D. LARSON.

ALTERNATING CURRENT MOTOR CONTROL.

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1,066,739. Patented July 8, 1913.

Fig. 1

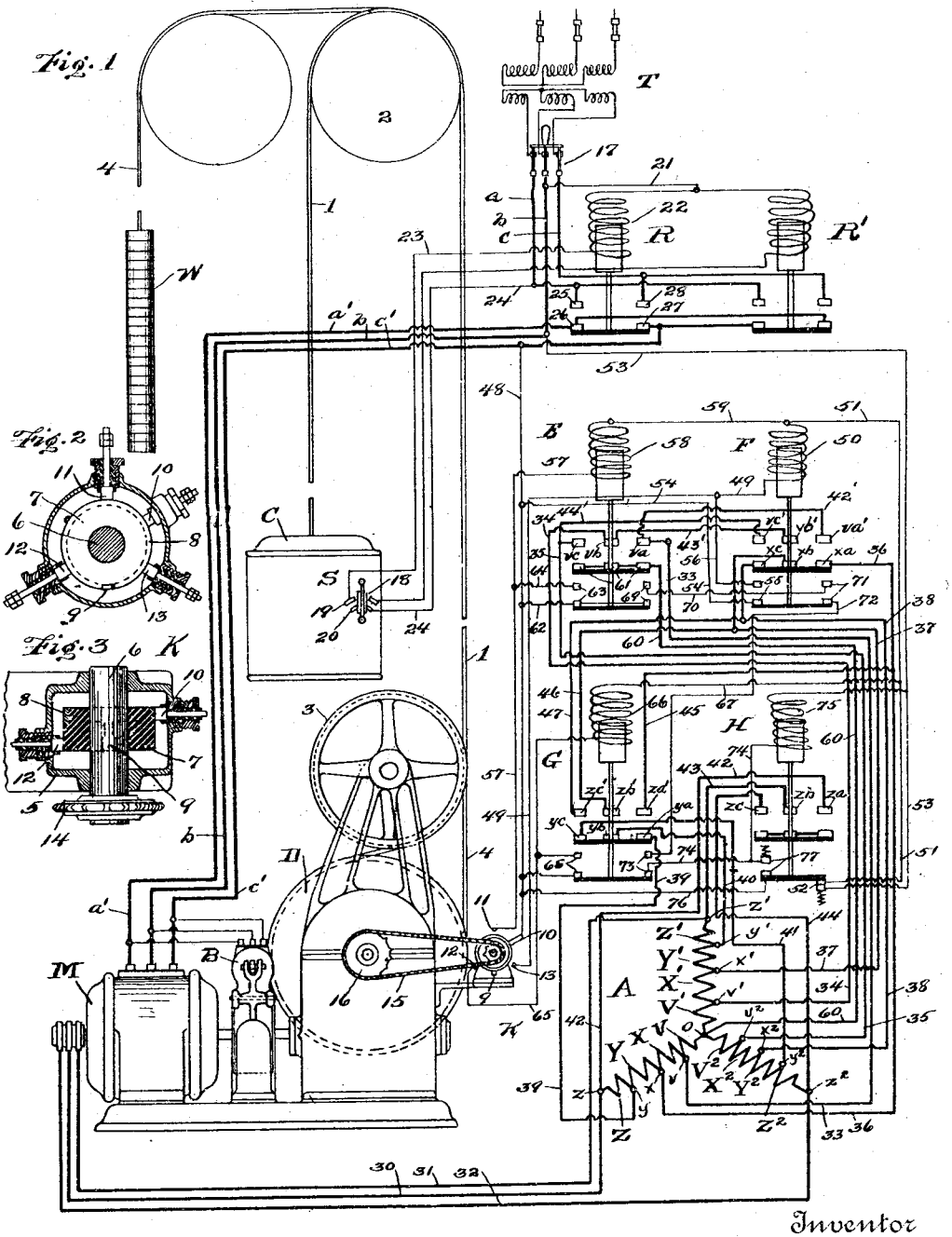


Fig. 2

Fig. 3

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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT-MOTOR CONTROL.

