No. 780,104. PATENTED JAN. 17, 1905.

J. D. IHLDER.

ELECTRIC CONTROLLING APPARATUS.

APPLICATION FILED JULY 31, 1903.

4 SHEETS—SHEET 1.

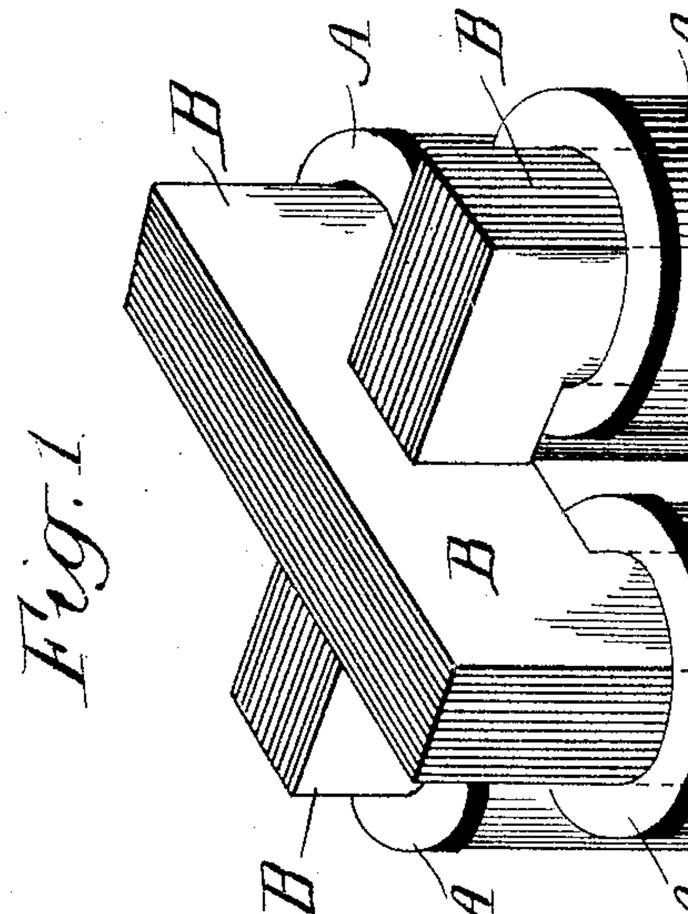

Fig. 2.

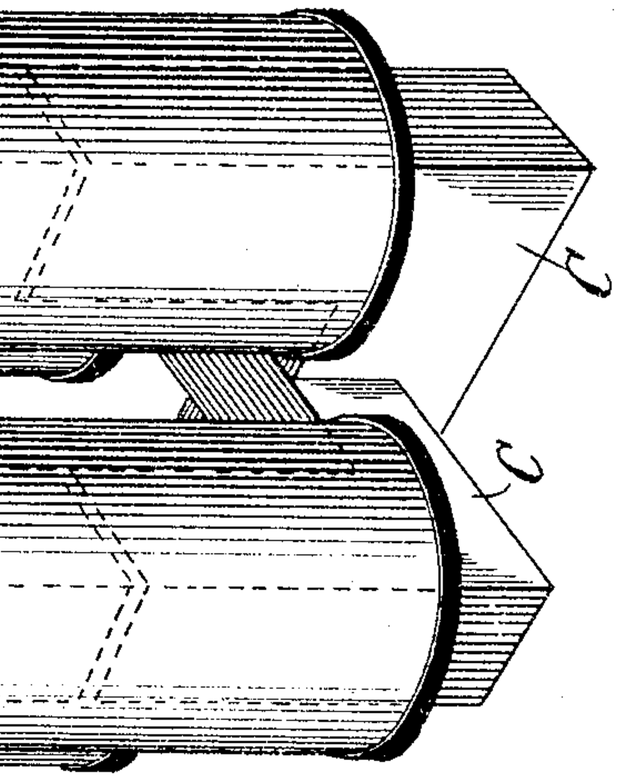

Fig. 3.

