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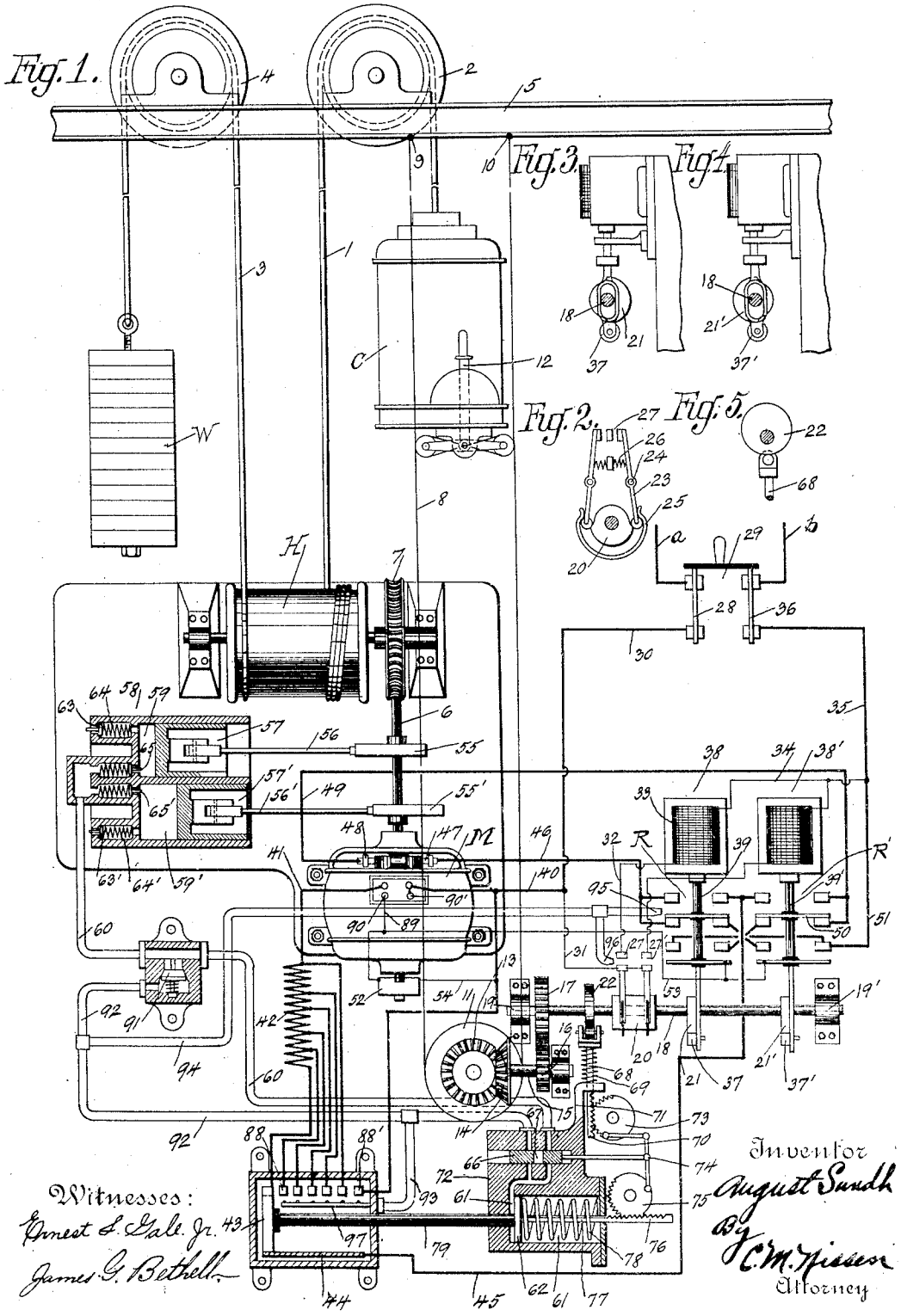
MOTOR CONTROL.

APPLICATION FILED MAR. 13, 1908.

