D. LARSON.

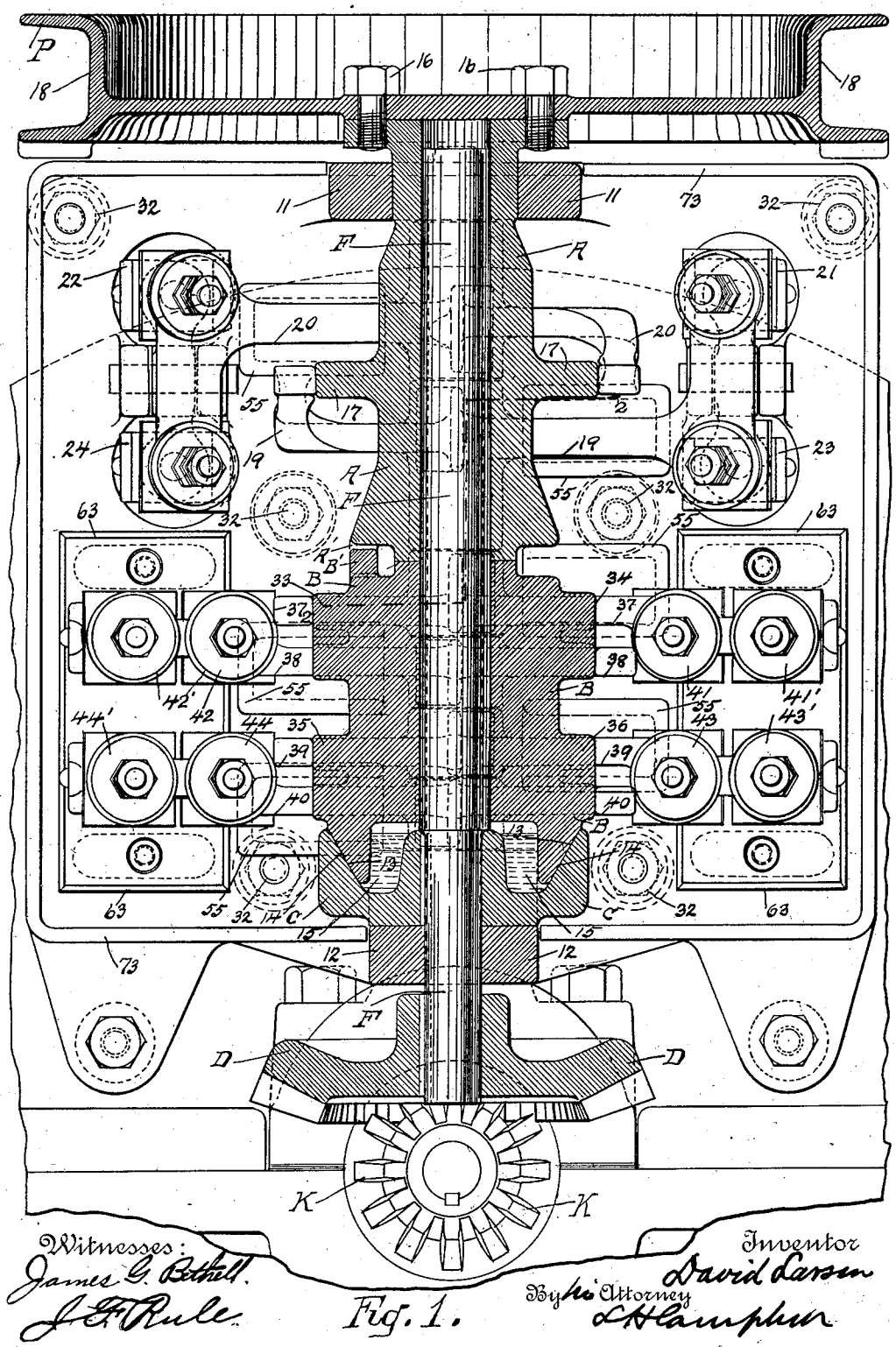
MECHANICAL REVERSING AND ACCELERATING SWITCH.

APPLICATION FILED MAR. 5, 1909.

1,014,234.

Patented Jan. 9, 1912.

4 SHEETS—SHEET 1.



Witnesses:
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Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 3.

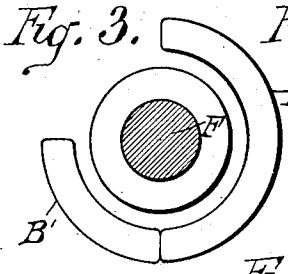


Fig. 4.

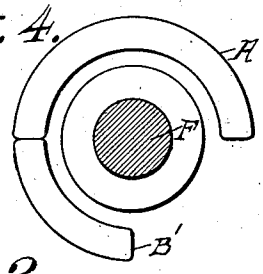


Fig. 5.