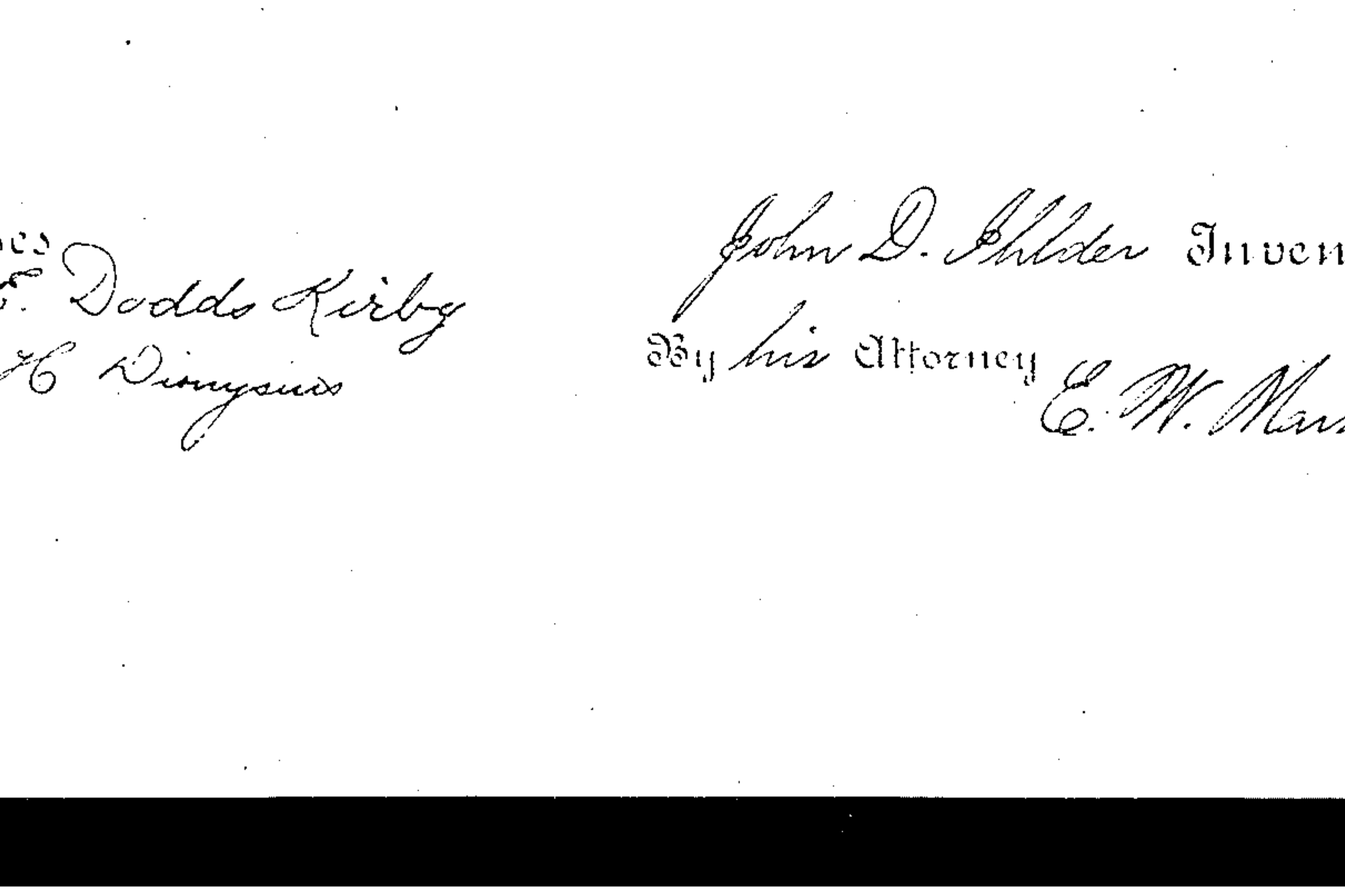

Fig. 1.

