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CONTROL SYSTEM

Filed April 23, 1931

Fig. 1.

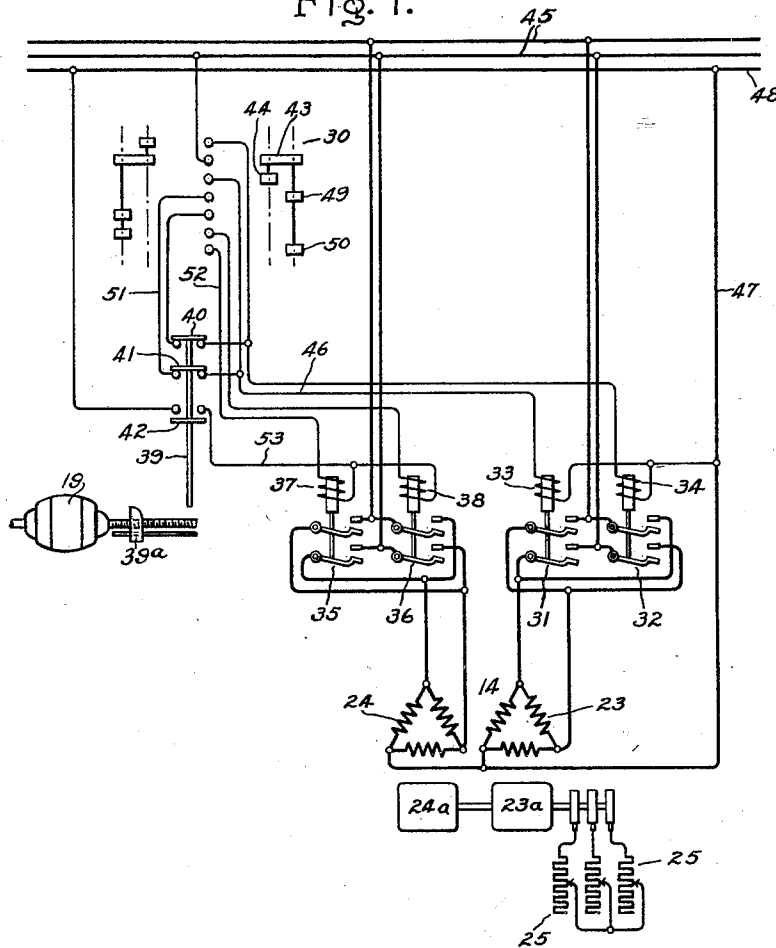
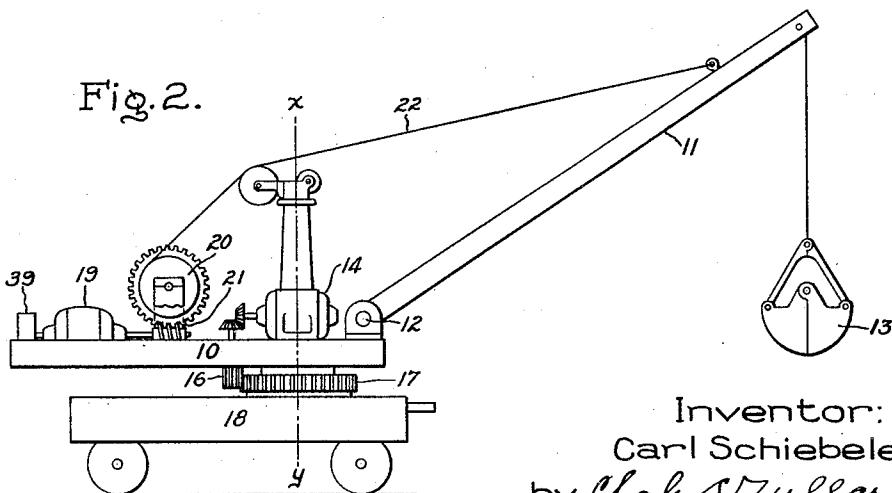


Fig. 2.