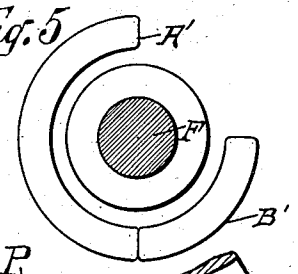
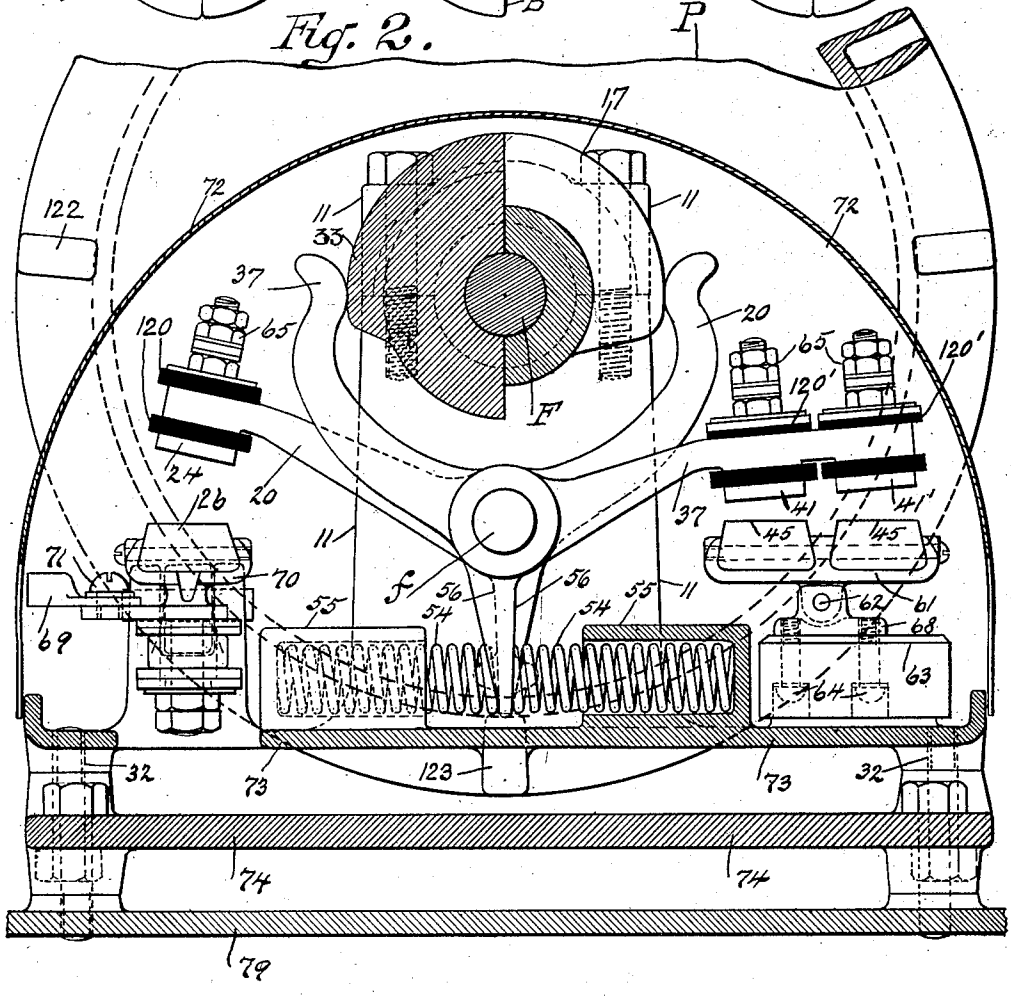


Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 6.

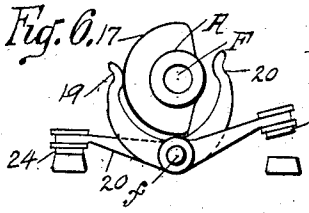


Fig. 7.

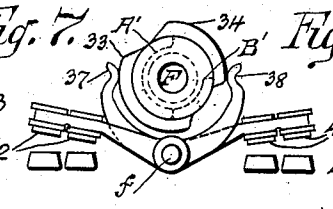


Fig. 8.

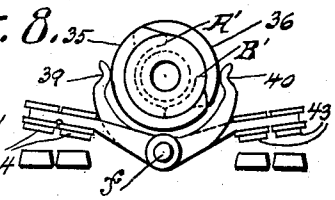


Fig. 6a.

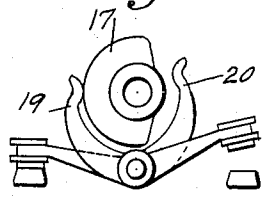


Fig. 7a.

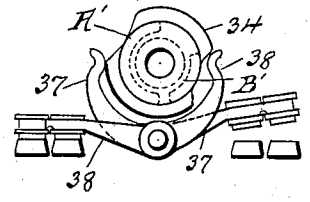


Fig. 8a.

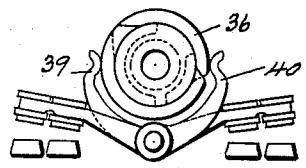


Fig. 6b.

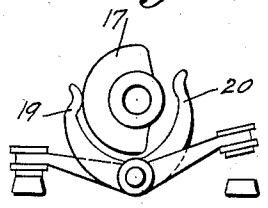


Fig. 7b.

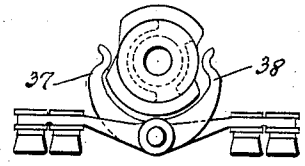


Fig. 8b.

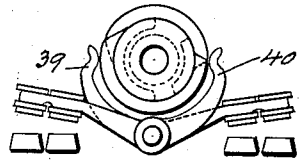


Fig. 6c.

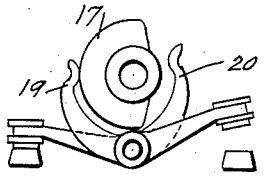


Fig. 7c.