Witnesses
Henry C. Dodds Kirby
George H Dimyeus

John D. Ihlder Inventor
By his Attorney E. W. Marshall

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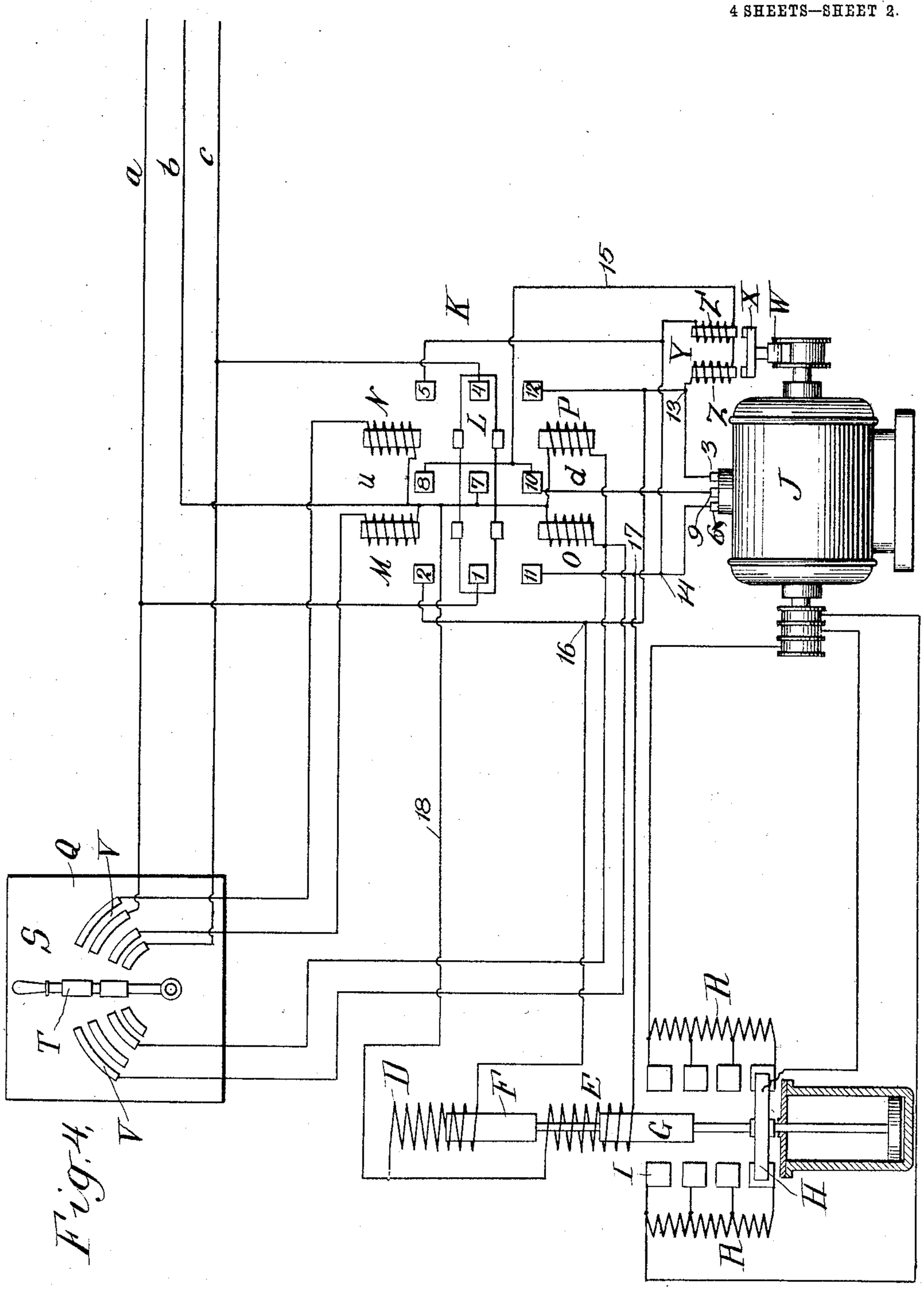

Fig. 4.

Witnesses
Henry E. Dodds Kirby
George H. Dionysius

John D. Ihlder Inventor
By his Attorney E. W. Marshall

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4 SHEETS—SHEET 3.

