motors respectively, a first control lever movable in opposite directions from a neutral position having means to engage said first switch contacts and vary said first resistance means, and a second control lever movable in any planar direction from a neutral position, said second lever having means to engage said second contacts and vary said second resistance means upon movement in a first direction from a first line extending through said neutral position and in a direction opposite thereto, said second lever having means to engage said third contacts and vary said third resistance means upon movement in a second direction from a second line extending through the neutral position at right angles to said first line and in a direction opposite said second direction.

2. A control system for controlling at least first, second and third driving motors in a crane, comprising first, sec-

ond and third switch contacts for controlling the direction of rotation of said first, second and third motors respectively, first, second and third variable resistance means for controlling the speed of rotation of said first, second and third motors respectively, a first control lever movable in opposite directions from a neutral position having means to engage said first switch contacts and vary said first resistance means, first spring means to bias said first lever to its neutral position, a second control lever movable in any planar direction from a neutral position, said second lever having means to engage said second contacts and vary said second resistance means upon movement in a first direction from a first line extending through said neutral position and in a direction opposite thereto, said second lever having means to engage said third contacts and vary said third resistance means upon movement in a second direction from a second line at right angles to said first line and in a direction opposite thereto, and second spring means to bias said second lever to its neutral position.

3. A control system for controlling at least first, second and third driving motors in a crane, comprising first and second control levers, a pivotal mounting for said first control lever to mount said lever for movement in a first direction and in an opposite direction from a neutral position, first spring means biasing said first lever to its neutral position, a first rheostat means for varying resistance associated with said first motor to vary the speed of rotation thereof, said first lever having means to engage said first rheostat means and vary the resistance thereof in accordance with movement of said first lever, first electrical reversing switches controlling electrical power to said first motor for reversing the direction of rotation thereof, said first reversing switches having first and second positions each corresponding to a direction of rotation, said first reversing switches being actuated to said first position by movement of said first control lever from its neutral position in said first direction and to said second position by movement of said first control lever from its neutral position in a direction opposite said first direction, a universal mounting for said second control lever to mount said second lever for movement in any planar direction from a neutral position, second spring means to bias said second lever to its neutral position, second and third rheostat means for varying resistance associated with said second and third motors respectively to vary the speed of rotation thereof, said second control lever having means to engage said second rheostat means and vary the resistance thereof in accordance with movement of said second lever from its neutral position in a first direction and in a direction opposite said first direction, said second control lever having means to engage said third rheostat means and vary the resistance thereof in accordance with movement of said second lever from its neutral position in a second direction at right angles to said first direction and in a direction opposite said second direction, and second and third electrical reversing switches controlling power to said second and third motors respectively for reversing the direction of rotation thereof, said second and third reversing switches each having a first and a second position corresponding to a direction of rotation, said second reversing switches being actuated to said first position by movement of said second control lever from its neutral position in said first direction and to said second position by movement of said second lever from its neutral position in a direction opposite said first direction, said third reversing switches being actuated to said first position by movement of said second control lever from its neutral position in said second direction and to said second position by movement of said second control lever from its neutral position in a direction opposite said second direction.

4. A control system for controlling at least first, second and third driving motors in a crane, comprising first and second control levers, a pivotal mounting for said first control lever to mount said lever for movement in a first direction and in an opposite direction from a neutral position, first spring means biasing said first lever to its neutral position, a first rheostat means for adding a variable amount of resistance to said first motor connections to cause operation of said first motor at selectable decreased speeds of rotation, a first linkage between said first control lever and said first rheostat means to decrease the resistance added to said first motor by said first rheostat means with movement of said first lever away from its neutral position, first electrical reversing switches controlling electrical power to said first motor for reversing the direction of rotation thereof, said first reversing switches having first and second positions each corresponding to a direction of rotation, said first reversing switches being actuated to said first position by movement of said first control lever from its neutral position in said first direction and to said second position by movement of said first control lever from its neutral position in a direction opposite said first direction, a universal mounting for said second control lever to mount said second lever for movement in any planar direction from a neutral position, second spring means to bias said second lever to its neutral position, second and third rheostat means for adding a variable amount of resistance to said second and third motor connections respectively to cause operation of said second and third motors at selectable decreased speeds of rotation, a second linkage between said second control lever and said second rheostat means to decrease the resistant added to said second motor by said second rheostat means with movement of said second lever in a first direction from a first line extending through said neutral position and in a direction opposite said first direction, second electrical reversing switches controlling power to said second motor for reversing the direction of rotation thereof, said second reversing switches having first and second positions each corresponding to a direction of rotation, said second reversing switch being actuated to said first position by movement of said second control lever from said first line extending through said neutral position in said first direction and to said second position by movement of said second control lever from said first line in a direction opposite said first direction, a third linkage between said second control lever and said third rheostat means to decrease the resistance added to said third motor by said third rheostat means with movement of said second lever in a second direction from a second line extending through said neutral position at right angles to said first line and in a direction opposite said second direction, and third electrical reversing switches controlling power to said third motor for reversing the direction of rotation thereof, said third reversing switches having first and second positions each corresponding to a direction of rotation, said third reversing switch being actuated to said first position by movement of said second lever from said second line extending through said neutral position in said second direction and to said second position by movement of said second control lever from said second line in a direction opposite said second direction.