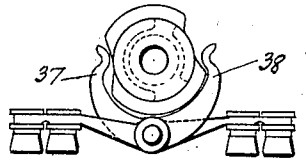


Fig. 8c.

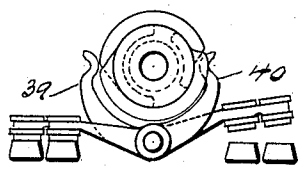


Fig. 6d.

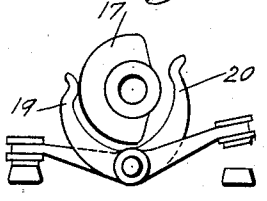


Fig. 7d.

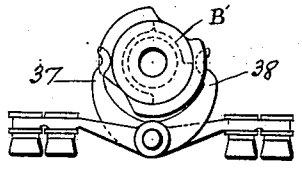
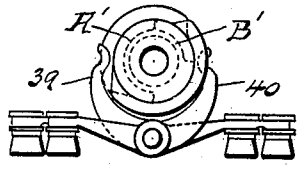


Fig. 8a.



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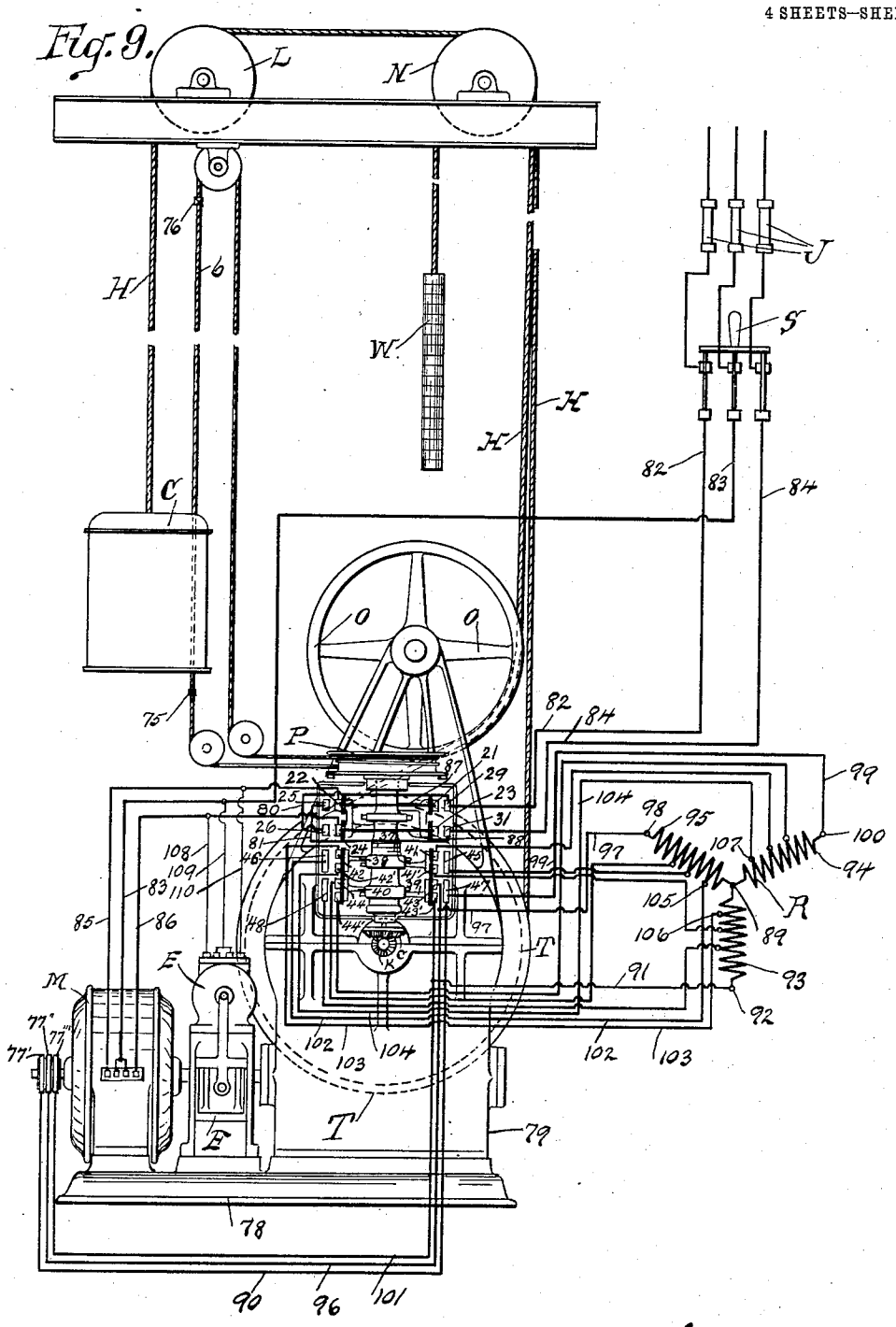
1,014,234.

Patented Jan. 9, 1912.

4 SHEETS—SHEET 4.

Fig. 9.



Witnesses:

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J. T. Rule

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By his Attorney

L. V. Campbell

UNITED STATES PATENT OFFICE.

DAVID LARSON, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MECHANICAL REVERSING AND ACCELERATING SWITCH.