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UNITED STATES PATENT OFFICE

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CONTROL SYSTEM

Application filed April 23, 1931, Serial No. 532,361, and in Germany May 3, 1930.

This invention relates to control systems for shovels, cranes and the like and has for its object the provision of control means for limiting the slewing speed in dependence upon the position of the jib.

The efforts made to increase the output of shovels, cranes and the like have not been limited to an increase in lifting speed but also have been directed to higher slewing speeds. In cranes having a large jib, however, the slewing speed is limited by the mechanical stresses set up by the acceleration and deceleration forces. Moreover, the turning radius of the jib must be taken into consideration when working luffing cranes with adjustable jib, the turning radius of which varies between high and low limits. In other words, when the jib forms a small angle with the horizontal the slewing speed must be low to avoid accidents resulting from the large radius.

In accordance with the invention the slewing gear of the crane is operated by a three-phase motor having different numbers of poles, thereby giving different speeds. The motor is controlled so that the low speed winding may be energized for low speed slewing at all radii but the high speed winding only with small radii. This change in control is effected by means of a limit switch operated in dependence upon the position of the jib.

For a more complete understanding of my invention reference should be had to the drawings, Fig. 1 of which is a diagrammatic view of a control system for shovels, cranes and the like embodying my invention, while Fig. 2 is a simplified elevation view of an electric shovel embodying my invention.

Referring to the drawings, the invention is illustrated in connection with a shovel provided with a platform 10 which can be moved in a substantially horizontal plane about a turning axis $x-y$. The platform carries a jib 11 pivotally secured at one end to the platform at point 12 and carrying on its outer end a grab bucket 13. The platform 10 with the jib 11 can be slewed around by means of a three-phase motor 14 provided with a pair of armature windings providing

respectively low and high speeds. This motor is connected by a gearing 16 to a large gear 17 secured to the truck 18 carrying the shovel. It will be understood that the large gear 17 has its center lying on the turning axis $x-y$ so that rotation of the motor 14 causes the platform to slew around in the desired direction. The jib 11 may be raised and lowered by means of an electric motor 19 connected to a winding drum 20 through suitable worm gearing 21, the winding drum operating on a cable 22 connected to the jib. This motor 19 is provided with suitable manual operated control switching means, not shown. It will be understood that suitable operating means, not shown, will be provided for the bucket 13.

While two separate driving motors having different speeds may be used for slewing, a single motor is shown provided with a pair of three-phase armature windings 23 and 24 having different numbers of poles whereby different speeds are obtained. For example, the armature winding 23 for the low speed may be arranged to produce 16 poles while the winding 24 for the high speed may be arranged to produce 8 poles. Preferably the high speed winding 24 is provided with a squirrel cage rotor 24a while the low speed winding 23 is provided with a distributed rotor winding 23a connected to slip rings across which resistances 25 are connected to control the starting of the motor. The two rotors may be mechanically separate on a common shaft with the armature windings associated therewith in a common motor housing. It will be understood, that if desired suitable timing mechanism may be used to automatically short circuit the resistances 25 in sections after the lapse of predetermined time intervals in order to bring the motor up to its low speed.

The motor windings 23 and 24 are controlled to control the slewing of the shovel by means of a hand operated switch 30 of the drum type. As shown, this switch has two positions, i. e., low and high speed for each direction of rotation. The control of the windings is effected by electromagnetic reversing switches, the winding 23 being pro-

vided with reversing switches 31 and 32 which are normally open as shown and may be closed by operating coils 33 and 34. Similar reversing switches 35 and 36 operated respectively by coils 37 and 38 are provided for the motor winding 24.

The control of the motor 14 is also dependent upon the position of the jib 11 in elevation and this control is effected by means of a limit switch 39 which is operated in dependence upon the elevation of the jib. As shown this limit switch is associated with the driving motor 19 and operated by a traveling nut 39a on a screw shaft turned by the motor. As shown in Fig. 1 this limit switch is provided with three bridging contacts 40, 41 and 42. When the jib is in a lower position such that its turning radius is greater than a predetermined value the limit switch is in its lower position shown in the drawing, the bridging members 40 and 41 being in their closed circuit position while the bridging member 42 is in its open circuit position.

