

Dec. 15, 1970

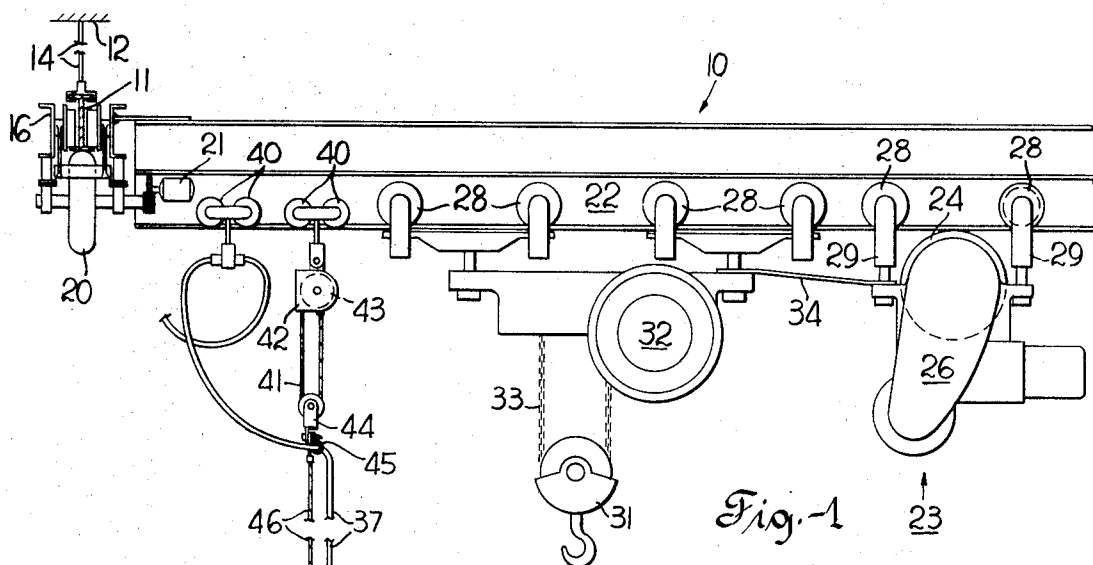
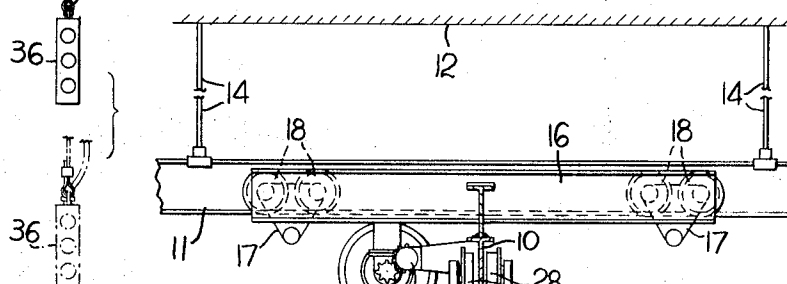
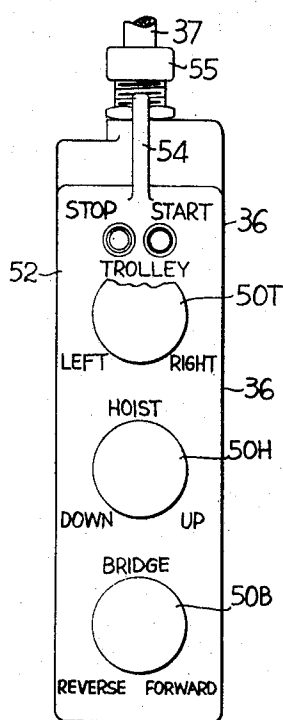
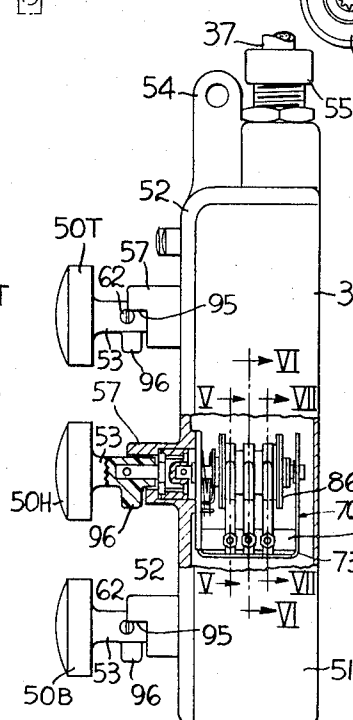
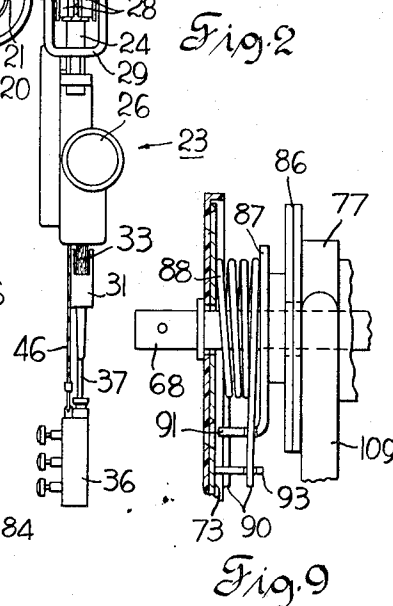
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3,548,272