1,011,267. Patented Dec. 12, 1911.



UNITED STATES PATENT OFFICE.

AUGUST SUNDH, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MOTOR CONTROL.

1,011,267. Specification of Letters Patent. Patented Dec. 12, 1911.

Application filed March 13, 1908. Serial No. 420,332.

To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States, residing in Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Motor Control, of which the following is a specification.

My invention relates to motor controlling apparatus, and, although herein shown applied to an elevator system, it may have a general application.

One of the objects of my invention is the provision of simple and efficient means for starting, operating and stopping an electric motor.

The specific objects of the invention will appear hereinafter, the novel combinations of elements being set forth in the appended claims.

In the accompanying drawings, Figure 1 represents an elevator system with my invention applied thereto; Fig. 2 is a detail of the switches for controlling the reversing switch magnets; Figs. 3 and 4 are side elevational views of the two portions of the reversing switch apparatus for the motor; and Fig. 5 is a fragmentary side view of the eccentric cam for transmitting motion to the pilot valve of the fluid pressure controlling apparatus.

Referring to Fig. 1, C designates an elevator car, H the hoisting drum, and W the counterweight. A hoisting cable or cables 1 extends from the top of the car C over the overhead sheave 2 to the hoisting drum H. A counterweight cable 3 is connected to the counterweight W and extends over the sheave 4 to the drum H. The sheaves 2 and 4 are journaled in fixed bearings in the stationary overhead beam 5. M designates an electric motor, which in this instance is of the direct current shunt wound type. The shaft 6 of this motor is connected to a worm in mesh with the worm wheel 7 mounted to rotate with the drum H so as to transmit motion thereto when the motor M receives current. An elevator system of any other type than that illustrated may be used if desired.

In the elevator shaft is a standing rope 8 connected at its upper ends 9, 10 to fixed points, such as the overhead beam 5, the lower loop being in frictional contact with the pulley 11 and the intermediate portions of this rope being associated with the pulleys of the manual actuating apparatus comprising the lever 12 in the car. When the lever 12 is moved in one direction, motion is transmitted to the pulley 11 in a corresponding direction; and when the lever 12 is moved in the opposite direction, the pulley 11 will also be moved in the opposite direction. Connected to rotate with the pulley 11 is a bevel gear wheel 13 which is in mesh with another bevel gear 14 on the shaft 15. The latter shaft has also a spur gear 16 which is in mesh with the spur gear 17, the latter being connected to the shaft 18 to transmit rotative movement thereto. The latter shaft is mounted in the bearings 19, 19′ and carries the cam 20, the cams 21, 21′ and the eccentric cam 22. The cam 20 is shown in end view in Fig. 2. The cams 21 and 21′ are shown in side view in Figs 3 and 4. And the eccentric cam 22 is shown in detail in Fig. 5. Now, when the lever 12 is moved to the right, for instance, the pulley 11 will be moved clockwise and transmit rotative movement to the shaft 18 in an anti-clockwise direction when looked at from the right in Fig. 1. The cam 20 shown in Fig. 2 will therefore be moved in an anti-clockwise direction to move the lever 23 on the pivot 24 against the action of the springs 25 and 26 to close the switch 27. A circuit will therefore be closed from the main *a* through the blade 28 of the main line switch 29, thence through the conductors 30, 31, switch 27, conductor 32, solenoid 33, conductor 34, conductor 35, blade 36, to the other main *b*. The main conductors *a* and *b* are connected to any suitable source of current supply.

It will be observed that the cams 21, 21′ on the shaft 18 initially press against the rollers 37, 37′ to hold the switches R, R′ in their initial positions as indicated in Fig. 1. When, however, the shaft 18 is rotated in an anti-clockwise direction in the manner indicated, the roller 37 will be released by the cam 21 to permit the magnet 38 to move upwardly the stem 39 to close the switch R. At this time the cam 21′ still holds the switch R′ in its initial position. If the lever 12 in the car is moved to the left, then clockwise rotation is transmitted to the

shaft 18 and the switch 27′ is closed, and the magnet 38′ energized to effect the closure of the switch R′. In the latter case, the cam 21 being rotated in an opposite direction will hold the switch R open.