1,014,234. Specification of Letters Patent. **Patented Jan. 9, 1912.**

Application filed March 5, 1909. Serial No. 481,394.

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 Mechanical Reversing and Accelerating Switches, of which the following is a specification.

My invention relates to a mechanical reversing and accelerating switch, more particularly described as used in connection with an alternating current motor for an elevator system, and one of the objects of the invention is to provide an electric switch for controlling a motor where phase reversal in the motor would be dangerous or likely to cause destruction of or damage to the machinery.

Another object is to prevent the starting of the motor too rapidly by an inexperienced attendant.

A further object is to provide that in case of phase reversal, the switch shall be returned to a neutral position and the motor stopped.

A still further object is to provide a switch of this character which shall be strong and durable in construction, and effective and efficient in operation.

For the attainment of these ends and the accomplishment of other useful objects, the invention consists in the features of novelty in the construction, combination and arrangement of the parts, hereinafter more completely described, and claimed in the appended claims.

Figure 1 is an elevation view partly in section of a switch constructed in accordance with the principles of this invention. Fig. 2 is a part sectional plan view of the same showing the relative positions of the various parts, the cross section through the members B and A being taken on the line 2—2 of Fig. 1. Figs. 3, 4, 5 are views of the interlocking parts which control the reversing mechanism. Figs. 6–6ª, 7–7ª, and 8–8ª, illustrate diagrammatically the controller levers and operating cams in the several stages of operation. Fig. 9 is an illustration of my invention applied to the controlling apparatus for an alternating current elevator installation.

Upon a shaft F (Fig. 1) are mounted the members A, B, C, and D.

D is preferably a bevel gear secured to the shaft F and having teeth meshing with the teeth of another bevel gear K, which is positively driven in either direction by connection with some part of the moving mechanism. Thus it is evident that the shaft F may also be rotated in either direction. The members A and B are loosely mounted on the shaft F so that it may be free to rotate in them. The member C is secured to the shaft F. Members B and C are provided with beveled surfaces which are adapted to make frictional contact with each other, and by which, B may be engaged by the member C and rotate with it under certain conditions. The shaft F is preferably arranged in an upright position, and an annular recess 15 in the member C may be filled with oil or other suitable lubricating material.

The member A is mounted in the bearing 11, so that the shaft F is mounted in the bearing 12 at one end and in the member A at the other end. The member A is provided with a projecting cam 17 which engages the levers 19, 20; this cam 17 does not extend entirely around the member A as may be seen in Fig. 6. To the member A a shipper sheave P with a grooved portion 18 is secured by the bolts 16 or other suitable means, and the turning of this sheave P in either direction operates either one or the other of the reversing switch levers 19, 20. The lever 20 carries contacts 22 and 24 insulated from each other and from the lever by bushings 120. When the lever 20 is operated, the contacts 22 and 24 are brought into engagement respectively with stationary contacts 25 and 26 (Fig. 9). These stationary contacts are each clamped in a metallic holder 70 (Fig. 2) to which the terminal clip 69 of a conductor is secured by means of a screw 71. The lever 19 carries contacts 21 and 23 similar to those on the lever 20, and movable into engagement with stationary contacts 29 and 31 respectively. The operation of the lever 20 establishes connection between the motor M and the source of current supply, and effects the operation of the motor in one direction, while the operation of the lever 19 reverses the connections and secures the operation of the motor in the reverse direction in a well known manner.

The member B is provided with cams 33, 34, 35 and 36, which engage levers 37, 38

39 and 40 respectively. These levers each carry a pair of switch contacts insulated from each other and from the lever by bushings 120′ (Fig. 2). The contacts 41 and 41′ carried by the lever 37 are movable into engagement with a pair of stationary contacts 45 secured in a metal contact holder 61 pivoted at 62 to a bracket 68. The contacts 45 form in effect a single stationary contact as indicated diagrammatically in Fig. 9. Screws 64 secure the bracket 68 to a block 63, and may also serve as binding posts to electrically connect a conductor to the stationary contacts. A similar arrangement of contacts is provided in connection with the levers 38, 39 and 40. The contacts carried by these levers are designated 42 and 42′, 43 and 43′, 44 and 44′, and are adapted to bridge the stationary contacts 46, 47 and 48 respectively.

The contact levers 19, 20, 37, 38, 39, 40 are all pivotally mounted on the shaft *f* which is preferably fixed in the end bearing mounts 11 and 12; each lever is held in contact with its corresponding member A or B by means of a spring 54 bearing against the lever and which is held in position by a suitable casing 55 and a projecting lug 56 of each lever. It is evident that as the members A and B are turned on the shaft F, the said levers will be operated.

Integral with members A and B are the interlocking portions A′ and B′, the preferable form thereof being shown in Figs. 3, 4, 5, and their function being to cause circuits to be opened in case of phase reversal.

In Fig. 2 the two levers 20 and 37 are shown, the former having two contacts 22, 24 parallel with the shaft F, and the latter having two contacts 41, 41′ in a line at right angles to the shaft F.

The base 73 of the switch is secured to a rigid support 74 by some suitable means 32 and a cover 72 is provided for the switch, to keep it free from dirt or from contact with any foreign material.