PENDANT CONTROL FOR OVERHEAD CRANE

Filed May 24, 1967

2 Sheets-Sheet 1



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PENDANT CONTROL FOR OVERHEAD CRANE

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2 Sheets-Sheet 2

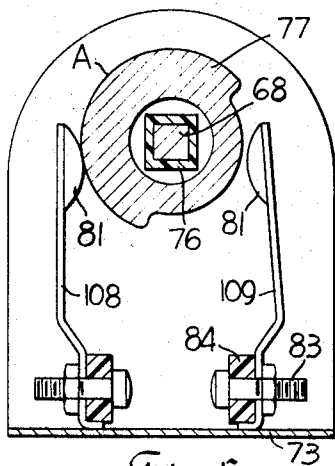


Fig. 5

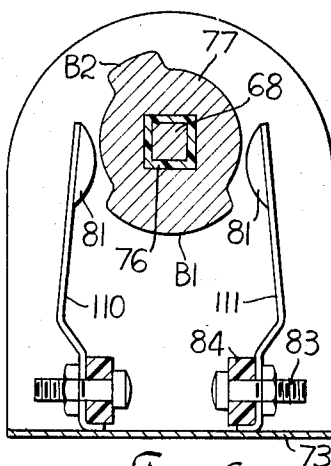


Fig. 6

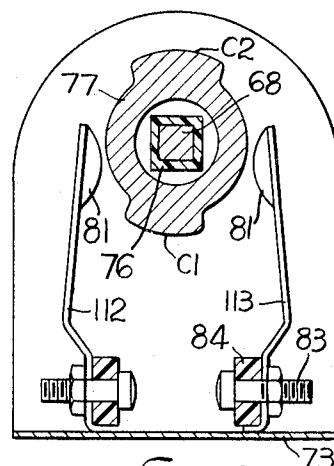


Fig. 7

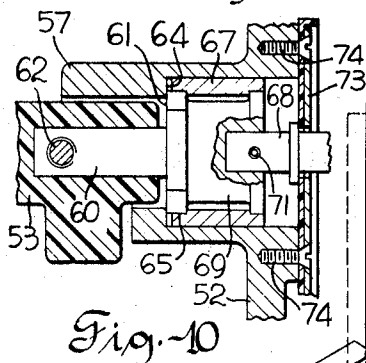


Fig. 10

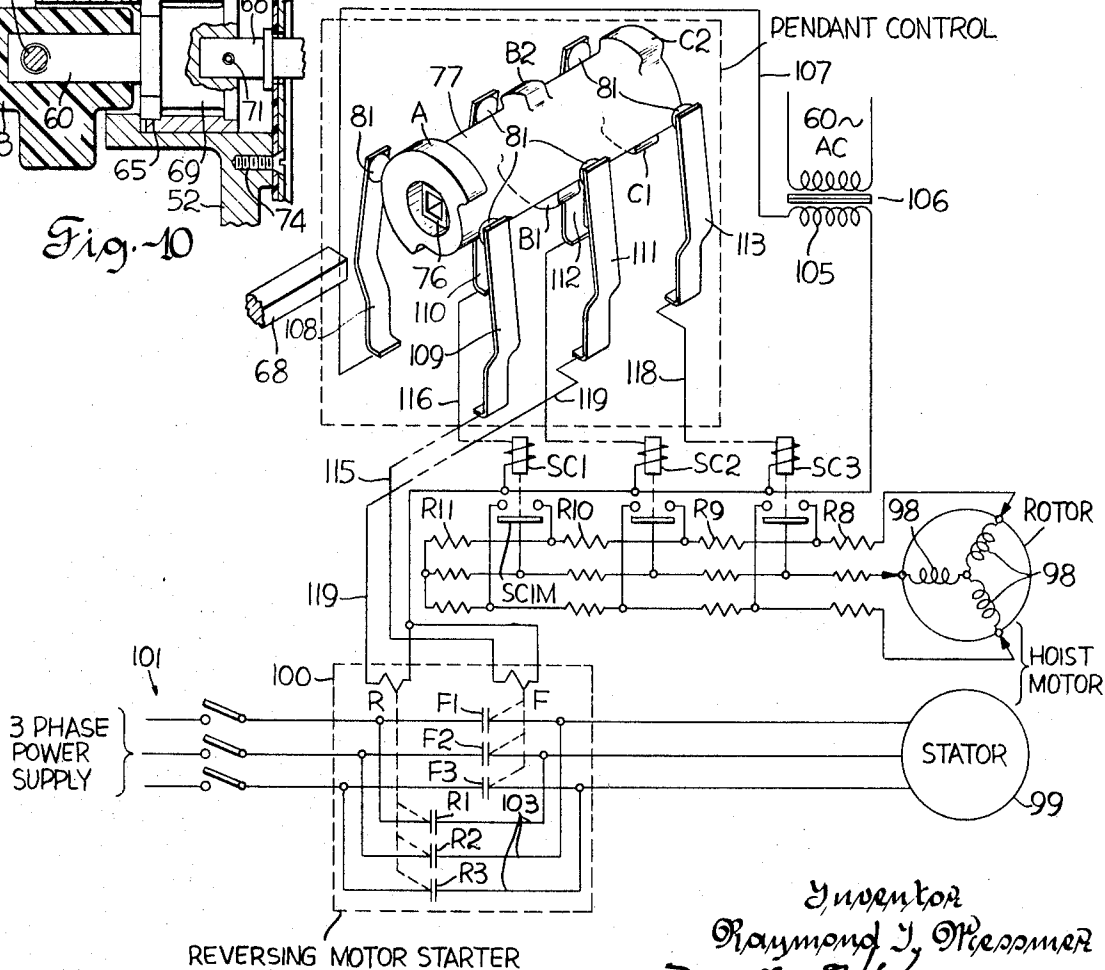


Fig. 8

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3,548,272

PENDANT CONTROL FOR OVERHEAD CRANE
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19 Claims

ABSTRACT OF THE DISCLOSURE

A pendant control for an overhead bridging crane having reversible trolley, bridge and hoist motors includes a pendant housing, an electrical cable attached to the housing, means movable along the crane bridge for suspending the housing and counterbalancing its weight, and three drum switches on the housing coupled to the trolley, bridge and hoist motors through the cable for controlling motor direction as a function of the direction of switch rotation from a normal position and motor speed as a function of the angle of rotation from normal position. Each switch has a control knob adapted to be grasped by one hand to pull the housing to the load site and control direction and angle of switch rotation. Each switch also has resilient means to return it to the normal position when released so that it is "fail safe" and has contacts spaced from insulation upon which tracking resulting from arcing at the switch contacts could occur.

This invention relates to manually operated controls for traveling bridge cranes and in particular to pendant controls which permit operation of the bridge, trolley and hoist motors of the crane from the floor and control both direction and speed of such motors.

Overhead bridge cranes are conventionally controlled by a "craneman" who rides in a cab on the crane and manipulates electrical switches to control movement of the crane in bridge, trolley and hoist directions to the locations of the load where another workman on the ground, sometimes referred to as the "hookon," secures the crane hook to the load. The trend in recent years has been to eliminate the operator in the cab on the crane and to control the crane from the ground by means of radio type controls or pendant controls having a plurality of pushbutton type, electrical switches for controlling direction and speed of the bridge, trolley and hoist motors. Radio type controls are prohibitively expensive for factories having numerous cranes. Known pendant crane controls of the pushbutton type are bulky, cumbersome and difficult to operate; they are expensive and difficult to maintain; and they are dangerous in that they occasionally fail electrically and cause loss of control of the crane by the operator and result in a "runaway" crane.