When the switch R is closed, a circuit will be closed through the motor M as follows:— from the main *a*, through blade 28, conductors 30, 40, series field of the motor, conductor 41, sectional starting resistance 42, resistance-varying member 43, contact bar 44, conductor 45, switch R, conductor 46, armature brush 47, the armature windings, armature brush 48, conductor 49, blade 50 of the switch R′, switch R, conductor 51, blade 36, to the other lead or main *b*. At the same time that the switch R is closed, the brake magnet 52 is connected across the mains by the conductors 53 and 54 to release the brake apparatus applied to the brake pulley on the motor shaft 6. At the same time that a circuit is closed through the brake magnet 52, a circuit is also closed through the shunt field windings of the motor M through the conductors 53, 89, and the shunt field terminals 90, 90′. The electric motor now receiving power and having all the starting resistance 42 in circuit therewith, may rotate at slow speed and transmit motion to the car C through the intermediate mechanism.

On the shaft 6 are two eccentric devices 55, 55′ for transmitting reciprocatory motion to the connecting rods 56, 56′ and the pistons 57, 57′ of the fluid compressor 58. In this instance this compressor comprises the pistons 57, 57′ fitting into the open ended chambers 59, 59′. Suitable check valves are arranged in this compressor to effect the transmission of air through the duct or pipe 60 to the chamber 61 in which fits the piston 62 of the motor accelerating apparatus. In this instance when the piston 57 is moved to the right, air is drawn into the chamber 59 through the check valve 63 against the action of the spring 64, the check valve 65 being at this time closed. At the same time that the piston 57 moves to the right, the piston 57′ moves to the left and forces air from the chamber 59′ through the check valve 65′. When the piston 57 is moved to the left, the check valve 63 automatically closes and air is forced from the chamber 59 past the check valve 65 into the pipe 60. Therefore as soon as the motor starts, the compressor is operated to force air from the pipe 60 to the chamber 61. The flow of this air from the pipe 60 to the chamber 61 is controlled by the pilot valve 66 which has a transverse passage 67 initially in the position shown in Fig. 1 when communication between the pipe 60 and the chamber 61 is cut off. Whether the lever in the car, and consequently the shaft 18, is moved in one direction or the other, the eccentric cam 22 would transmit downward motion to the rod 68 against the action of the spring 69. The rod 69 is extended at its lower end into a rack 70, and the said rod is guided through a bracket 71 extending from the casting 72 in which the chamber 61 is formed. The rack 70 is in mesh with the gear wheel 73 which is connected by links and levers 74 to the pilot valve 66 and to an additional gear wheel 75. The latter is in mesh with the rack 76 extending from a rod 77 connected to move with the piston 62. Initially, the gear wheel 75 is held stationary by the rack 76, and therefore when the rack 70 is moved downwardly motion is transmitted to the valve 66 to move the same to the right and establish communication between the pipe 60 and the chamber 61. It is therefore evident that when the pilot valve has been actuated manually from the car through mechanical connections, and the motor starts, the compressor 50 will pump air into the chamber 61 to force the piston 62 to the right against the action of the spring 78. The piston 62 being connected by the rod 79 to the resistance varying member 43, will transmit motion to the latter to move the same over the series of contacts 88 which are connected to sections of the starting resistance 42 and to the series field of the motor. In an obvious manner, as the resistance varying member 43 moves to the right over the contacts 81, the starting resistance will be gradually cut out, and finally also the series field when the member 43 engages the contact 88′. The motor may then operate at full speed as a shunt wound motor.