1,066,739. Specification of Letters Patent. Patented July 8, 1913.

Application filed August 11, 1908. Serial No. 447,935.

To all whom it may concern:

Be it known that I, DAVID LARSON, a subject of the King of Sweden, residing at Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Alternating-Current-Motor Control, of which the following is a specification.

The present invention relates to a system of electric motor control, and is herein shown as applied to an alternating current motor used to operate an elevator system.

One of the objects of the invention is the provision of improved means for controlling the starting resistance of the motor.

Other objects of the invention will appear hereinafter; the novel combinations of elements being set forth in the appended claims.

Referring to the accompanying drawings, Figure 1 is a diagrammatic view of an elevator system and the controlling and operating circuits and mechanism for the motor; Fig. 2 is a sectional elevation of an automatic controller for the starting resistance; and Fig. 3 is a sectional plan view of the same.

The motor M is geared to the hoisting drum D by means of a worm and worm wheel (not shown). The car C is connected to the drum by hoisting ropes or cables 1 engaging the overhead sheave 2, the vibrator sheave 3, and wound around the drum. The counterweight W is connected to the hoisting drum by cables 4 wound around the drum in the opposite direction. The motor brake B has its magnet circuits connected in parallel with the stator of the motor so as to receive current and release the brake in a well known manner whenever the motor receives current. This elevator system is shown merely to illustrate one of the various uses to which the motor may be applied.

Although the invention is herein shown as used in connection with a three-phase alternating current motor, it will be understood that it is also well adapted for use with motors using currents of other phase, or direct currents.

The electric system here shown comprises a transformer T, reversing switches R, R′, a car switch S, starting resistance A, electromagnetic switches E, F, G, H controlling the circuits of the starting resistance, and an automatic controller K controlling the magnet circuits of the switches E, F, G, H.

The controller K, shown in detail in Figs. 2 and 3, comprises a stationary frame 5, a shaft 6 journaled therein, and a cylindrical block or disk 7 of insulating material fixed to the shaft. A metal contact ring 8 is secured on one end of the block 7 and completely surrounds the same. This ring has an extension or contact arm 9 which extends across the block 7 to the end opposite the ring. A spring-pressed contact 10 mounted in the frame 5 bears continually on the ring 8, and three similar contacts 11, 12 and 13 bear on the insulating block 7 in position to successively engage the contact 9 as the block is rotated. A sprocket wheel 14 secured to the shaft 6 is connected by a sprocket chain 15 to the sprocket wheel 16 keyed to the shaft of the hoisting drum D so that the shaft 6 rotates whenever the motor is running.

The primary of the transformer T is connected to any suitable source of current supply, and the secondary is connected through the main line switch 17 to the leads *a*, *b*, *c*. The lead *b* is connected directly to a terminal of the stator winding of the motor, while the leads *a* and *c* are adapted to be connected to the motor through the reversing switches.

When it is desired to start the motor to lift the car, for example, the operator in the car moves the lever of the car switch S to the left so that the contact 18 on the switch lever bridges the contacts 19, 20. This completes a circuit through the magnet coil of the reversing switch R as follows:—from the lead *b* through conductor 21, magnet coil 22 of reversing switch R, conductor 23, contacts 19, 18, 20, and conductor 24 to the lead *a*. The reversing switch R is therefore closed and completes a circuit as follows:—from the lead *a* through switch contacts 25, 26, conductor *a′*, stator windings of the motor, conductor *c′*, switch contacts 27, 28 to the lead *c*. The stator of the motor now receives current and induces a current in the rotor and starts the motor. The starting resistance A is at this time all connected in circuit with the rotor, the terminals *z*, *z′*, *z²* of the resistance being connected by conductors 30, 31 and 32, respectively, to the collector rings of the motor. The starting

resistance A comprises sections V, V′, V² controlled by the switch E, sections X, X′, X² controlled by the switch F, sections Y, Y′, Y² controlled by the switch G, and sections Z, Z′, Z² controlled by the switch H, the latter switch also controlling the entire resistance.