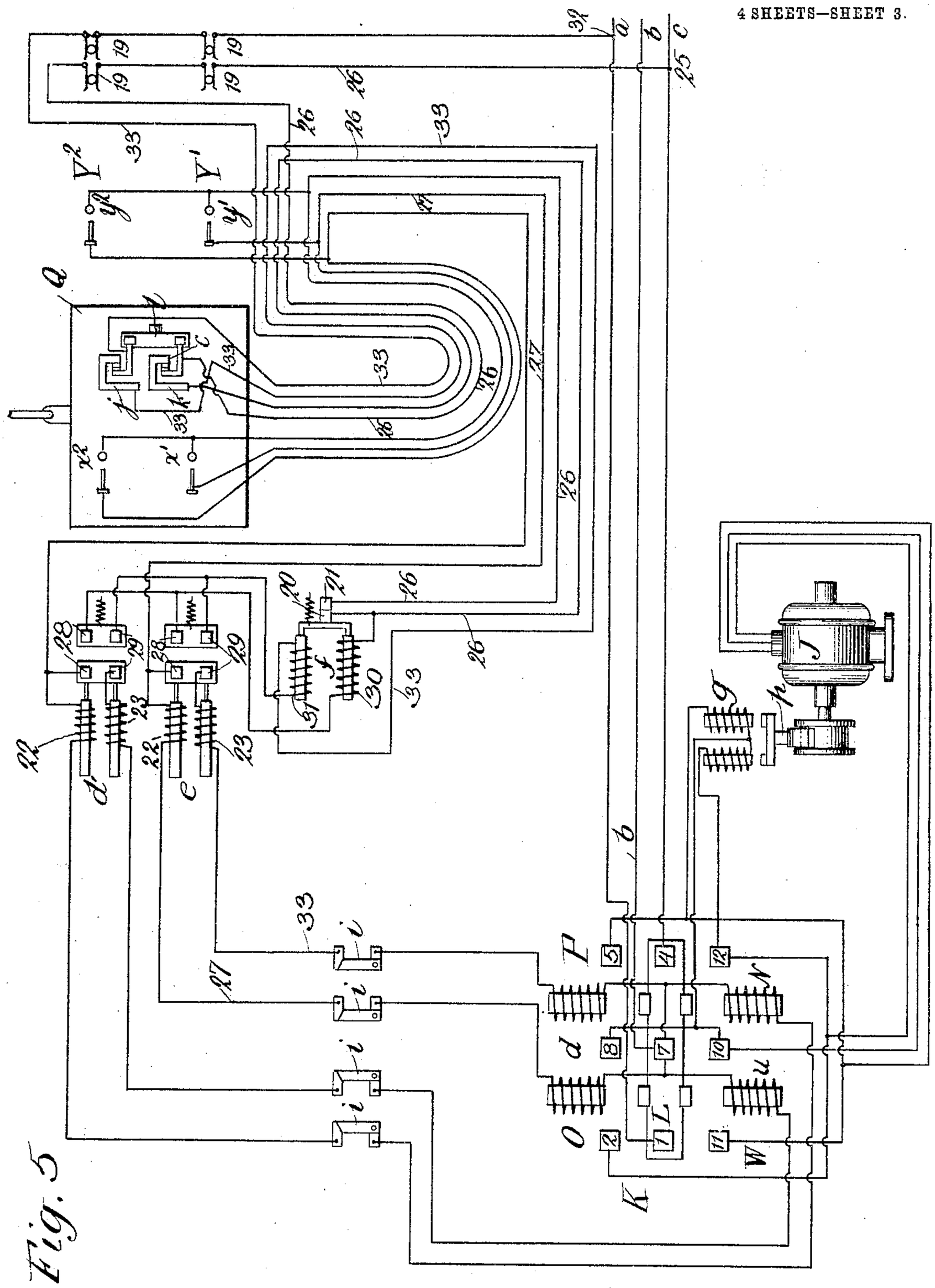

Fig. 5

Witnesses
Henry E. Dodds Kirby
George H. Dionysius

John D. Ihlder Inventor
By his Attorney E. W. Marshall

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4 SHEETS—SHEET 4.

Fig. 6,

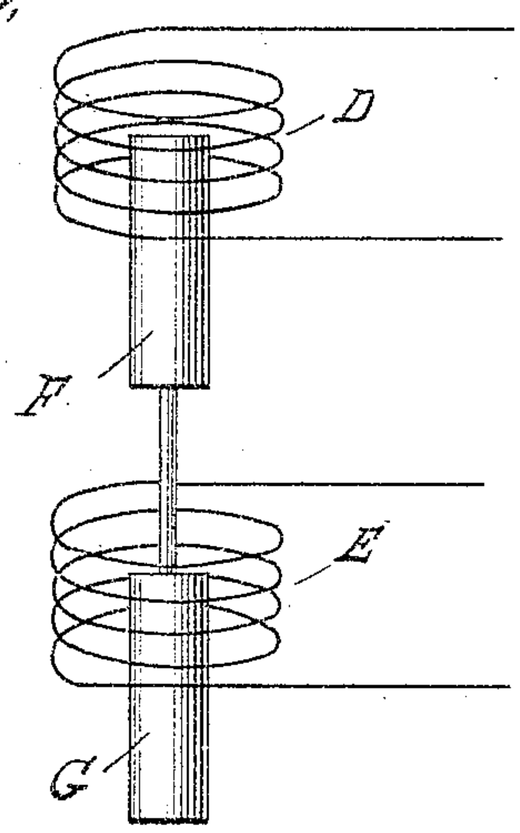
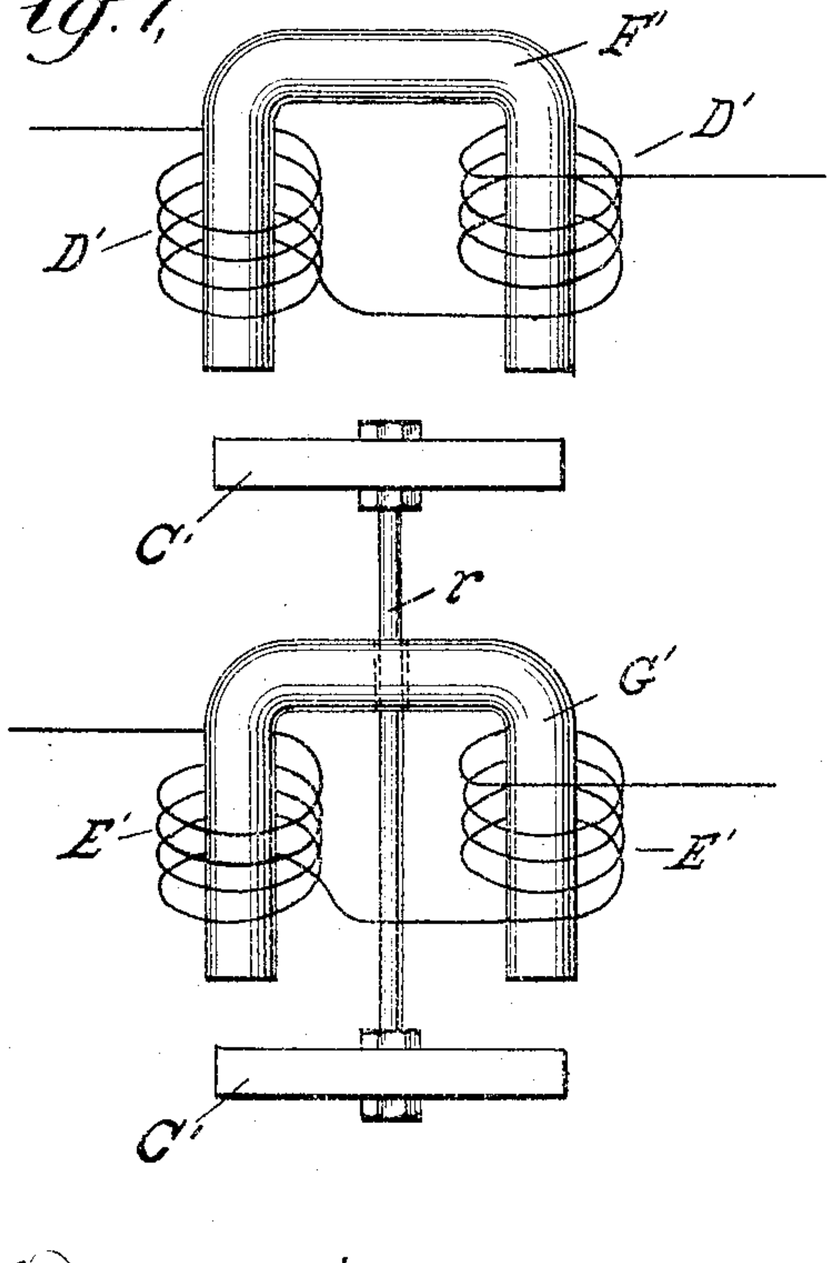


