No. 749,255. PATENTED JAN. 12, 1904.

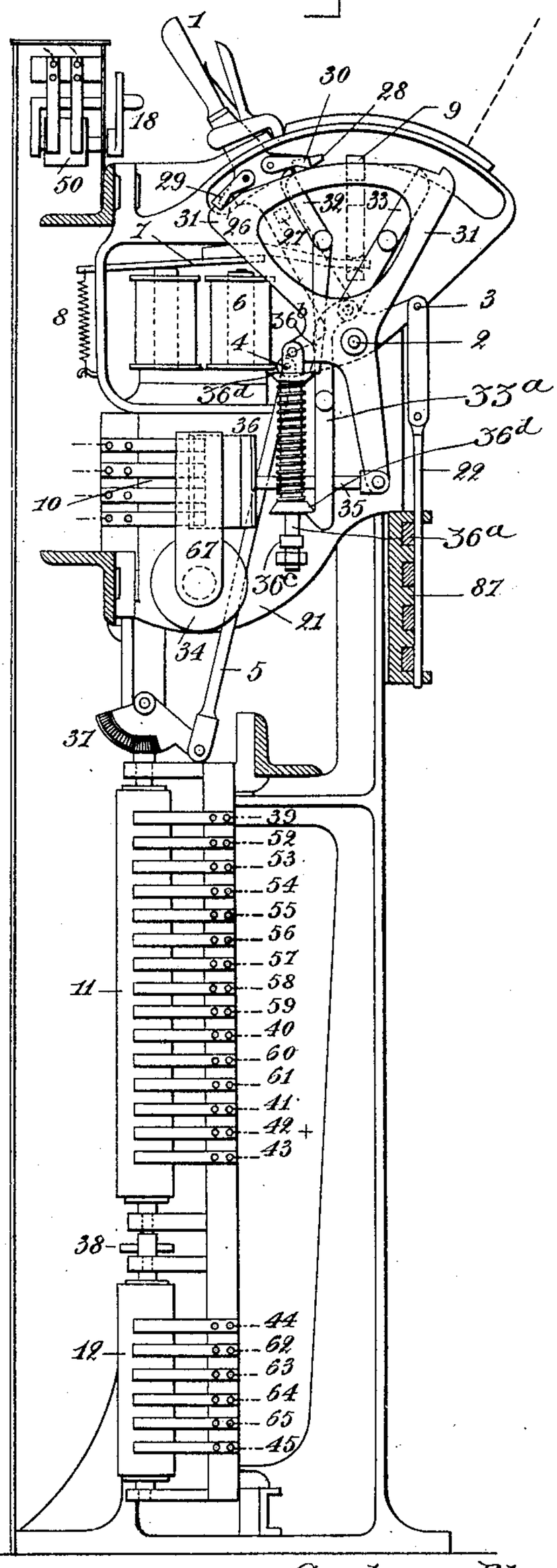
G. BLEYNIE & T. DUCOUSSO.

ELECTRIC INTERLOCKING SWITCH AND SIGNAL SYSTEM.

APPLICATION FILED MAR. 6, 1902.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1