The junctions between the sections V X, X Y and Y Z are designated respectively v, x and y. The junctions between the other sections of the resistance are correspondingly designated. Conductors 33, 34 and 35 lead from the junctions v, v', v^2 to the contacts v^a, v^b, v^c, respectively, of the switch E. Conductors 36, 37, 38 connect the junctions x, x', x^2 to the contacts x^a, x^b, x^c, respectively, of the switch F. Conductors 39, 40, 41 connect the junctions y, y', y^2 to the contacts y^a, y^b, y^c, respectively of the switch G. Conductors 42, 43, 44 connect the junctions z, z', z^2 with the contacts z^a, z^b, z^c, respectively of the switch H. Also the contacts v^a, v^b and v^c of the switch E are connected respectively to contacts $v^{a'}$, $v^{b'}$, $v^{c'}$ of switch F by conductors 42′, 43′, 44′, and the contacts x^a, x^b and x^c of the switch F are connected to the contacts $x^{a'}$, $x^{b'}$, and $x^{c'}$ of switch G by conductors 45, 46 and 47.

When the motor is started as above described, the controller K commences to rotate in a counter-clockwise direction. Assuming the controller to start from the position indicated in Figs. 1 and 2, the first step in the controlling operation will take place when the contact arm 9 runs under the brush 13. This will close a circuit through the magnet coil of switch F as follows:—from the conductor c' through conductor 48, contact 10, ring 8, contacts 9, 13, conductor 49, magnet coil 50 of switch F, conductor 51, back switch contacts 52, and conductor 53 to the lead b. The switch F now lifts its magnet core and brings the contacts x^a, x^b and x^c against the contacts $v^{a'}$, $v^{b'}$, and $v^{c'}$, respectively, thereby short-circuiting the sections of resistance X, X′, X² through the connections already described. The short-circuit across the resistance X, for example, may be traced from the junction x through conductor 36, contacts x^a, $v^{a'}$, conductor 42′, contact v^a, conductor 33 to junction v. The resistances X, X′, X² being short-circuited, the current in the motor is increased and permits an increase in speed. The operation of the switch F also establishes a holding circuit for its magnet coil through conductors 48, 54, contacts 55, conductor 56, magnet coil 50, conductor 51, contacts 52, and conductor 53. The magnet F will therefore be held closed independently of controller K which only maintains the circuit through the contacts 9, 13 for a short time. The next step occurs when the contact 9 of the controller K reaches the brush 11. This establishes a circuit through the magnet winding of switch E as follows:—through conductor 48, brush 10, ring 8, contacts 9, 11, conductor 57, magnet coil 58, conductors 59, 51, switch contacts 52 and conductor 53. The operation of the switch E short-circuits the sections V, V′, V² of the starting resistance. The short-circuit across the resistance V, for example, may be traced from the center or zero point o of the starting resistance, through conductor 60 to the lower contacts 61 of the switch E, thence through contact v^a and conductor 33 to the junction v. The sections V′ V² are likewise short-circuited. The resistance being thus reduced permits a further acceleration of the motor. The operation of the switch E also establishes a holding circuit for its magnet by way of conductors 48, 62, contacts 63, conductors 64, coil 57, coil 58, conductors 59, 51, switch 52 and conductor 53. The next step takes place when the contact 9 runs under the brush 12. This closes a circuit for the magnet of switch G as follows:—through conductor 48, brush 10, ring 8, contact 9, brush 12, conductor 65, magnet coil 66, conductors 67, 51, switch 52, and conductor 53. The operation of the switch G brings the contacts y^a, y^b and y^c into engagement with the contacts $z^{a'}$, $z^{b'}$, and $z^{c'}$, respectively, and thereby short-circuits the resistances Y, Y′, Y². The short-circuit across the resistance Y, for example, may be traced from the junction x through conductors 36, 45, contacts $z^{a'}$, y^a, and conductor 39 to junction y. A holding circuit for the magnet coil of switch G is also established by way of conductor 48, contacts 68, magnet coil 66, conductors 67, 51, switch 52, and conductor 53. The three switches E, F and G being now closed, a circuit is established through the magnet coil of switch H as follows:—through conductors 48, 62, contacts 69, conductor 70, contacts 71, conductor 72, contacts 73, conductor 74, magnet coil 75 and conductor 53. The switch H now operates to short-circuit the entire resistance A by way of the conductors 42, 43 and 44, permitting the motor to run up to full normal speed. The switch H closes a holding circuit through its magnet by way of conductors 48, 76, contacts 77, conductor 74, coil 75, and conductor 53. The operation of the switch H also opens the back switch 52 and as each of the circuits for the magnets of switches E, F and G includes the switch 52, the electro-magnetic switches E, F and G will each be opened, leaving only the switch H closed. The continued operation of the controller K will have no further effect on the circuits controlled thereby. The switch H will remain closed until the reversing switch R is opened, when all current will be cut off from the motor and controlling mechanism, the brake will be applied, the motor brought