In order that the mechanical operation of the switch may be readily understood, the action thereof is here explained. Starting with the switch in a position to be operated, the shipper sheave P, and member A attached thereto, may be rotated in either direction; if turned in a counter-clockwise direction as viewed in Fig. 2 until the stop 122 carried by the shipper sheave engages the fixed stop 123, and the cam 17 on member A takes the position shown in Fig. 6, the lever 20 will be operated by a spring 54, and the contacts 22, 24, attached to this lever 20 will engage the stationary contacts 25 and 26 respectively. The motor now receives current and the operating mechanism is set in motion and the shaft F rotated in a counter-clockwise direction.

When the member A takes the position shown in Fig. 6, the portion A′ will take the position shown in Fig. 7, the member B having been turned by the contact of the projecting portion B′ with the projection A′, until B′ takes the position shown by the dotted outline of B′ in Fig. 7. The cam projections 33, 34 will then be as shown in Fig. 7, and the cam projections 35, 36 as shown in Fig. 8. In these positions all of the accelerating levers 37, 38, 39, 40 are held from making connections with their corresponding fixed contacts.

The rotation of the shaft F and the friction member C cause the sleeve member B to be rotated therewith; when this sleeve B is thus rotated until the cam 34 reaches the position shown in Fig. 7[a] the lever 38 is operated. In a similar way the continued rotation of the sleeve member B next operates the lever 37, as shown in Fig. 7[b]; then lever 40 (Fig. 8[c]), and finally lever 39 Fig. 8[d] is operated. The position of the projection B′ is then shown by Fig. 8[d] in which B′ is against the projection A′ of member A. And since the shipper-sheave P is held by the stop 123 against further rotation in the same direction, the member A attached thereto is held, and by the engagement of projections A′ and B′, the sleeve member B is also held stationary, the frictional connection between the members B and C permitting the independent rotation of the shaft F.

If for any reason the shaft mechanism and friction member C should operate the member B in the reverse direction, the projection B′ would engage the projection A′ of member A, which would then turn the member A backward until the lever 20 is engaged by the cam projection 17 on said member A and operated to open position, and the shipper-sheave returned to the unoperated position. In a similar way if the member A has been rotated in the opposite direction to operate the lever 19, the contacts 21 and 23 would engage the stationary contacts 29 and 31 and connect the motor for operation in the reverse direction, the accelerating switches would be operated in the same order and in a way similar to that described; the mechanism being rotated in the opposite direction.

It is evident that the connections made by the operation of the levers 19, 20 may be such as to close circuits by the operation of one lever which shall be the reverse of circuits closed by the other. And the levers operated by the cam projections on the member B may make various connections with a resistance controlling the starting and acceleration of an electric motor. The member A operates the reversing switch contact levers, and the sleeve member B operates the accelerating lever contacts of the switch. In this embodiment, my invention is applied

to control the circuits for an alternating current motor in conjunction with an elevator car and hoisting apparatus therefor. In Fig. 9, the car C is shown suspended by the ropes or cables H which pass over the pulleys L, N, around the traction drum T, and over the guide pulley O in a well known manner, and have a counterweight W connected to their opposite end. The governor rope 6 passes through the car C and around the shipper-sheave P of the switch, and is provided with the devices 75, 76, which are engaged by the car C to operate the governor rope and usually act in the capacity of safety devices to stop the car at the upper and lower limits of travel. When the main switch S is closed, the operation of the reversing switch will close circuits to the motor windings from the supply mains through the protecting fuses J. The operation of the reversing switch is effected by pulling the governor rope G, which will turn the shipper-sheave P and with it the attached member A, causing either the lever 19 or lever 20 to be operated as previously explained. If lever 20 is operated, its contacts 22 and 24 engage the two fixed contacts 25 and 26 respectively. There will then be the three necessary paths from the mains to the motor M; first, wire 83 directly from the main to the motor winding; secondly, wire 82 through contact 29, wire 80, contacts 26, 24, and wire 86 to the motor; third, through wire 84, contact 31, wire 81, contacts 25, 22, and wire 85 to the motor. If the lever 19 had been operated instead of lever 20, contacts 21 and 23 would engage the stationary contacts 29 and 31 respectively, and the paths from mains to the motor M would then be: (1) wire 83 directly from the main to the motor; (2) through wire 82, contacts 29, 21, conductor 87, contact 22, wire 85 to the motor; and (3) through wire 84, contacts 31, 23, conductor 88, contact 24, wire 86, to the motor winding. From this it is seen that in the first instance wire 82 is connected through the reversing switch contacts to the motor-lead wire 86 and in this latter instance to the motor-lead wire 85; also that wire 84 is connected through the switch contacts to motor-lead wire 85 in the first instance and to the motor-lead wire 86 in the latter instance. Since the motor is of the three-phase type, the reversal of these two motor connections to the mains reverses a phase and the direction of rotation of the motor is changed thereby.

The motor M is provided with a wound secondary and has the slip ring connections 77′, 77″, 77‴. A well known type of three-phase resistance R is suitably connected to the slip rings, and is provided with taps and circuit connections to the contacts of the accelerating switches. By the successive operation of the accelerating levers 38, 37, 40, 39, portions of the resistance R are short-circuited, in this way reducing the resistance of the wound secondary of the motor and effecting the acceleration of the motor in a manner well understood in the art.