5. In a crane having an overhead bridge adapted to travel transversely to its length, a carriage mounted on said bridge for travel lengthwise thereof, a hoisting mechanism mounted on said carriage, a first electric motor mounted on said carriage for driving said hoisting mechanism to raise and lower a load, a second electric motor for moving said carriage back and forth along said bridge, and a third electric motor for moving said bridge to the left and right transversely of its length, a control system comprising first and second control levers, a pivotal mounting for said first control lever to mount said first lever for forward and backward movement from a neutral position in a direction parallel to the length of said bridge, first spring means biasing said first lever to its neutral position, a first rheostat means for adding vairable amounts of resistance to the circuit of said first motor to vary the

speed of rotation thereof, said first lever being linked to said first rheostat means to decrease the resistance added by said first rheostat means as said first lever is moved away from its neutral position, first electrical reversing switches controlling electrical power to said first motor for controlling the direction of rotation thereof, said first reversing switches having first and second positions each corresponding to a direction of rotation, said first reversing switches being actuated to said first position by movement of said first control lever from its neutral position in said forward direction and to said second position by movement of said first control lever from its neutral position in said backward direction, a universal mounting for said second control lever to mount said second lever for movement in any planar direction from a neutral position, second spring means biasing said second lever towards its neutral position, a second rheostat means for adding variable amounts of resistance to the circuit of said second motor to vary the speed of rotation thereof, a first linkage extending from said second control lever to said second rheostat means and arranged to decrease the resistance added by said second rheostat means to the circuit of said second motor as said second lever is moved away from a first line extending through said neutral position substantially at right angles to the length of said bridge, second electrical reversing switches controlling electrical power to said second motor for controlling the direction of rotation thereof, said second reversing switches having a first position corresponding to a direction of motor rotation during said carriage forward along said bridge and a second position corresponding to a direction of motor rotation driving said carriage backward along said bridge, said second electrical reversing switches being actuated to said first position by movement of said second control lever forward from said first line and to said second position by movement of said second control lever backward from said first line, a third rheostat means for adding variable amounts of resistance to the circuit of said third motor to vary the speed of rotation thereof, a second linkage extending from said second control lever to said third rheostat means and arranged to decrease the resistance added by said third rheostat means to the circuit of said third motor as said second lever is moved away from a second line extending through said neutral position substantially parallel to the length of said bridge and third electrical reversing switches controlling electrical power to said third motor for controlling the direction of rotation thereof, said third reversing switches having a first position corresponding to a direction of motor rotation driving said bridge to the left and a second position corresponding to a direction of motor rotation driving said bridge to the right, said third electrical reversing switches being actuated to said first position by movement of said second control lever to the left away from said second line and to said second position by movement of said second control lever to the right away from said second line.

6. A control system for a crane according to claim 5 further including a snap action push-button switch mounted on said first control lever, said push-button switch being adapted to energize an electromagnet carried by said crane to attract and hold a load of magnetic material.