Fig. 7,



WITNESSES:

Henry E. Dodds Kirby

George H. Dionysius

INVENTOR

John D. Ihlder

BY

E. W. Marshall

ATTORNEY

No. 780,104. Patented January 17, 1905.

UNITED STATES PATENT OFFICE.

JOHN D. IHLDER, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRIC CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 780,104, dated January 17, 1905.

Application filed July 31, 1903. Serial No. 167,768.

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, a citizen of the United States, and a resident of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electric Controlling Apparatus, of which the following is a specification accompanied by drawings.

This invention relates to electric controlling apparatus for controlling the operation of dynamo-electric machines, but more particularly for electric elevator-controlling apparatus utilizing alternating currents.

In a division of this application, Serial No. 235,246, filed December 2, 1904, I have broadly claimed the construction of the alternating-current electromagnet which is embodied in the electric controlling apparatus hereinafter set forth, and I have particularly claimed in said division the combination with a tractive magnet having a plurality of windings, a core for each winding, and means for supplying different phases of alternating current to each winding, and hence I do not claim the foregoing subject-matter in my present application.

The objects of the invention are to improve upon the construction of the alternating-current controlling-magnets used in the controlling-circuits, thereby preventing chattering of the magnet-armatures and increasing the certainty and efficiency of operation.

Further objects of the invention will hereinafter appear; and to these ends the invention consists of apparatus for carrying out the above objects, embodying the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as hereinafter fully described and claimed in this specification and shown in the accompanying drawings, in which—

Figure 1 is a perspective side elevation of an alternating-current magnet embodying this invention. Fig. 2 is a plan view of the same. Fig. 3 is a plan view of a modified form of magnet. Fig. 4 is a diagrammatic view of circuits and apparatus, illustrating magnets constructed in accordance with this invention and utilized in connection with electrical elevator-controlling apparatus in which the motor is controlled from a switch on the car. Fig. 5 is a diagrammatic view of circuits and apparatus embodying an automatic push-button system for controlling elevators and utilizing magnets in accordance with this invention. Figs. 6 and 7 show other forms of magnets comprising my invention.

Referring to the drawings, in Fig. 1 an alternating-current magnet is shown, a plurality of coils A, and cores B. The cores in this instance are shown U-shaped, although they may be made of any suitable construction. When alternating currents are used in magnets according to the usual construction, the magnetism rises and falls and causes the armature of the magnet to fall away from the core periodically, and thus keep up a constant chattering. By using two or more phases of a multiphase current in the different windings of a magnet the magnetism in one winding may always be kept at a maximum while that in the others is dying down, and this construction always affords a strong field to attract the armature of the magnet.

In the construction of magnet shown in Figs. 1 and 2 one phase of an alternating current may be sent through two of the windings on one of the U-shaped cores B while another phase is sent through the other two windings on the other U-shaped core B. The armatures C are also shown U-shaped and extending into the windings A. According to this construction the magnetism will be maximum in the windings of one core B while it is dying away in the windings of the other core, and thus strong magnetism is always present for holding the armature C. Moreover, according to the construction of magnet shown, the armature C is attracted at each end, and thus strongly held tightly against the core B. One phase will always be at a maximum, and therefore strong magnetism will always be present in one pair of the windings for holding the armature against the core, and thus preventing chattering.