Continuing the explanation of the electrical operation of the switch; after the reversing switch has closed circuits to the motor M, the motor starts, with all the resistance in the secondary circuits. Following the paths from the motor slip rings of the secondary winding to the common point 89 of the star resistance R; (*a*) from slip ring 77′ through wire 90, contact 47, wire 99, to resistance terminal 100, through resistance 94 to the common point 89; (*b*), from slip ring 77″ through wires 96, 97 to terminal 98, through resistance 95 to the common point 89; (*c*), from slip ring 77‴ through wires 101, 91, to terminal 92, through resistance 93 to the common point 89. When the first accelerating lever 38 is operated its contacts 42, 42′ engage the stationary contact 46. These three contacts 46, 42, 42″, are connected by wires 102, 103, 104, to the taps 105, 106, 107 respectively of resistance R, the effect of connecting the three fixed contacts together by the operation of lever 38 being to cut out a part of the resistance in each of the three paths to the common point 89 thereof. Since the taps 105, 106, 107 are all connected together through the fixed contacts when the lever 38 is operated, this short-circuits the portions of the resistance R from taps 105, 106, 107 to the common point 89, and thus cuts out part of the resistance in each path to the common point. In this same manner, the successive operation of levers 37 and 40 successively cuts out portions of the resistances in each path or each phase circuit. Leads 90, 96, 101 from the slip rings are directly connected to the contacts 47, 43, 43′ respectively, and when the last accelerating lever 39 is operated, the secondary winding of the motor M is short-circuited through these contacts, and the motor is accelerated to full speed. The cams 33, 34, 35 and 36 for operating the accelerating switch levers are preferably of the shape and arrangement herein shown and described, the purpose thereof being that the said levers be operated successively in the same order whether the driving shaft F is rotated in one direction or the other. For instance, if the member A were rotated in the reverse direction from that already described, it would assume a position substantially opposite or 180° in advance of the position shown in Fig. 6, thereby releasing the arm 20 and closing the switch contacts 21, 23. During this movement of the member A, the projection A′ engages the projection B′ and rotates the member B in a clockwise direction through substantially 90°. This will be ap-

parent from a consideration of Figs. 3 and 5 which show the extreme positions of the projection A′. The member B having thus been moved forward 90°, it will be seen that the cams 33, 34, 35, 36 (Figs. 7 and 8) are in position to operate the accelerating switch levers in the order already described, as the member B is further rotated by the friction clutch.

The electro-magnetic brake device E is preferably of a well known type, and it is connected to the motor leads by the wires 108, 109, 110.

In my invention it is evident that the acceleration of the motor may be accomplished slowly or rapidly, by changing the mechanism which controls the rotatable shaft F. If the phase relations of the supply current becomes changed, the motor will be stopped, and commence to rotate in the reverse direction. As this reverses the rotation of the shaft F, the clutch member C will at once carry the cam member B′ from the position shown in Fig. 7[a] to the position shown in Fig. 7, permitting the accelerating switches to open and re-insert the starting resistance R. The stop B′ is now in contact with the lower end of the stop A′ and the continued rotation of the shaft F carries the cam back to central position, so that the reversing switch is opened, the current supply cut off, the brake applied and the motor stopped. The motor is therefore effectually prevented from speeding up in the reverse direction. If the cam member A should be carried back far enough to close the other reversing switch, current would be supplied to the motor to stop the reverse rotation and start it in the original direction. The dangers incident to phase reversal or change in the direction of rotation of a motor are thus obviated by the use of my improved reversing and accelerating switch.

I desire not to be limited to the precise construction and arrangement of the several parts, as herein set forth, as it is clearly evident that various changes may be made without departing from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent is:—

1. The combination with an electric motor, of manually operable starting and stopping means, and automatic selective means operated by the motor for accelerating itself when started in the intended direction and for effecting the stopping thereof when started in the opposite direction.

2. The combination of an electric motor, of manually operable starting and stopping means, and automatic mechanical means operated by the motor to accelerate the motor when it starts in the intended direction and to return the manual means to open position when the motor starts in the direction opposite to that intended.

3. The combination of an electric motor, of manually operable starting and stopping means, accelerating switches automatically closed by the rotation of the motor in the direction presumed in a closing of the starting means, and mechanical devices to effect the operation of the said stopping means and the stopping of the motor by rotation of the motor in the direction opposite to that intended.

4. The combination with an electric motor, of controlling mechanism therefor operable manually into positions to effect the starting in either direction and stopping of the motor, and means to automatically operate said mechanism to the motor stopping position when the direction of the motor is reversed independently of said mechanism.

5. The combination with an electric motor and circuits therefor, of mechanism for opening and closing said circuits to effect the rotation of the motor in either direction, and means for automatically operating said mechanism to cut off the supply of current to the motor when the direction of rotation of the motor is reversed.

6. The combination with an electric motor and a circuit for supplying current to the motor, of a device operable manually to effect rotation thereof in either direction, and means automatically to operate the device to cut off the supply of current to the motor when its direction of rotation is reversed.

7. The combination with an electric motor, of rotatable controlling mechanism therefor, and means dependent upon a reversal of the motor automatically to operate the mechanism and to stop the motor.

8. The combination with an electric motor, of controlling mechanism therefor, manual means for operating said mechanism to start the motor, and mechanical means for automatically operating said mechanism into position to stop the motor when the phase of the supply current is reversed.

9. The combination with an electric motor, of a manual controlling device operable from an initial position into position to effect the operation of the motor in either direction, and means operated by the motor to return the controlling device to initial position when the direction of the motor is reversed.