Commercially available pendant crane controls usually have eight or more pushbutton switches mounted in a row in an elongated casing to permit the operator to vary both direction and speed of the bridge, trolley and hoist motors. The difficulty of locating the desired pushbutton requires the operator to take his eyes off the load and the hoisting block. Further, the large number of pushbuttons makes it difficult for the operator to quickly acquire the familiarity needed for effective operation of the control. The casings for such pendant controls are heavy and bulky and require the operator to use both hands to grasp the control with sufficient force to pull the control to the site of the load. The weight and large size of the control often necessitates tilting the control so that the operator can see which pushbutton to press, and the continual tilting soon results in breakage of the wires of the control cable. Commercially available pendant crane controls utilize

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spring loaded pushbutton switches which require such high actuating force that the operator must squeeze with thumb and fingers of both hands to operate the switch and hold it closed, and the operator's fingers are soon fatigued from holding the pushbutton switch operated. The bulkiness of the pendant control, the difficulty of locating the desired pushbutton without taking the operator's eyes off the load, and the difficulty of operating the switches make it impracticable for the control operator to also hook on the load.

The pushbutton switches of commercially available pendant controls are of the type wherein movable metallic contacts sequentially bridge between different pairs of stationary metallic contacts arranged around the inner periphery of the insulating switch housing. Arcing between stationary and movable contacts of the pushbutton switches causes deposition of carbon particles, or "tracking," on the surface of the switch insulating housing. Such tracking often causes sustained arcing between the switch contacts with consequent destruction of the switch housing by the heat of the arc. Further, such arcing occasionally results in loss of control of the crane and a "runaway" condition which is a hazard to life and property.

It is an object of the invention to provide an improved pendant control for an overhead bridge crane which eliminates both the operator in the cab on the crane and the "hookon" on the floor and permits any worker on the floor to easily control the crane and to hook on the load.

It is a further object of the invention to provide an improved pendant control for an overhead bridge crane which a worker can easily grasp and pull with one hand to the load site and hook on the load with one hand while controlling the crane with the other hand.