Fig. 3 shows the arrangement used with a three-phase current.

In Fig. 6 is shown another construction. In

this case the cores F and G are connected in tandem, and each enters a separate solenoid-winding D and E. D is connected in one phase and E in another phase of the current-supply. When these are energized, the cores will be pulled in. As one phase is at its maximum while the other is at its minimum strength the magnetic pull on the pair of cores will be maximum all the times the coils are energized, and as one phase will increase in strength as the other diminishes this pull will be constant.

Fig. 7 shows another way of accomplishing this result. Two magnets F′ and G′ of the horseshoe type are used and their armatures C′ C′ connected together. The winding D′ is connected in one phase and the winding E′ in another phase and the result above set forth is obtained.

The invention is not to be limited to any particular construction of magnet, core, and armature, for many and various arrangements and constructions of the windings and cores and armatures may be provided without departing from the spirit of this invention. I have illustrated in Figs. 1, 2, 3, 6, and 7 suitable and convenient forms of apparatus which have been found to operate efficiently and well and have afforded satisfaction; but many other forms will be found to operate equally as well.

In Fig. 4 two windings D and E are shown with two cores F and G connected to each other and provided with a contact-arm H traveling over the contacts I for cutting in and out the resistance R in the rotor of the elevator-motor J. J is shown as an alternating-current motor, and two of the phases are led to the windings D and E of the switch-magnet, one phase passing through the winding D and another through the winding E, so that there is always magnetism in one or the other of the windings for maintaining the armature F or G attracted, and thus cutting out the resistance R from the rotor-circuit. The motor J, as stated, may be any suitable multiphase alternating-current motor. K represents a reversing-switch for the motor, the armature L of which is connected to be controlled by the up-magnet *u* and down-magnet *d*, each of which magnets *u* and *d* comprises two alternating-current windings M N and O P. One winding of each magnet is connected to receive one phase of the alternating-supply current and the other winding is connected to receive another phase, so that when the core L of the switch K has been attracted there will always be magnetism in one of the windings of magnet *u* or *d* to maintain the said core attracted and prevent chattering and consequent noise and loss of efficiency. *a*, *b*, and *c* represent the alternating-current-supply mains. Q represents the car diagrammatically provided with a switch S, comprising the hand-lever T and contacts V, arranged at each side thereof. The contacts V are so connected with the mains *a b c*, the reversing-switch K, and the stator of the motor J that according to the direction in which the lever T is moved magnets *u* or *d* will be energized, the reversing-switch will be operated, and the motor will be started in one direction or the other to move the car up or down, as desired. Any suitable operative connections may be provided between the motor and the car for raising and lowering the car from the motor.

In the operation of the apparatus if the lever T of the switch S on the car is moved to the right a circuit will be completed from the main *a*, upon which one phase of the current is impressed through contacts V, winding N of magnet *u*, and back to the common return *b*. A circuit will also be completed from the main *c*, upon which another phase of the alternating-current is impressed through contacts V and winding M of magnet *u* and back to the common return *b*. Thus the windings M and N of magnet *u* each receive a different phase of the current and the armature L of the reversing-switch K will be attracted, thereby completing the circuits to the motor for causing it to rotate in a direction to move the car upward. When the armature L is attracted by magnet *u*, one circuit will be completed from the main *a*, through contacts 1 and 2, to binding-post 3 on the motor, another circuit will be completed from the main *c*, through contacts 4 and 5, to the binding-post 6 on the motor, and the third will be completed from the common return *b*, through contacts 7 and 8, to the binding-post 9 on the motor. When the armature L is attracted by magnet *d*, the circuit from the common return *b* to the binding-post 9 on the motor is completed as before, but now through contacts 7 and 10; but the connections to binding-posts 3 and 6 are reversed, for a circuit is completed from the main *a*, through contacts 1 and 11, to binding-post 6, and another circuit is completed from the main *c*, through contacts 4 and 12, to binding-post 3, thus causing the motor to rotate in the opposite direction and move the car downward.

A suitable brake W is shown which is provided with an armature X, controlled by the brake-magnet Y, provided with the windings Z and Z′, each winding being supplied with current of different phase, so that strong magnetism is always provided for the brake. As will be seen, the winding Z is connected at the point 13 to the connector for binding-post 3 and winding Z′ is connected at the point 14 to the connector for binding-post 6, while a single wire 15 connects both the windings Z and Z′ with contacts 8 and 10, which complete the circuit to the common return-main *b*. When the circuit is completed to the stator through the reversing-switch in either direction, circuits will be completed to the windings D and E of the switch controlling the resistance R. It will be seen that the wind-

ing D is connected at the point 16 with the electrical connections leading to the binding-post 3, while winding E is connected at the point 17 with the electrical connections leading to the binding-post 6. A common lead 18 connects both windings D and E with the common return *b* of the alternating-current main. It will therefore be seen that different phases of alternating current will always pass through windings D and E no matter in which direction the motor may be rotating.