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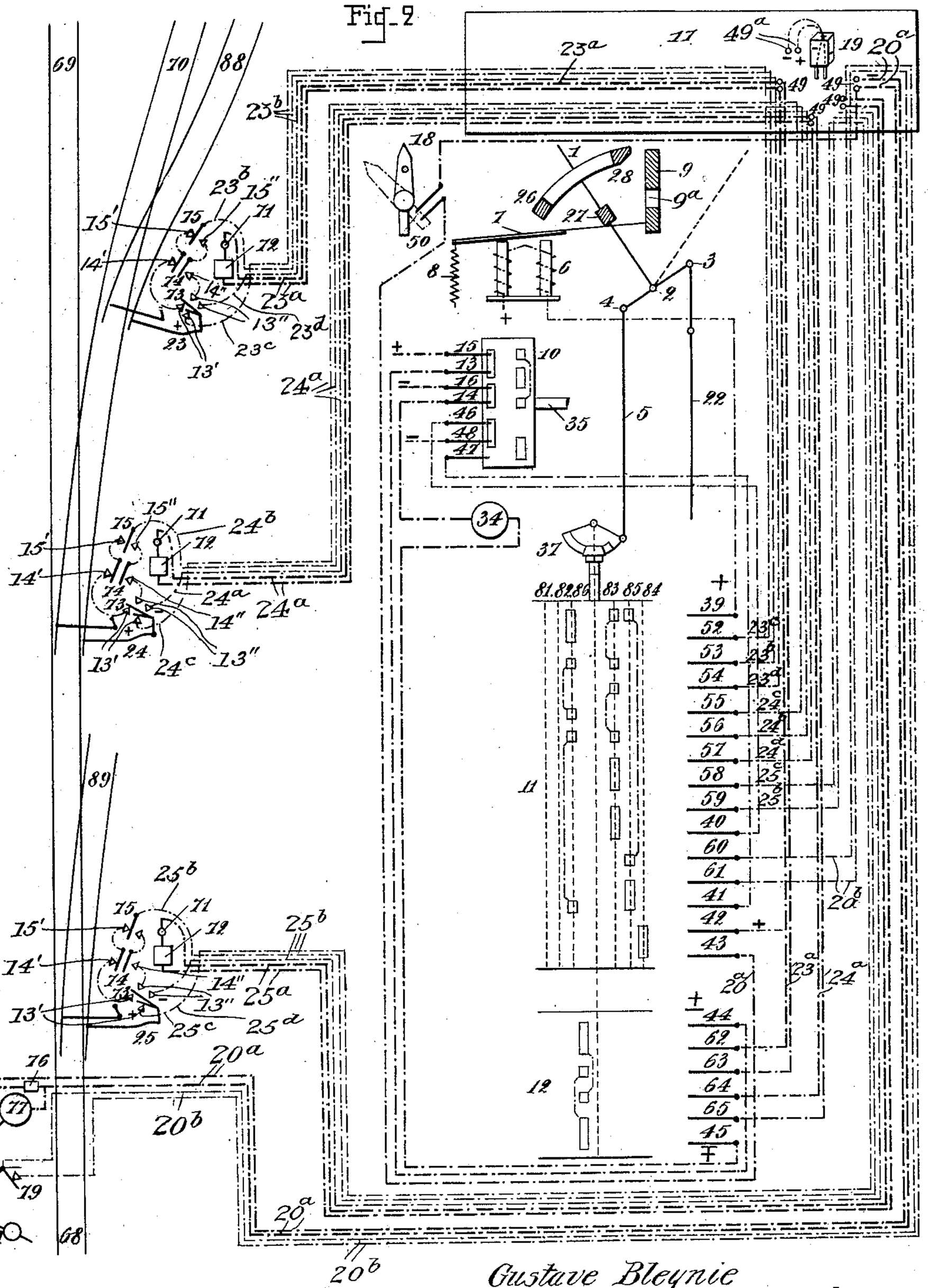
NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2



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NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3