It is a further object of the invention to provide such a pendant crane control having a minimum number of switch actuating means which must be actuated to control direction and speed of the hoist, bridge and trolley motors and which actuating means can be selected by touch only, thus permitting the operator to continually keep his eyes on the load as it is being hooked up and hoisted. Another object is to provide such a pendant crane control having switch actuating means which require only small force to operate with one hand and do not fatigue the operator's fingers to hold the switch operated and which actuating means itself may be grasped by the operator with one hand to pull the control to the vicinity of the load. Still another object is to provide such pendant crane control which is considerably smaller, lighter and more rugged than prior art devices; which is easier and simpler to operate than prior art devices; and which requires less maintenance and installation time than prior art pendant crane controls. A still further object is to provide such a pendant crane control which permits the operator to quickly acquire the familiarity required for effective operation.

A further object of the invention is to provide a "fail safe" pendant crane control wherein the switch actuating means automatically restore the switches to off position when they are released, thereby stopping the crane. Another object is to provide such a control which prevents loss of control and "runaway" condition of the crane as occurred with prior art apparatus. A still further object is to provide such a pendant crane control wherein the contacts of the electrical switches which control direction and speed of the bridge, trolley and hoist motors are spaced a substantial distance from the switch insulation and sustained arcing between switch contacts cannot result from deposition of carbon or tracking.

These and other objects and advantages of the invention will be more readily apparent from the following

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detailed description when considered in conjunction with the accompanying drawing wherein:

FIG. 1 is a front view of a typical overhead crane embodying the invention;

FIG. 2 is an end view of the apparatus of FIG. 1;

FIG. 3 is a front view of the switch housing of the pendant control of FIG. 1;

FIG. 4 is a side view of the device of FIG. 3 with a portion of a sidewall removed to illustrate the switch construction;

FIGS. 5, 6 and 7 are views taken along lines V—V, VI—VI and VII—VII of FIG. 4;

FIG. 8 is a schematic diagram of a portion of the electrical circuit for one of the motors, namely, the hoist motor of the crane of FIG. 1;

FIG. 9 is an enlarged view of the switch return, torsion spring means shown in FIG. 4; and

FIG. 10 is an enlarged view of the portion of FIG. 4 showing the switch actuating means.

Referring to FIGS. 1 and 2, the invention is shown applied to a typical overhead bridging crane having a bridge 10 traveling along spaced apart parallel crane runways 11 (only one being shown). The crane bridge 10 is illustrated as an I-beam, and the crane runways 11 are shown as I-beams suspended from the ceiling 12 by depending rods 14. The crane bridge 10 runs on the lower flanges of the I-beam runways 11 and each end thereof is rigidly affixed to an end truck having a pair of spaced apart end truck channel members 16 extending parallel to and disposed on opposite sides of runway 11. Brackets 17 are affixed to the ends of the truck channel members 16, and end truck wheels 18 rotatably mounted on brackets 17 ride on the lower flanges of the I-beam runways 11. The crane bridge 10 is propelled along the crane runways 11 by traction wheels 20 fastened to the crane end trucks and engaging the lower surface of the I-beam runways 11. The traction wheels 20 are driven by a bridge motor 21 mounted on the bridge 10 through means shown only schematically in the drawing.

Supported by and operating on I-beam bridge 10 is an electric hoist mechanism 23 propelled along the crane bridge by a trolley mechanism including a traction wheel 24 engaging the lower surface of I-beam bridge 10 and driven by a trolley motor 26. Wheels 28 engaging the lower flange of I-beam bridge 10 support the trolley mechanism through yoke members 29. Hoist mechanism 23 includes a hoist hook block 31 raised or lowered by means of a hoist motor 32 through hoist chain 33 and supported by wheels 28 engaging the lower flange of I-beam bridge 10. The trolley mechanism may be connected to the hoist mechanism by means of a link 34.

The particular overhead crane disclosed does not constitute a novel part of the present invention and is only described to illustrate a typical apparatus which the invention controls.

The bridge, trolley and hoist motors 22, 26 and 32, respectively, of the crane are remotely controlled by a worker at ground level by means of a pendant crane control box, or switch housing 36, connected to an electrical control cable 37. Electrical connections from the control cable 37 to the motors on the movable crane may be completed through conventional power collector bars and power collector shoes which do not constitute part of the invention and are omitted to shorten the description and facilitate the understanding of the invention.

Control box 36 and several loops of control cable 37 are preferably supported for movement by the operator along bridge 10 by means of wheels 40 engaging the lower flange of I-beam bridge 10. Control box 36 is normally suspended in midair in a convenient position where it is readily accessible to the worker and its weight and that of control cable 37 are counterbalanced by a wire cable 41 depending from a cable rewinding reel 42 supported on a pair of the wheels 40 for movement along bridge 10.