7. In a crane having an overhead bridge adapted to travel transversely to its length, a carriage mounted on said bridge for travel lengthwise thereof, a hoisting mechanism mounted on said carriage, a first electric motor mounted on said carriage for driving said hoisting mechanism to raise and lower a load, a second electric motor for moving said carriage back and forth along said bridge, a third electric motor for moving said bridge to the left and right transversely of its length, and a fourth electric motor to rotate the load carried by said crane, a control system comprising first and second control levers, a pivotal mounting for said first control lever to mount said first lever for forward and backward movement from a neutral position in a direction parallel to the length of said bridge, first spring means biasing said first lever to its neutral position, a first rheostat means for adding variable amounts of resistance to the circuit of said first motor to vary the speed of rotation thereof, said first lever being linked to said first rheostat means to decrease the resistance added by said first rheostat means as said first lever is moved away from its neutral position, first electrical reversing switches controlling electrical power to said first motor for controlling the direction of rotation thereof, said first reversing switches having first and second positions each corresponding to a direction of rotation, said first reversing switches being actuated to said first position by movement of said first control lever from its neutral position in said forward direction and to said second position by movement of said first control lever from its neutral position in said backward direction, a control handle mounted to said first control lever for limited rotational movement about the axis of said first control lever, first and second electrical switch means mounted to said second control lever, first and second operating members extending from said first and second switch means respectively, means projecting from said control handle engaging said first and second operating members whereby rotation of said control handle in one direction will actuate said first electrical switch and rotation of said control handle in the opposite direction will actuate said second electrical switch, circuit means connecting said first electrical switch means and said fourth motor to cause rotation of said fourth motor in one direction with actuation of said first electrical switch means and connecting said second electrical switch means and said fourth motor to cause rotation of said fourth motor in the opposite direction with actuation of said second electrical switch means, a universal mounting for said second control lever to mount said second lever for movement in any planar direction from a neutral position, second spring means biasing said second lever towards its neutral position, a second rheostat means for adding variable amounts of resistance to the circuit of said second motor to vary the speed of rotation thereof, a first linkage extending from said second control lever to said second rheostat means and arranged to decrease the resistance added by said second rheostat means to the circuit of said second motor as said second lever is moved away from a first line extending through said neutral position substantially at right angles to the length of said bridge, second electrical reversing switches controlling electrical power to said second motor for controlling the direction of rotation thereof, said second reversing switches having a first position corresponding to a direction of motor rotation driving said carriage forward along said bridge and a second position corresponding to a direction of motor rotation driving said carriage backward along said bridge, said second electrical reversing switches being actuated to said first position by movement of said second control lever forward from said first line and to said second position by movement of said second control lever backward from said first line, a third rheostat means for adding variable amounts of resistance to the circuit of said third motor to vary the speed of rotation thereof, a second linkage extending from said second control lever to said third rheostat means and arranged to decrease the resistance added by said third rheostat means to the circuit of said third motor as said second lever is moved away from a second line extending through said neutral position substantially parallel to the length of said bridge, and third electrical reversing switches controlling electrical power to said third motor for controlling the direction of rotation thereof, said third reversing switches having a first position corresponding to a direction of motor rotation driving said bridge to the left and a second position corresponding to a direction of motor rotation driving said bridge to the right, said third electrical reversing switches being actuated to said first position

by movement of said second control lever to the left away from said second line and to said second position by movement of said second control lever to the right away from said second line.

8. A control handle for a crane comprising a lever portion and a handle portion mounted for limited rotation to said lever portion, first and second switches having an outer casing mounted to said lever portion, each of said switches having operating members extending from said casings, springs biasing said operating members outwards, first contact means movable by said operating members, and second contact means mounted on said casings, said first and second contact means being actuated to a closed condition by depression of said operating members, means on said handle portion engaging said operating members of said first and second switches whereby rotation of said handle portion in one direction will close the contacts of said first switch and rotation in the other direction will close the contacts of said second switch.

9. A control handle for a crane comprising a lever portion and a handle portion mounted for limited rotation to said lever portion, first and second switches mounted to said lever portion, each of said switches having an outer casing provided with an opening, an operating member extending through said opening for longitudinal movement therethrough, restraining means for limiting the longitudinal movement of said operating members within predetermined limits, springs biasing said operating members longitudinally outwards, first contacts movable by said operating members, and second contacts mounted to said casings, said first and second contacts being actuated to a closed condition by depression of said operating members, means projecting from said handle portion engaging the ends of said operating members of said first and second switches whereby rotation of said handle portion in one direction will close the contacts of said first switch and rotation in the other direction will close the contacts of said second switch.

10. A control handle for a crane comprising a lever portion pivotally mounted at its lower end, a T-shaped handle portion having an upright and a cross portion, said upright being mounted in axially aligned relationship to said lever portion for limited rotational movement, first and second switches each having an outer casing provided with an opening, a cylindrical operating member extending through said opening for longitudinal movement therethrough, restraining means for limiting the longitudinal movement of said operating members within predetermined limits, coil springs biasing said operating members longitudinally outwards, first contacts carried on a resilient mounting on the inner end of said operating member, and second contacts mounted to said casings, said first and second contacts being actuated to a closed condition by depression of said operating members inwards, projection means extending from said upright, said first and second switches being mounted to said lever on opposite sides of said projection means with said operating members engaging said projecting means whereby rotation of said handle in one direction will close the contacts of said first switch and rotation in the other direction will close the contacts of said second switch.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 22,785	Clay	Sept. 3, 1946
2,849,548	Young	Aug. 26, 1958
2,857,485	Brooks	Oct. 21, 1958
2,913,129	Lindstrom	Nov. 17, 1959