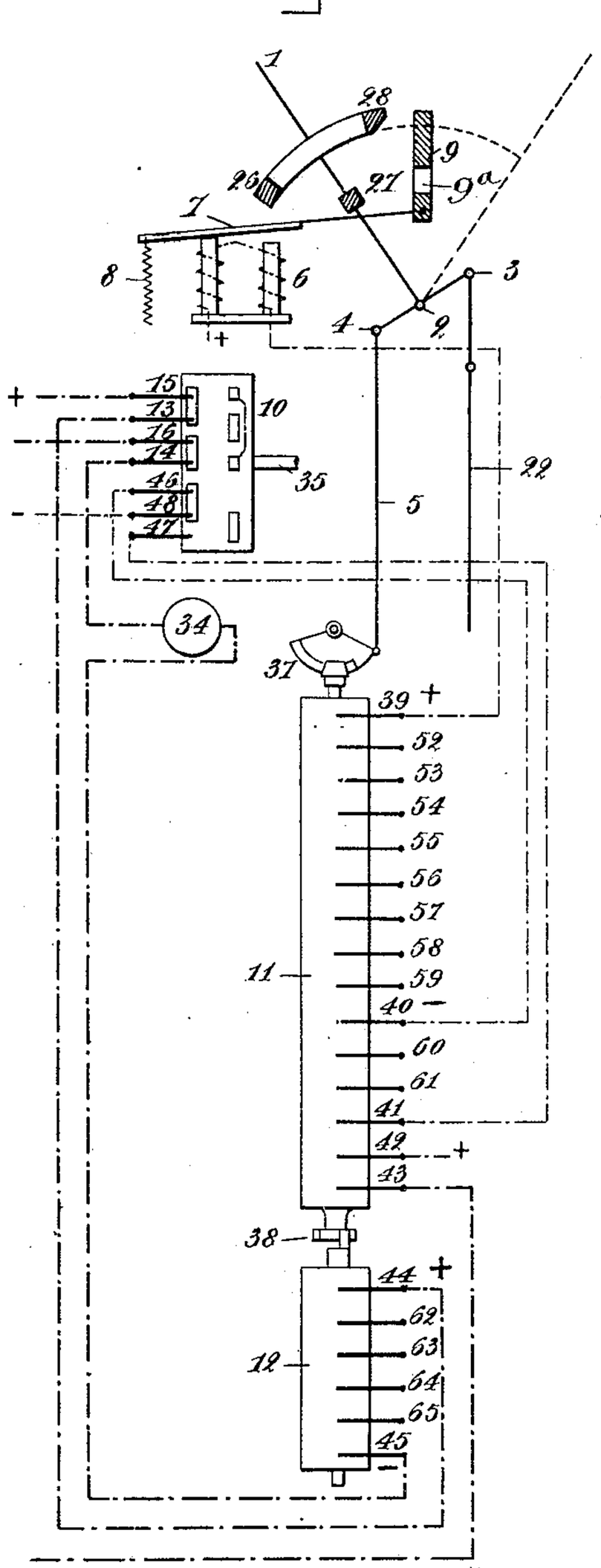
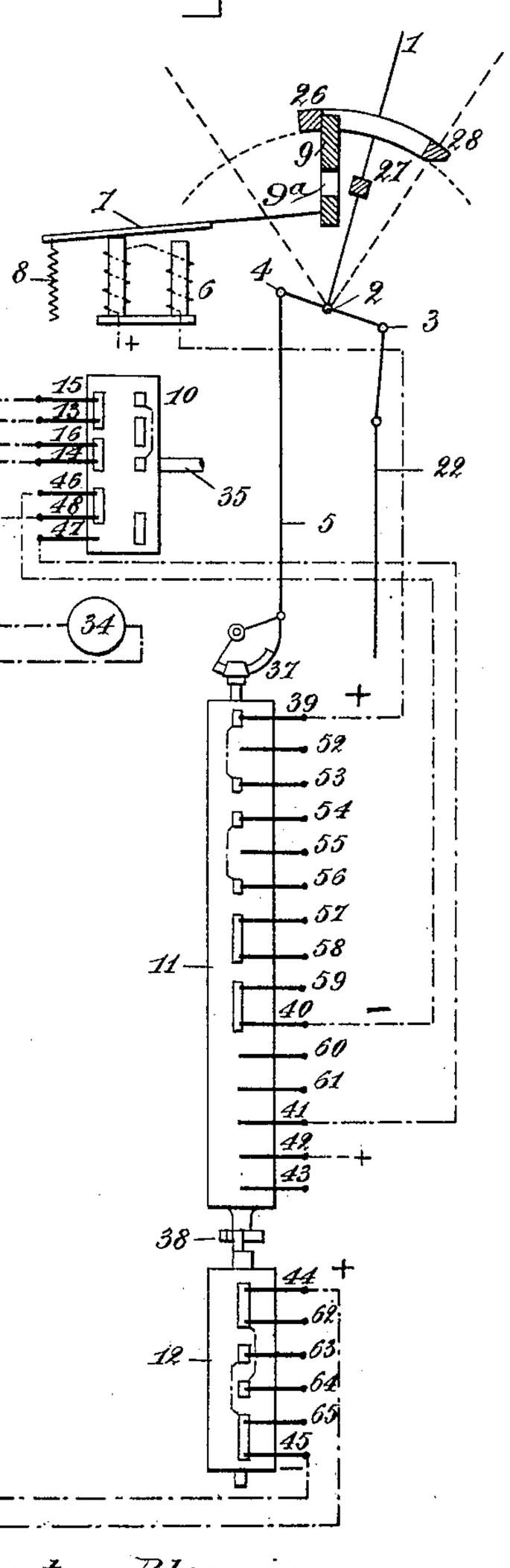