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One end of wire cable 41 may be affixed to a rotatable drum 43 of cable rewinding reel 42 urged by a clock type spiral spring (not shown) to provide an upward lifting force on cable 41 slightly greater than the weight of control box 36 and control cable 37 and to resiliently resist withdrawal of cable 41 from reel 42 when control box 36 is pulled downward by the operator to any desired position, such as that shown in dotted lines in FIG. 1, and to retract wire cable 41 and raise control box 36 to its normal position when released by the operator. Wire cable 41 may run through a pulley rotatably mounted on a pulley block 44 and be affixed at its other end to rewinding reel 42, and pulley block 44 may be connected to control box 36 by a stub piece of wire cable 46 and be affixed to the electrical cable 37 at a point removed from control box 36 by suitable clamping means 45. Reel 42 retracts wire cable 41 until pulley block 44 abuts against reel 42, and it will be appreciated that pulley block 44 thus acts as a stop to normally position control box 36 in a convenient horizontal plane.

Control box 36 is only approximately one-third the height and a minor fraction of the weight of commercially available pushbutton type pendant crane controls, and it will be appreciated that no flexing of the control cable 37 occurs as the control box 36 is lowered to convenient height by the operator. The rewinding reel 42 counterbalances the weight of control box 36 and control cable 37 so that the operator may easily move control box 36 up or down with one hand if required to bend over to hook in the load with his other hand.

As shown in FIGS. 3 and 4, control box 36 has three rotatable, doorknob shaped, switch actuating handles, or control knobs 50T, 50H and 50B thereon which control both speed and direction of the trolley, hoist and bridge motors 22, 26 and 32, respectively. Each control knob 50 is easily grasped by one hand of the operator to pull control box 36 to the site of the load, and the reduction in the number of switch actuating means to three, in comparison to the eight pushbuttons of commercially available pendant crane controls, permits the operator to easily select the desired switch actuating means by touch only and does not necessitate tilting the control box and taking the operator's eyes off the hoist and the load as is required by pushbutton type pendant controls.

Control box 36 preferably comprises an elongated hollow casing 51 closed by a removable L-shaped cover 52 and secured thereto by machine screws. Both casing 51 and cover 52 may be castings of suitable light weight metal such as aluminum. Stub cable 46 is affixed to an eye 54 integral with cover 52, and electrical control cable 37 may extend into the interior of casing 51 through a threaded connector 55 on cover 52. Three spaced apart tubular projections 57 on cover 52 receive the reduced diameter portions 53 of control knobs 50T, 50H and 50B. Each control knob 50 has an axial bore which receives the shaft portion 60 of a coupling member 61 and is rigidly affixed thereto by a set screw 62 which is threaded into the shaft portion 60. The tubular projections 57 are counterbored from the inner surface thereof to provide shoulders 64 against which enlarged diameter portions 65 of the coupling members 61 abut to prevent movement in an axially outward direction. The coupling members 61 are positioned within sleeve bearings 67 disposed within the counter-bored portions of the tubular projections 57, and each coupling member 61 has an axial bore which receives the operating shaft 68 of an electrical drum switch, or controller 70 and is affixed to shaft 68 by a radially extending roll pin 71.

The three drum switches 70 complete energizing circuits to contactors or relays described hereinafter which open and close circuits for controlling speed and direction of the bridge, trolley and hoist motors 22, 26 and 32. The three drum switches 70 are identical and only one will be described. Drum switch 70 has a U-shaped mount-

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ing frame 73, one leg of which is affixed to the inner surface of cover 52 by screws 74. The portion of switch operating shaft 68 disposed between the legs of U-shaped mounting frame 73 is of square cross section, an insulating tube 76 of square cross section (see FIGS. 5-8) surrounds this portion of shaft 68, and a cylindrical metallic cam, or drum 77, having an axial bore of square cross section fits over insulating tube 76 and is electrically isolated from the mounting frame 73 by insulating tube 76. Drum 77 has three sets of radially extending movable contact portions A, B and C at axially spaced positions adapted when operating shaft 68 is rotated to sequentially engage contact buttons 81 on upstanding metallic stationary contact fingers 108-113. Drum switch 70 has three sets, or pairs, of stationary contact fingers 108-113 with the fingers of each pair disposed on opposite sides of drum 77 in radial alignment with the corresponding movable contact portions A, B or C on drum 77. The three axially spaced stationary contact spring fingers on each side of drum 77, for example fingers 109, 111 and 113, are mounted by metallic screws 83 on an elongated insulating strip 84 supported between the upstanding legs of the mounting frame 73, and the screws 83 constitute terminals for connection of electrical leads. Thin insulating disks 86 surround switch operating shaft 68 at both ends of drum 77. A dog 87 having an axial opening of square cross section fits over and rotates with the square cross section portion of switch operating shaft 68. A helical torsion switch return spring 88 surrounding switch operating shaft 68 has a pair of arcuately spaced radially extending ears 90 at the ends of the spring which are disposed on opposite sides of an axially extending arm 91 on dog 87 and also on opposite sides of an axially extending stop pin 93 affixed to an upstanding leg of U-shaped mounting frame 73.