This limit switch performs its control function when the control switch 30 is thrown to its second or high speed position for either direction. For low speed the low speed winding 23 only is energized. When the control switch is thrown to the high speed position, however, the particular winding to be energized depends upon the position of the limit switch. In the position shown in the drawing the bridging members 40 and 41 maintain closed auxiliary circuits for the operating coils 33 and 34 of the control for the low speed winding 23 while the bridging member 42 is in its open circuit position and maintains open a circuit for the two operating coils 37 and 38 for the high speed winding 24. Under these conditions therefore, i. e., with the jib 11 in some lower position whereby its turning radius is greater than a predetermined value only the low speed winding can be used in both positions of the drum.

However, when the jib is raised whereby its turning radius is decreased to a value lower than the predetermined value, then the limit switch is operated to its upper position whereby the bridging members 40 and 41 are in their open circuit position and the bridging member 42 is in its closed circuit position. Under these conditions, when the control switch 30 is thrown to its high speed position, the operating coil 33 or 34, as the case may be, is deenergized and one or the other of the coils 37 and 38 is energized depending upon the direction of rotation of the switch. This energizes the high speed winding for the proper direction of rotation.

When the switch 30 is thrown, for example, to the first position to engage the drum contacts 43 and 44 with their stationary contacts, it will be observed that a circuit is completed

from one of the supply mains 45 of the three-phase supply source through the switch 30, the conductor 46, the operating coil 33 and the conductor 47 to the supply main 48. The switch 31 thereupon is closed. When the switch 30 is thrown to the high speed position in the same direction the circuit through the contact 44 is broken by disengagement of this contact with its stationary contact but the switch contacts 49 and 50 engage with their cooperating stationary contacts. With the limit switch 39 in the position shown, a circuit is then completed from the switch contact 49 through the conductor 51, the bridging member 41, the conductor 46 and the operating coil 33 whereby the switch 31 is maintained closed as before and the low speed winding 23 continues to be energized for both the low and high speed positions. However, if the limit switch should be in its upper position, it will be observed that a circuit will be established in the high speed position of switch 30 assumed from the contact 50 through conductor 52, coil 37, conductor 53, and bridging member 42 to the supply main 48. This closes the switch 35 whereby the high speed winding 24 is energized for the same direction of rotation. It is believed that the operation in reverse direction will be clear from this description.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination in a crane or the like provided with a jib and slewing mechanism therefor, of low and high speed driving means for said slewing mechanism and means dependent upon the elevation of the jib for controlling the operation of said high speed driving means.

2. The combination in a crane or the like provided with a jib and slewing mechanism therefor, low and high speed driving means for said slewing mechanism; a control switch for said driving means having low and high speed positions and means dependent upon the elevation of the jib for selectively controlling the operation of said low and high speed driving means when said control switch is in said high speed position.

3. The combination in a shovel or the like provided with a jib and slewing mechanism therefor, means for adjusting the elevation of said jib, low and high speed driving means for said slewing mechanism, control means for said driving means provided with low and high speed positions, and auxiliary control means for said driving means operated by said jib elevating means for preventing the operation of said high speed driving means when the elevation of the jib is greater than a predetermined amount.

4. The combination in a shovel or the like provided with a jib and slewing mechanism therefor, low and high speed driving means for said slewing mechanism, means for ad-

justing the elevation of said jib, a control switch for said driving means having low and high speed positions, an auxiliary switch arranged to establish connections for selective operation of said high or low speed driving means when the control switch is in its high speed position, and means responsive to the position in the elevation of said jib for operating said auxiliary switch.

10 In witness whereof I have hereunto set my hand.

CARL SCHIEBELER.

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