It will be observed that as the piston 62 moves to the right, the rack 76 will rotate the gear 75 in an anti-clockwise direction and thereby effect the restoration of the valve 66 back to its initial position as shown in Fig. 1. The arrangement may be such that upon a comparatively small movement of the lever 12, the cam 20 and the cam 21 or 21′ will be operated to effect the starting of the motor at once, and upon further movement of the lever in the car to various positions the cam 22 will be moved to corresponding positions to effect successive operation of the valve 66 to secure further movement of the member 43 or to hold the same in any intermediate position desired. This will be clear when it is observed that the larger portions of the cams 20, 21 and 21′ are concentric as to the shaft which carries them. When the valve 66 cuts off communication between the pipe 60 and the chamber 61 while the motor is still operating the compressor 58, the pressure in the pipe 60 will increase to such a value that the check valve 91 will open automatically to let the air into the pipe 92, through which it is transmitted to the pipe 93 and thence to the series of nozzles 97 which are so ar-

ranged as to blow out any arcs which may form while the resistance-varying member 43 is moving from one contact to another of the contacts 88. Air is also forced through the branch pipe 94 to the nozzles 95 for the reversing switches R, R′ and the nozzle 96 for the switches 27, 27′. An additional function of the arrangement for directing air under pressure to the contacts of the switches is to keep them cool and free from dust or other matter. The principal utility of the branch pipes leading from the check valve 91 to the nozzles mentioned, is to direct currents of air over the contacts of the switches when the latter are being opened or restored to initial position. For instance, when the lever 12 in the car is brought back to its central or neutral position, the cam 22 will be correspondingly moved to its initial position to permit the spring 69 to move the rack 70 upwardly, which will transmit motion to the valve 60 to move the same to the left and establish communication between the chamber 61 and the pipe 92. The spring 78 will therefore at once act to force the air in the chamber 61 through the pipes 92, 94 to the nozzles 95 and 96, and through the pipe 93 to the nozzles 97. Therefore, while the current is being cut off from the motor and it is coming to rest, all arcs are blown out where switch contacts are being separated. Owing to the escape of air through the nozzles 95, 96 and 97 the pressure of air in the pipe 92 is at this time insufficient to compress the spring 78 or prevent it from moving the piston 62 to its innermost position. When the piston 62 is moved to the left, the gear 75 is rotated clockwise to move the valve 66 back to its closed position as indicated in Fig 1.

It will be observed that after the motor starts it must run a short period of time before the air in the pipe 60 and chamber 61 is compressed sufficiently to move the piston 62 against the action of the spring 78. The rate of movement of the piston 62 after the motor starts will depend upon the capacity of the compressor 58 and the resistance offered by the spring 78. This spring may be so constructed that the resistance thereof is increased as it is compressed, and, in any event, under given conditions of load, etc., it will be a predetermined length of time after current is applied to the motor for the resistance-varying member 43 to move to its extreme right-hand position or any selected intermediate position to effect a gradual acceleration of the motor to full speed or an intermediate speed. As before explained, the speed of the motor will depend upon the position of the lever 12 in the car, or more directly upon the position of the cam 22.

Although I have shown a direct current shunt wound motor, which is considered the most practicable for the operation of elevators where direct current is available, it should be understood that an alternating current motor, such as a three-phase induction motor, may be used where only alternating current is available. In such event the apparatus may be so arranged as to cut in and out sections of windings of a transformer to vary the applied voltage, or starting resistance may be controlled.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of my invention, and I desire therefore not to be limited to the precise construction herein disclosed.

Having thus fully described my invention, what I claim and seek to have protected by Letters Patent of the United States is:—

1. The combination with an electric motor, of accelerating mechanism therefor, apparatus for propelling fluid to actuate said accelerating mechanism in proportion to the speed of said motor, mechanical appliances for controlling the flow of fluid, and manual mechanical means for operating said mechanical controlling appliances.

2. The combination with a motor, of two sources of power, one being electric and the other being fluid pressure and in strength proportional to the speed of said motor, means operated by said electric power for starting said motor, appliances operated by said fluid pressure for accelerating the motor, mechanical controlling mechanism, and manual means for operating said controlling mechanism.

3. The combination with an electric motor, of a fluid actuator driven only when said motor operates, starting switches for said motor, electric means for operating said starting switches, a mechanical device for closing the circuits to said starting switches, manual mechanism for actuating said mechanical device, and means operated by the fluid actuator for controlling the acceleration of said motor.