In Fig. 5 an automatic push-button system is shown for controlling electric elevators. As before, J represents the elevator-motor, which may be any suitable alternating-current motor, provided with current from the mains *a*, *b*, and *c*, of which, as before, *b* is the common return. Y′ and Y² represent floors or stations opposite which the car Q is to be moved or at which the car is to be stopped, as desired. Push-buttons *y′ y²* are provided at the landings and push-buttons *x′ x²* are provided upon the car, said push-buttons on the car corresponding to those on the landings. In this instance but two push-buttons are shown and but two landings, and the circuits and apparatus are so arranged that when either push-button *x′* or *y′* is manipulated circuits will be completed to the motor to start the car downward. 19 represents diagrammatically door-contacts connected to be operated by the doors of the elevator-well, so that when one of the doors is open the controlling-circuit is broken at the door-contact. Any suitable operative connections may be provided between the motor and the car for moving the car up and down by means of the motor. The push-buttons *x′ x²* are arranged in parallel with the push-buttons *y′ y²* and the arrangement of apparatus is such that after a push-button has been manipulated and the motor had started automatic devices come into play which break the push-button circuit, so that interference with the operation of the motor from one of the stations or landings is prevented until the car has come to rest and the control is restored to the landings. The magnets *u* and *d* are alternating-current magnets with different phases of current in different windings, so that the magnet-armature is held tightly against the magnet-cores. The magnets *d′* and *e* are also provided with double windings through which different phases of the current pass, while non-interference magnet *f* and brake-magnet *g* are likewise provided with double windings for different phases of the current. The brake is provided with a suitable brake-shoe *p*, which is lifted by the brake-magnet. *i i i i* represent limit-switches. *j* and *k* represent safety-switches arranged upon the car and connected to be controlled in common by the hand-operated button *l*, so that circuit is broken at both switches at the same time. A circuit is completed through the switch *j* from the main *a* with one phase of the current and a circuit is completed through the switch *k* from the main *c* with another phase of current. When the circuits are broken at the switches *j k*, the controlling apparatus cannot be operated from the stations or landings. The non-interference magnet *f* controls the contacts 20 and 21, connected in circuit with the push-buttons, so that when circuit is broken at contacts 20 and 21 the push-button circuit is broken, as stated. In the operation of the apparatus the windings 22 of magnet *d′* or *e* are energized with one phase of the current, as from the main *c*, according to the direction in which the car is to travel. If the car is to travel upward, winding 22 of magnet *d′* is energized, and if the car is to travel downward winding 22 of magnet *e* is energized. The circuit of the windings 23 of magnet *d′* and *e* is completed for the other phase of the current when the first winding 22 has been energized, and when both windings are energized with different phases the contacts are held tightly closed without chattering and efficient operation is obtained. The armature L of the reversing-switch K is provided with contacts, as hereinbefore described in connection with Fig. 4.

The operation of the apparatus shown in Fig. 5 diagrammatically is briefly as follows: Let it be assumed that it is desired to call the car downward from a station or suppose that the operator on the car desires to move the car downward. If the apparatus is to be controlled from a landing, push-button *y′* is manipulated or else the operator on the car manipulates push-button *x′*. In either case a circuit is completed first as follows: from the main *c* at the point 25, through wire 26, door-contacts 19, to and through the switch K, and still by wire 26 to and through contacts 20 and 21 on non-interference magnet *f*, to and through either push-button *x′* or *y′*, which are connected in parallel, and by wire 27 to and through winding 22 of magnet *e*, and still by wire 27 through limit-switch *i*, winding O of down-relay *d*, to contact 7 of reversing-switch K, and from thence to the common return-main *b*. It will thus be seen that a circuit is completed through one of the windings 22 of magnet *e* and through the winding O of down-relay *d* of the reversing-switch. The energizing of magnet *e* causes contacts 28 and 29 to close, and the closure of contacts 28 on magnet *e* completes a short circuit around the push-buttons, through the winding 30 of non-interference magnet *f* to the wire 27, and thence back to the common return-main *b*. The energizing of winding 30 of magnet *f* breaks the circuit of the push-buttons at contacts 20 and 21, thus preventing interference with the operation of the motor from the landings. The closure of contacts 29 on magnet *e* completes a circuit through the winding 31 of the non-interference magnet *f* and

through the winding 23 of magnet *e*, with a different phase of current in circuit from that which passes through the winding 30 of magnet *f* and 22 of magnet *e*. The circuit completed by the closure of contacts 29 of magnet *e* is as follows: from the point 32 on the main *a*, through the door-contacts 19, and by wire 33 to and through switch *j*, and still by wire 33 to and through the winding 31 of magnet *f*, and from thence to and through contacts 29, and the winding 24 of magnet *e*, and then by wire 33, limit-switch *i*, to the winding P of the down-relay *d* of reversing-switch K, and from thence out by means of the common return-main *b*. At this stage in the operation of the apparatus it will be seen that all the double windings of the controlling-magnets in the apparatus have been energized by currents of different phases. As shown, the circuit of the brake-magnet *g* is connected to be completed when the reversing-switch K is operated. The car may be brought to a stop by manipulating the switches *j* and *k* on the car, or automatic means may be provided connected to operate the limit-switches *i* by the movement of the car to stop the car automatically at the desired floor or station, as in the usual operation of automatic push-button systems of the character described.