10. The combination with an electric motor, of reversing switch mechanism therefor, and means operated by the motor to return the reversing switch mechanism to initial position whenever the motor is operated in the reverse direction from that normally produced by the operation of said mechanism.

11. The combination with an electric motor, of reversing switch mechanism, operable in either direction from an open position to effect a rotation of the motor in a corresponding direction, and means operated by the motor to return the switch mechanism to open position when the direction of the motor is reversed independently of the operation of the reversing switch mechanism.

12. The combination with an electric motor, of a manually operable controlling device therefor, a driving member geared to the motor, and a friction clutch connecting said driving member with the controlling device.

13. The combination with an electric motor, of a controlling device therefor, operable in either direction to effect a rotation of the motor in a corresponding direction, means for manually operating said device, and mechanism driven by the motor when the latter is rotating in a given direction for automatically operating said device in the direction required to cause the motor to rotate in said direction.

14. The combination with an electric motor, of a reversing switch, accelerating switches, a manual device for effecting the successive operation of said switches, and mechanical means operated automatically by the motor for operating said switches in the reverse order to initial position when the motor has been reversed while said switches are in the operated position.

15. The combination of a motor, reversing and accelerating switch contact levers, rotatable members, cams integral with said members for operating the levers, and mechanical connections between the motor and the rotatable members.

16. The combination of a motor, accelerating switch contact levers, a rotatable sleeve member having cams integral therewith, and mechanical means connecting the motor and the said member operative automatically to close the switch contact levers in a certain order when the motor is started in either direction.

17. The combination of a motor, reversing switch contact levers, a rotatable member provided with cams positioned to operate said levers when said member is rotated, accelerating switch contact levers, a sleeve member provided with cams, and connections between the motor and the said sleeve member to operate the accelerating levers in regular succession after the manual operation of the first named member.

18. The combination of a shaft, a rotatable member and a sleeve member mounted on the shaft and provided with cam surfaces, reversing switch contact levers operated by the cams on the rotatable member, accelerating switch contact levers operated by the sleeve member cams, and a motor started by the operation of the said rotatable member and thereafter operative to effect the operation of the said sleeve member to accelerate the motor.

19. The combination with a mounted rotatable member, a shaft with one extremity rotatably mounted in the rotatable member, a sleeve member rotatably mounted on the shaft, projecting cams in connection with each of said members, reversing and accelerating contact levers, means for operatively applying the cams on the first named member to the reversing contact levers, and means for automatically applying the cams of the sleeve member to the accelerating contact levers in a regular succession.

20. The combination with a shaft, of a sleeve member rotatably mounted thereon, a rotatable member providing a bearing for the said shaft, cams integral with said members, reversing and accelerating contact levers, means for rotating the said members, means for operating the levers by rotating the said member, and means for rotating the shaft independently of said members.

21. The combination with a shaft, of sleeve members provided with cams rotatably mounted thereon, reversing and accelerating switch contact levers operable by said cams, means for manually controlling the reversing switch levers, and means for automatically operating the accelerating switch contact levers in regular successive order.

22. The combination with a shaft, of sleeve members provided with cams rotatably mounted on the shaft, reversing and accelerating switch contact levers, means to rotate the shaft, means for manually operating one of said members and thereby operating the reversing switch contact levers, the cams on the other of said members being arranged for mechanically operating the accelerating switch contact levers in a successive order.

23. The combination with a shaft, of sleeve members provided with cams rotatably mounted on the shaft, reversing and accelerating switch contact levers, means for manually operating the reversing switch levers, means for rotating the said shaft, and means associated with the shaft for rotating the sleeve member to operate the accelerating switch contact levers.

24. The combination with reversing and accelerating switch contact levers, a rotatable shaft, sleeve members rotatably mounted on the shaft and provided with projecting cams to engage adjacent sleeve members, means for operating the reversing switch contact levers, and means for automatically operating the accelerating switch contact levers in a regular succession.

25. The combination with a shaft, of

sleeve members provided with cams rotatably mounted thereon, an auxiliary shaft, reversing and accelerating switch contact levers pivotally mounted thereon, means for operatively engaging the levers on said cams, and means for automatically operating one of the sleeve members to actuate the accelerating levers in regular succession.

26. The combination with a shaft, of sleeve members provided with cams rotatably mounted on the shaft, an auxiliary shaft, reversing and accelerating switch contact levers pivotally mounted thereon, coil springs, means associated therewith for operatively contacting the levers with the said cams, means for mechanically operating the reversing switches, and means automatically operating one of the sleeve members to actuate the accelerating levers in regular succession.

27. The combination with a shaft, of sleeve members rotatably mounted thereon, said members being provided with cams and end projections, for engaging adjacent sleeve members, reversing and accelerating switch levers, means for operatively engaging the levers on the cams, means for manually operating the reversing switch levers, and means associated with the said shaft for mechanically operating one of the sleeve members to actuate the accelerating levers in successive order.

28. The combination with reversing and accelerating switch contact levers, of a rotatable member provided with cams, means for operatively engaging the reversing switch contact levers with the cams, a rotatable sleeve member provided with cams, means for operatively engaging the said sleeve member to actuate the accelerating switch contact levers, separate means for rotating each of said members, and means for engaging one of the said members with the other and for preventing operative engagement of the accelerating switch contact levers unless both of said members are rotated in the same direction.