Manual turning of control knob 50 by the operator, results in rotation of switch operating shaft 68 and dog 87 affixed thereto, thereby displacing one radially extending ear 90 on torsion spring 88 while the other end is prevented from movement by stop pin 93 and resulting in loading of torsion spring 88. Switch actuating control knob 50 is thus resiliently urged by torsion spring 88 towards its normal position when it is rotated in either the clockwise or counterclockwise direction from the normal position. It will thus be appreciated that the disclosed control is "fail safe" in that the switch control knobs 50B, 50T and 50H for controlling the bridge, trolley and hoist motors are always restored to their normal position when released by the operator. Further, it will be appreciated that all arcing between movable and stationary switch contacts occurs in air and is spaced a substantial distance from any enclosing insulation members, thereby avoiding the "tracking" of insulation which caused the runaway condition in prior art crane controls of the pushbutton type.

Tubular projections 57 on cover 52 have radially extending surfaces 95 which interfere with radial arms 96 or control knobs 50 to limit movement of the control knobs in both directions of rotation.

The electrical circuits completed by the drum switch controllers 70 actuated by the bridge, trolley and hoist control knobs 50B, 50T and 50H are substantially identical and only the schematic circuits completed by hoist control knob 50H will be described. Such electrical circuits are schematically shown in FIG. 8 which omits the power collector bars and power collector shoes used to complete energizing circuits to the motors on the crane and also omits the start and stop circuits which may be controlled by START and STOP pushbutton switches on control box 36. Hoist motor 32 is shown as being of the three phase slip ring type having a rotor with phase windings 98 and a stator 99. Rotation of hoist motor 32 in the forward direction to raise the load on hook block 31 is accomplished by energizing the forward winding F of a reversing magnetic motor starter 100 to close mov-

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ble contacts F1, F2 and F3 and complete an energizing circuit from a three phase power supply line 101 to stator 99 of hoist motor 32. Rotation of hoist motor 32 in the reverse direction to lower the load on hook block 31 is effected by energizing the reverse winding R of reversing motor starter 100 to close its movable contacts R1, R2 and R3 and complete an energizing circuit from power supply line 101 to stator 32 over conductors 103 in which two of the phases are reversed.

The phase windings 98 of the rotor are brought out through slip rings (not shown) to the serial arrangement of resistors R8, R9, R10 and R11 in each phase connected to a common point such as ground to reduce the speed of rotation of the hoist motor 32. The speed of hoist motor 32 illustrated in FIG. 8 may be increased in three steps. Operation of speed control relay SC1 closes its movable contacts SC1M and shorts the resistances R11 in the three phases. Similarly, operation of speed control relays SC2 and SC3 in sequence short circuits the resistances R10 and R9 and increases the speed of hoist motor 32 in second and third steps to increase the rate at which the load is raised or lowered.

Electrical power for energizing windings F and R of reversing motor starter 100 and for energizing the operating coils of relays SC1, SC2 and SC3 may be derived from the secondary winding 105 of a transformer 106 having its primary winding connected to a suitable source of alternating current power. One side of transformer secondary winding 105 is connected over a conductor 107 to stationary contact finger 108 which maintains continuous wiping engagement with raised cam portion A (see FIGS. 5 and 8) extending around approximately 220 degrees of metallic drum 77 of controller 70. The opposite side of transformer secondary winding 105 is connected through conductor 110 to one side of each of the forward and reverse windings F and R of motor starter 100 and also to one side of the operating coils of each of the speed control relays SC1 and SC2 and SC3.

Rotation of hoist control knob 50H in clockwise direction, as seen from the front of control box 36, brings raised cam portion A on drum 77 into engagement with finger contact 109 disposed on the opposite side of drum 77 from finger contact 108 and completes an energizing circuit through a conductor 115 connected to finger 109 to forward winding F of motor starter 100, thereby closing contacts F1, F2 and F3 and causing hoist motor 32 to run in the forward direction at its lowest speed. Further rotation of hoist control knob 50H in the clockwise direction brings a raised cam portion B1 extending approximately 110 degrees around metallic drum 77 into engagement with control finger 110 disposed adjacent contact finger 108 to complete an energizing circuit over a conductor 116 connected to finger 110 to the operating winding of speed control relay SC1, thereby closing its contacts SC1M and shorting out resistances R11 to increase the speed of hoist motor 32. It will be appreciated that cam portion A remains in wiping contact with stationary contact finger 108 to keep forward winding F energized while the speed of motor 32 is being changed. Further rotation of hoist control knob 50H in the clockwise direction brings a raised cam portion C1 extending over approximately 70 degrees of metallic drum 77 into engagement with stationary contact finger 112 disposed adjacent finger 110 to complete an energizing circuit over a conductor 117 connected to finger 112 to the operating coil of relay SC2, thereby causing it to operate its contacts and short out resistances R10 and thus increase the speed of hoist motor 32 in another step. Still further rotation of hoist control knob 50 in the clockwise direction brings a raised cam portion C2 extending over approximately 66 degrees of drum 77 into engagement with a stationary contact finger 113 disposed opposite finger 112 to complete an energizing circuit over conductor 118 connected to finger 113 to the operating coil of speed control relay SC3, thereby operating its con-

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tacts to short out resistances R9 and increase the speed of hoist motor 32 in another step. When the operator releases control knob 50H, loaded torsion spring 88 acting on arm 91 of dog 87 rotates the switch shaft 68 to restore the controller 70 to its normal position, thereby opening the circuits to forward winding F and speed control windings SC1, SC2 and SC3 and stopping motor 32.