The operation for moving the car upward is the same as for moving it downward, only with different sets of controlling-magnets in circuit.

Obviously some features of this invention may be used without others, and the invention may be embodied in widely-varying forms.

Therefore, without limiting the invention to the construction shown and described nor enumerating equivalents, I claim, and desire to secure by Letters Patent, the following:

1. In an electrical controlling system, the combination with an electrical machine to be controlled, of controlling-switches and apparatus therefor, alternating-current magnets each having a plurality of windings arranged to operate said switches and apparatus, and means for supplying alternating current of different phase to each winding of said magnets.

2. In an electrical controlling system, the combination with a motor, of reversing and starting switches therefor, magnets for controlling said switches, each magnet having a plurality of windings, and means for supplying different phases of alternating current to the different windings of each magnet.

3. In an electrical elevator-controlling system, the combination with the car and motor, of a switch for controlling the operation of the motor, a reversing-switch, circuits and connections including said switches and the motor, a magnet for controlling said reversing-switch, said magnet having a plurality of windings, and means for supplying alternating currents of different phase to each winding of the magnet.

4. In an automatic push-button elevator-controlling system, the combination with the motor, car, and stations, of push-buttons or switches and controlling devices with alternating-current circuits and connections including the push-buttons, controlling devices, the car and the motor, alternating-current magnets each having a plurality of windings included in said circuits, and provision for dividing the phases of the current, whereby different phases are supplied to the different windings of the magnets.

5. In an automatic push-button elevator-controlling system, the combination with the motor, car and stations, of controlling-circuits and devices for calling the car to a particular station, controlling-magnets included in said circuits, each magnet having a plurality of windings, means for preventing interference with the operation of the motor after the car has started, and means for first supplying one phase of alternating current to one of the windings of the controlling-magnets as the motor is started, and provision for then automatically supplying another phase of alternating current to another winding of the magnets.

6. In an automatic elevator-controlling system, the combination with a motor and circuits for controlling the operation of the same, of magnets included in said circuits, each magnet having a plurality of windings, and means for first supplying one phase of alternating current to the magnets, and for then supplying another phase to different windings thereon.

7. In an automatic elevator-controlling system, the combination with a motor, car and stations, of controlling-circuits and devices including the motor car and stations, controlling-magnets each having a plurality of windings in said circuits, provision being afforded by the arrangement of circuits for first supplying one phase of alternating current to a winding in each controlling-magnet, and for then supplying another phase of alternating current to another winding in each magnet, when the latter operates.

8. In an automatic elevator-controlling system, the combination with the motor, car and stations, of push-buttons or switches and controlling devices, of a plurality of electrical circuits including the switches, controlling devices and the motor, of alternating-current magnets each having a plurality of windings included in said circuits, and provision for dividing the phases of the current whereby different phases are supplied to the different windings of the magnets.

9. In an automatic push-button elevator-controlling system, the combination with the motor, car and stations, of a plurality of controlling-circuits each in a different phase of an alternating current, of devices for calling the car to a particular station, of controlling-mag-

nets having a plurality of windings and included in said controlling-circuits, means for preventing interference with the operation of the motor after the car has started, and means for first closing one of the controlling-circuits through one of the windings of the controlling-magnets, and provision for then automatically closing the other controlling-circuit.

10. In an electric elevator-controlling system, the combination with the car, and an alternating-current motor, of a switch in the car, a plurality of controlling-circuits, each in a different phase of an alternating current, a reversing-switch, magnets for operating the reversing-switch, said magnets having a plurality of windings, one in each of the controlling-circuits.

11. In an electric elevator-controlling system, the combination with the car and a motor, of a switch in the car, a reversing-switch controlling the motor, a brake, of a plurality of controlling-circuits each in a different phase of an alternating current, and magnets for operating the reversing-switch and the brake, said magnets having a plurality of windings, one in each of the controlling-circuits.

12. In an electric elevator-controlling system, the combination with the car and motor, of a switch in the car, a reversing-switch, a rheostat, and a brake controlling the motor, of a plurality of controlling-circuits each in a different phase of an alternating current, and magnets for operating the reversing-switch, the rheostat and the brake, said magnets having a plurality of windings, one in each of the controlling-circuits.

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

JOHN D. IHLDER.

Witnesses:
HERBERT S. MURPHY,
ERNEST W. MARSHALL.