to rest and the controlling mechanism restored to its original condition.

It will be noted that each of the switches E, F and G controls a certain portion of the starting resistance A independently of the other switches, so that it makes no difference in what order the switches are operated. The order in which they operate depends of course on the position in which the controller K may happen to be when the car is stopped. It should also be noted that the operation of the switch H can take place only when all three of the accelerating magnets E, F, G have operated, regardless of the order of operation. The operation of the magnets depends on the load on the motor; that is, if there is a heavy load, the acceleration of the motor will be comparatively slow and the controller K and magnets will operate more slowly so that an excessive current will not be thrown on the motor before it has time to speed up. Each of the accelerating magnets, when once operated, is held closed independently of the speed or potential of the motor armature.

It will be understood that any number of accelerating magnets, more or less than that shown, may be used if desired, the principles and method of operation remaining the same. Various changes also in the details and arrangement of parts may be made without departing from the spirit and scope of the invention, and I wish therefore not to be limited to the exact construction disclosed.

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

1. The combination with a sectional starting resistance, of a plurality of electro-magnetic switches independently controlling different sections of the resistance, an electro-magnetic switch controlling the entire resistance, means for effecting the successive operation of said first-named switches in various orders of sequence, and means dependent on the operation of all of said first-named switches to effect the operation of the switch controlling the entire resistance.

2. The combination with a motor, of sectional starting resistance, a plurality of accelerating magnet switches operative in various orders of sequence to successively short-circuit sections of the resistance, an electro-magnetic switch controlling the resistance, and switch contacts operated by each of said switches and included in series in the magnet circuit of said electro-magnetic switch.

3. The combination with a sectional resistance, of a plurality of accelerating magnets, a normally closed switch common to all of said magnets, means for successively operating said magnets in different orders of sequence, and an electro-magnetic switch controlling the sectional resistance and operatively connected to said normally closed switch.

4. The combination with a sectional resistance, of electro-magnetic switches controlling independent sections of the resistance and operable successively in different orders, a switch controlling the entire resistance, a normally closed switch in a circuit common to the magnet windings of said electro-magnetic switches, an electro-magnet operatively connected to the two last-named switches, and means for operating said magnets and switches.

5. The combination with an electric motor, of starting resistance therefor, and a controller controlling the acceleration of the motor and comprising a rotatable and a stationary member carrying coöperating contacts, said rotatable member being geared to the motor to make a complete rotation during the initial movement of the motor.

6. The combination with an electric motor, of sectional starting resistance therefor, a rotary controller, and mechanism electrically controlled thereby for successively short-circuiting the sections of resistance when the controller is started from any position.

7. The combination with an electric motor, of sectional starting resistance therefor, a rotary controller, a plurality of accelerating magnets, and circuits and connections for effecting the succesive operation of said magnets when the controller is started from any position.

8. The combination with an electric motor, of starting resistance therefor, a plurality of electro-magnetic switches controlling said resistance, a rotary controller geared to the motor and rotatable continuously with the motor, circuit connections between the controller and the magnet windings of said switches for effecting the successive operation of the switches when the controller is rotated, and means for maintaining the switches in their operated positions independently of the controller.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID LARSON.

Witnesses:
CHAS. M. NISSEN,
JAMES D. IVERS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."