Manual operation of hoist control knob 50H in the counterclockwise direction brings a raised cam portion B1 (see FIGS. 6 and 8) extending across approximately 110 degrees of metallic drum 77 into engagement with stationary contact finger 111 disposed between contact fingers 109 and 113 to complete an energizing circuit over a conductor 119 connected to finger 111 to the reverse winding R of motor starter 100, thereby closing contacts R1, R2 and R3 and causing hoist motor 32 to run in the direction to lower the load on hook 31. Further rotation of control knob 50H in the counterclockwise direction sequentially brings cam portions B2, C2 and C1 into engagement with contact fingers 110, 112 and 113, respectively, to complete energizing circuits to the operating windings of speed control relays SC1, SC2 and SC3 in sequence as control knob 50H is rotated further in the counterclockwise direction and thus control the speed of hoist motor 32 in three steps.

Portions of conductors 107 and 115-119 are shown in dotted lines to indicate that they are in control cable 37.

Control box 36 is light in weight and only approximately one-third the height of commercially available pushbutton type devices, and further its weight is counterbalanced by cable rewind reel 42. Switch control knobs 50 are easy to grasp by the operator with one hand to pull the control box 36 to the site of the load. Only three switch actuating knobs 50 are required to control both speed and direction of the crane bridge, trolley and hoist motors in comparison to six pushbuttons for the same purpose on commercially available pushbutton pendant crane controls, thereby permitting the operator to easily select the desired switch actuating means by touch only and operate it with one hand while permitting him to hook on the load with his other hand to keep his eyes on the load and hoist block at all times. The drum 77 and finger contacts are spaced a substantial distance from insulation so that deposition of carbon and "tracking" cannot occur which frequently causes sustained arcing in pushbutton switches of known pendant crane controls, and it will be appreciated that this feature prevents loss of control of the crane by the operator, eliminates the hazard of runaway cranes, and minimizes maintenance problems in comparison to pushbutton type pendant crane controls.

While only a single embodiment of the invention has been illustrated and described, many modifications and variations thereof will be readily apparent to those skilled in the art, and consequently it is intended to cover in the appended claims all such modifications and variations which are within the true spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination with a bridging crane having reversible trolley, bridge and hoist motors for moving the bridge and hoist of said crane in trolley, bridge and hoist directions,

a pendant switch housing,

means movable along the bridge of said crane for suspending said housing from said crane,

an electrical cable attached to said housing,

three rotatable switch means on said housing each of which is associated with a respective one of said motors and coupled thereto through said cable for controlling the direction and speed of said one motor as functions of the direction and angle of rotation of said switch means from a normal position, and

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three rotatable switch actuating handles on said housing each of which is operatively connected to one of said switch means and adapted to be grasped by one hand of the crane operator to pull said housing to the load site and being rotatable by one hand to control direction and angle of rotation of said switch means.

2. In the combination defined by claim 1 wherein each switch means is a drum switch having a rotatable operating shaft and said switch actuating handle in a control knob operatively connected to said shaft.

3. In the combination defined by claim 2 wherein each drum switch includes a rotatable metallic drum and a plurality of stationary contact fingers disposed adjacent said drum and wherein said drum has a plurality of radially projecting portions adapted to sequentially engage and make wiping electrical contact with said fingers when said drum is rotated by said control knob.

4. In the combination defined by claim 3 wherein each drum switch includes a plurality of pairs of contact fingers spaced apart axially of said drum and the fingers of each pair are disposed on opposite sides of said drum and said radially projecting portions on said drum are in radial alignment with said sets of fingers.

5. In the combination defined by claim 3 wherein one of said contact fingers is electrically connected to one side of a source of electrical power and is in continuous engagement with said drum and the engaging portions of said radially projecting portions and said contact fingers between which arcing may occur are spaced an appreciable distance from insulating members upon which tracking could result from said arcing.

6. In the combination defined by claim 1 and including resilient means for returning each said switch means and its actuating handle to said normal position when released by the operator.

7. In the combination defined by claim 1 wherein said bridge is a I-beam and said means for suspending said housing has a lifting component slightly greater than the weight of said housing and said cable and includes support wheels movable along the lower flange of said I-beam bridge and stop means for normally holding said switch housing in a predetermined horizontal plane.

8. In the combination defined by claim 7 wherein said means for suspending said housing includes a rewind reel supported from said wheels, an elongated flexible member affixed at its lower end to said switch housing and its upper end to said rewind reel, and wherein said reel has resilient means for pulling upward on said flexible member with a force slightly greater than the weight of said housing and said cable and said stop means is secured to said flexible member.