29. The combination with a shaft, of sleeve members provided with cams rotatably mounted on the shaft, reversing and accelerating switch contact levers provided with projecting lugs, coil springs engaging the projecting lugs for contacting the switch contact levers with the cams, means for manually operating the reversing switch contact levers, and means for automatically operating one of the sleeve members to actuate the accelerating levers in regular succession.

30. The combination with reversing and accelerating switch contact levers, of a shaft, a friction member secured to the shaft, a rotatable member mounted upon the shaft, means associated therewith for operating the reversing switch contact levers, a sleeve member rotatably mounted on the said shaft, means for frictionally engaging the sleeve member to rotate with the said friction member, and means associated with the sleeve member for operating the accelerating switch contact levers.

31. The combination with a rotatable shaft, of means for rotating the same, a friction member secured to the shaft, reversing and accelerating switch contact levers, a rotatable member provided with cams for operatively engaging the reversing switch contact levers, a rotatable sleeve member provided with cams for operatively engaging the accelerating switch contact levers, a frictional surface on the sleeve member for engaging the same with the said friction member secured to the rotatable shaft to rotate the sleeve member.

32. The combination with reversing and accelerating switch contact levers, of a rotatable member provided with cams for operatively engaging the reversing switch contact levers, a rotatable sleeve member provided with cams for operatively engaging the accelerating switch contact levers, means for engagement of the two members, and predetermined stop positions for limiting the rotative movement of the first named member in both directions of rotation.

33. The combination with reversing and accelerating switch contact levers, of a rotatable member provided with cams for operatively engaging the reversing switch contact levers, a rotatable sleeve member provided with cams for operatively engaging the accelerating switch contact levers, separate means for rotating each of the said members, stops for limiting the movement of the first named member in both directions of rotation, means for engaging the sleeve member with the first named member and for limiting the movement of the sleeve member.

34. The combination with reversing and accelerating switch contact levers, of a rotatable member provided with cams for operatively engaging the reversing switch contact levers, a rotatable sleeve member provided with cams for operatively engaging the accelerating switch contact levers, means to rotate the sleeve member after a reversing switch lever has been operatively engaged, means for limiting the rotation of the first member, and means for stopping the rotation of the sleeve member when all the accelerating switch contact levers have been operatively engaged.

35. The combination with reversing and accelerating switch contact levers, corresponding fixed contacts therefor, means for contacting the reversing lever contacts with the corresponding fixed contacts, means for contacting the accelerating lever contacts with the corresponding fixed contacts, in

regular succession after the reversing switch contacts are made, and mechanism for breaking the reversing switch contacts and the accelerating switch contacts, said mechanism being controlled by the said contacting means to effect said breaking of the reversing switch contacts after the accelerating switch contacts have been broken.

36. The combination with an electric motor, of a starting resistance therefor, reversing switch levers, accelerating switch levers, electrical connections, for starting the motor by operating a reversing switch lever, driving means in conjunction with the motor to operate the accelerating switch levers in accelerating the motor, and automatic stop means for preventing acceleration of the motor if the motor is rotating in the direction opposite to that intended.

37. The combination with an electric motor, of reversing switch levers, accelerating switch levers, electrical connections for starting the motor by operation of a reversing switch lever, and automatic means associated with the accelerating switch lever for stopping the motor if the motor starts in the direction opposite to the intended direction.

38. The combination with an elcctric motor, of a rotatable member, reversing switch levers operable by the said member, rotatable mechanism in connection with the motor, accelerating switch levers operable by the said mechanism, manually operable means for turning the rotatable member from a neutral position, means associated with the rotating mechanism to return the rotatable member to a neutral position when the rotating mechanism is rotated in a direction opposite to that of the rotatable member.

39. The combination with an electric motor, of reversing switches, accelerating switches, manual means for operating the reversing switches, mechanical connection with the motor for automatically operating the accelerating switches in succession, and engaging stops in connection with the reversing switch manual means for breaking the accelerating switch connections in reverse succession when the motor is to be stopped.

40. The combination with a polyphase motor, of reversing switches for closing circuits to start the motor in an intended direction, accelerating switches, means for automatically operating the accelerating switches, and engaging projections for preventing the operation of the accelerating switches if the motor starts in a direction opposite to that intended.

41. The combination with a polyphase motor, of reversing switches for starting the motor in an intended direction of rotation, accelerating switches, mechanical means for automatically operating the accelerating switches in succession, and stop means for preventing operation of the accelerating switches when a phase reversal changes the direction of rotation of the motor from the intended direction.

42. The combination with a polyphase induction motor, of a starting resistance, and a mechanical reversing and accelerating switch comprising manually operated reversing switches for starting the motor in either direction, mechanical gear connections with the motor for operating the accelerating switches in succession, and engaging connections between the reversing switch operating means and the accelerating switch operating means to prevent the operation of the latter and to stop the motor when the motor starts in the wrong direction.

43. The combination with a polyphase induction motor, of a mechanical reversing and accelerating switch, an elevator car, mechanism in connection with the elevator car and the motor for operating the said car, an electro-magnetic brake, a starting resistance for the motor, means for manual control of the reversing switches from the elevator car, means associated with the mechanism for automatically controlling the starting resistance to the motor, intersecting projections for preventing danger from "phase reversal," and means for automatically operating a reversing lever to stop the motor to limit the travel of the elevator car.

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

DAVID LARSON.

Witnesses:
OSGER W. FLAGG,
EDWARD H. STEELE.