4. The combination with an electric motor, of reversing switches therefor, electric means for operating said switches, and cam mechanism for actuating said switches to positively restore the same to normal position after every operation thereof.

5. The combination with an electric motor, of reversing switches therefor, electric means for closing said switches, and cam mechanism for positively actuating a part of said switches to open the same after every operation thereof.

6. The combination with an electric motor, of reversing switches therefor, mechanical appliances for normally holding both of said switches in open position, means for

operating said mechanical appliances to release one of said switches, and electric devices for closing said switches.

7. The combination with an electric motor, of a reversing switch therefor, electric means for operating said switch, and mechanism for positively actuating parts of said switch to move the same and hold the entire switch in open position after every operation thereof.

8. The combination with an electric motor, of reversing switches therefor, an electro-magnetic operating device for each of said switches, an actuator for each switch to positively move the same to open position and to hold said switch normally in open position, and means for operating said actuator to effect the release of one of said switches and permit the same to be closed.

9. The combination with an electric motor, of reversing switches therefor, an electro-magnet for each switch to operate the same, cam mechanism for positively moving said switches to open position, and manually operated mechanical appliances for actuating said cam mechanism.

10. The combination with an electric motor, of reversing switches therefor, electric means for closing said switches, a plurality of cams, a shaft carrying said cams, connections between said cams and switches, and mechanism for actuating said shaft to release one of said switches or to positively move a closed switch to open position.

11. The combination with an electric motor, of reversing switches therefor, accelerating apparatus and means for operating the same, electric devices for closing said switches, appliances for normally holding said switches in open position, a single mechanism for effecting the operation of said accelerating apparatus and mechanically operating said appliances.

12. The combination with an electric motor, of starting switches therefor, accelerating apparatus, a fluid-compressor, a device actuated by fluid pressure to operate said accelerating apparatus, a valve for controlling communication between the fluid-compressor and said operating device, branch pipes or ducts having nozzles at their ends at or near the contacts of said switches and accelerating apparatus, and a check valve between the fluid-compressor and such branches.

13. The combination with an electric motor, of controlling apparatus therefor, a fluid-compressor or pump, a device actuated by fluid pressure to operate a part of said controlling apparatus, a branch pipe or pipes having one or more nozzles at or near the switch contacts of said controlling apparatus, and a valve for controlling the flow of fluid into said device to effect the actuation thereof or to control the exhaust of fluid from said device through said branch pipes or ducts.

14. The combination with an electric motor, of reversing switch mechanism therefor, accelerating apparatus, an air pump operated by the motor, a motor device operated by air pressure to effect the operation of the accelerating apparatus, a pipe or duct between the air pump and said motor device, branch pipes having nozzles at their ends at or near the switch contacts of the reversing switch mechanism and accelerating apparatus, a check valve between the first-named pipe or duct and the branch pipes and opening from the former to the latter, and a pilot valve for controlling communication between the air pump and the motor device and between the latter and the branch pipes.

15. The combination with an electric motor, of reversing switches therefor, electric means for operating the switches, and additional means for positively restoring said switches to normal position after every operation thereof.

16. The combination with an electric motor, of reversing switches therefor, electric means for operating the switches, and mechanical means for positively restoring said switches to normal position after every operation thereof.

17. The combination with an electric motor, of reversing switches therefor, means for operating the switches, and cam mechanism for positively restoring said switches to normal position after every operation thereof.

18. The combination with an electric motor, of reversing switches therefor, electric means for operating said switches, and means operable from a distance for positively restoring said switches to normal position after each operation thereof.

19. The combination with an electric motor, of reversing switches therefor, electric means for operating said switches, and manually operable means for positively restoring said switches to normal position after each operation thereof.

20. The combination with an electric motor, of reversing switches therefor, electric means for operating said switches to closed position, and manually operable means for positively effecting an opening of said switches at any time.

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

AUGUST SUNDH.

Witnesses:
W. H. BRADY,
CHAS. M. NISSEN.