9. In the combination defined by claim 3 wherein first and second of said stationary contact fingers are first engaged by said radially projecting portions of said drum when said drum switch is rotated in the clockwise and counterclockwise directions respectively from said normal position and wherein said crane has associated with each motor electromagnetic switching means having forward and reverse windings for completing electrical circuits to rotate said motor in forward and reverse directions when said forward and reverse windings respectively are energized and wherein said first and second contact fingers are electrically connected to said forward and reverse winding through said cable.

10. In the combination defined by claim 9 and including a plurality of electromagnetic relay means associated with each said motor for varying the speed of said motor and wherein a plurality of said contact fingers of the drum switch associated with said motor are connected to the operating coils of said relay means through said cable and said radially extending projections on said drum sequentially engage said plurality of contact fingers when said drum switch is operated in a first direction from a normal position and also engage said same plurality of

contact fingers in the same sequence when said drum switch is operated in the opposite direction from said normal position.

11. In combination with a bridging crane having reversible trolley, bridge and hoist motors for moving the bridge and hoist of said crane in trolley, bridge and hoist directions, electromagnetic switch means associated with each motor having forward and reverse windings for controlling the direction of motor rotation and being adapted to complete electrical circuits to operate said motor in forward and reverse directions when said forward and reverse windings are energized, and electrically operated means associated with each motor for changing motor speed;

a switch housing,
means movable along the bridge of said crane for suspending said switch housing from said crane,
an electrical cable attached at one end to said housing, three rotatable switch means in said housing each of which is associated with a respective one of said motors and coupled thereto through said cable for completing electrical energizing circuits to said forward and reverse windings respectively when rotated in opposite directions from a normal position and for completing an electrical energizing circuit to said speed changing means when rotated through a predetermined angle in either clockwise or counterclockwise directions from said normal position, and three rotatable switch actuating handles on said housing each of which is operatively connected to one of said rotatable switch means and adapted to be grasped and rotated with one hand.

12. In the combination defined by claim 11 wherein said speed changing means varies motor speed in a plurality of steps and has a plurality of operating windings and changes motor speed one step when each said operating winding is energized and wherein said rotatable switch means associated with said motor completes electrical energizing circuits sequentially to said operating windings when rotated in both the clockwise and the counterclockwise directions from said normal position.

13. In combination with a bridging crane having reversible trolley, bridge and hoist motors for moving the bridge and hoist of said crane in trolley, bridge and hoist directions, electromagnetic switch means associated with each motor having forward and reverse windings for completing electrical circuits to operate the motor in forward and reverse directions when said forward and reverse windings are energized, and means for changing the speed of said motor in a plurality of steps, said speed changing means having a plurality of operating windings and being adapted to vary motor speed one step when each operating winding is energized,

a pendant switch housing,
means movable along the bridge of said crane for suspending said switch housing from said crane,
an electrical cable attached to said housing,
three rotatable drum switch means on said housing each of which is associated with a respective one of said motors and coupled to said forward and reverse and operating windings through said cable for completing electrical energizing circuits to said forward and reverse windings when rotated in clockwise and counterclockwise directions respectively from a normal position and for sequentially completing elec-

trical energizing circuits to said operating windings when rotated in either the clockwise or counterclockwise directions from said normal position, and three rotatable switch actuating control knobs on said switch housing each of which is operatively connected to one of said drum switch means and adapted to be grasped and rotated with one hand to operate said drum switch means and to pull said housing along said bridge to the site of the load.

14. In the combination defined by claim 13 wherein each drum switch means has resilient means for returning it to said normal position when said control knob is released.

15. In the combination defined by claim 14 wherein said bridge is an I-beam and said means for suspending said housing includes wheels movable along the lower flange of said I-beam, a depending elongated flexible member affixed at its lower end to said housing, means having an upward lifting component slightly greater than the weight of said housing and said cable supported from said wheels and secured to the upper end of said flexible member, and stop means on said flexible member for normally positioning said housing in a predetermined horizontal plane.

16. In the combination defined by claim 13 wherein said electromagnetic switch means is a reversible motor starter having forward and reverse windings and said drum switch means completes energizing circuits to said forward and reverse windings when rotated in opposite directions from said normal position.

17. In the combination defined by claim 15 wherein said speed changing means includes a plurality of electrical relay means for changing the speed of said motor and said drum switch means sequentially completes energizing circuits to the operating coils of said relay means when rotated in both the clockwise and in the counterclockwise directions from said normal position.

18. In the combination defined by claim 17 wherein said drum switch means includes a rotatable metallic drum and a plurality of stationary contact fingers disposed adjacent said drum and wherein said drum has a plurality of radial projections adapted to sequentially engage said contact fingers when said drum is rotated.

19. In the combination defined by claim 18 wherein one of said fingers is in continuous engagement with said drum and including a source of electrical power one side of which is connected to said one finger and the other side of which is connected through said cable to one side of said forward and reverse windings and to one side of said operating coil of each of said relay means.

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