Fig. 4



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NO MODEL. 6 SHEETS—SHEET 4.

Fig. 5

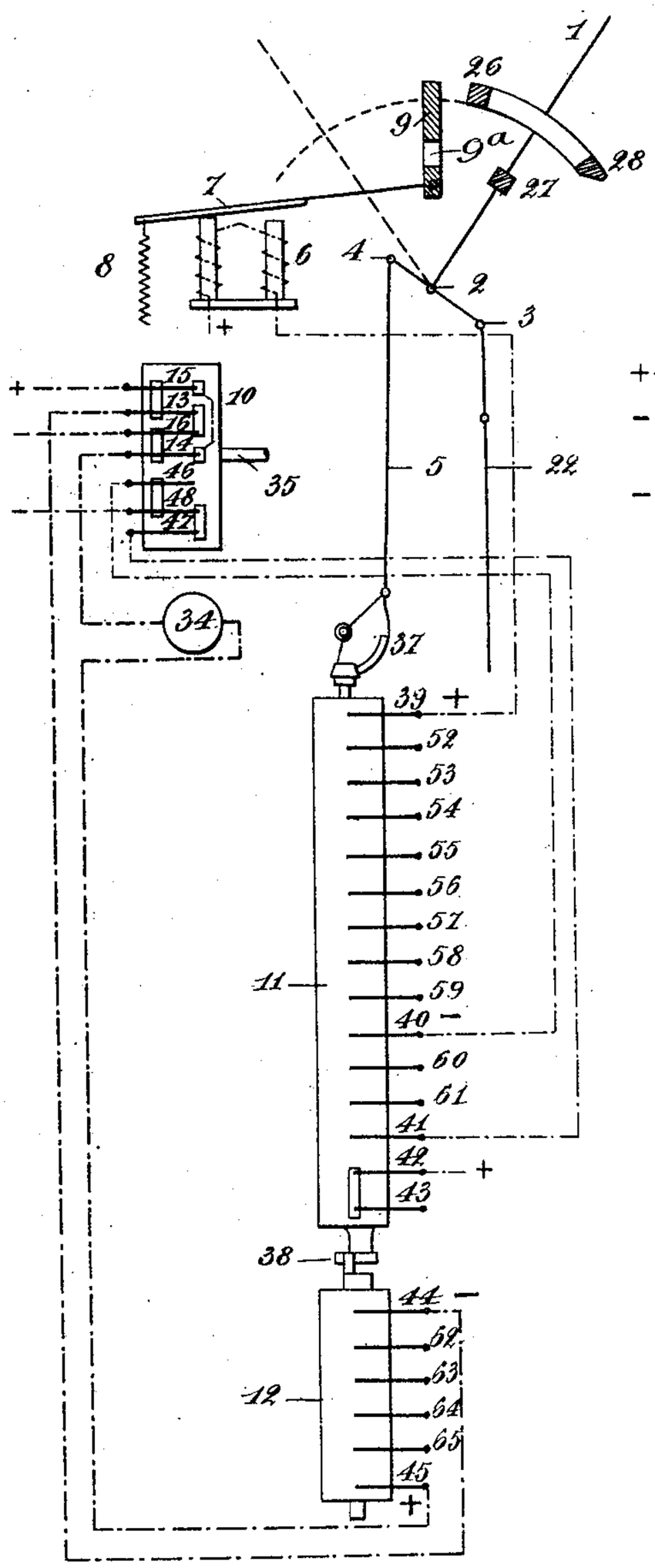
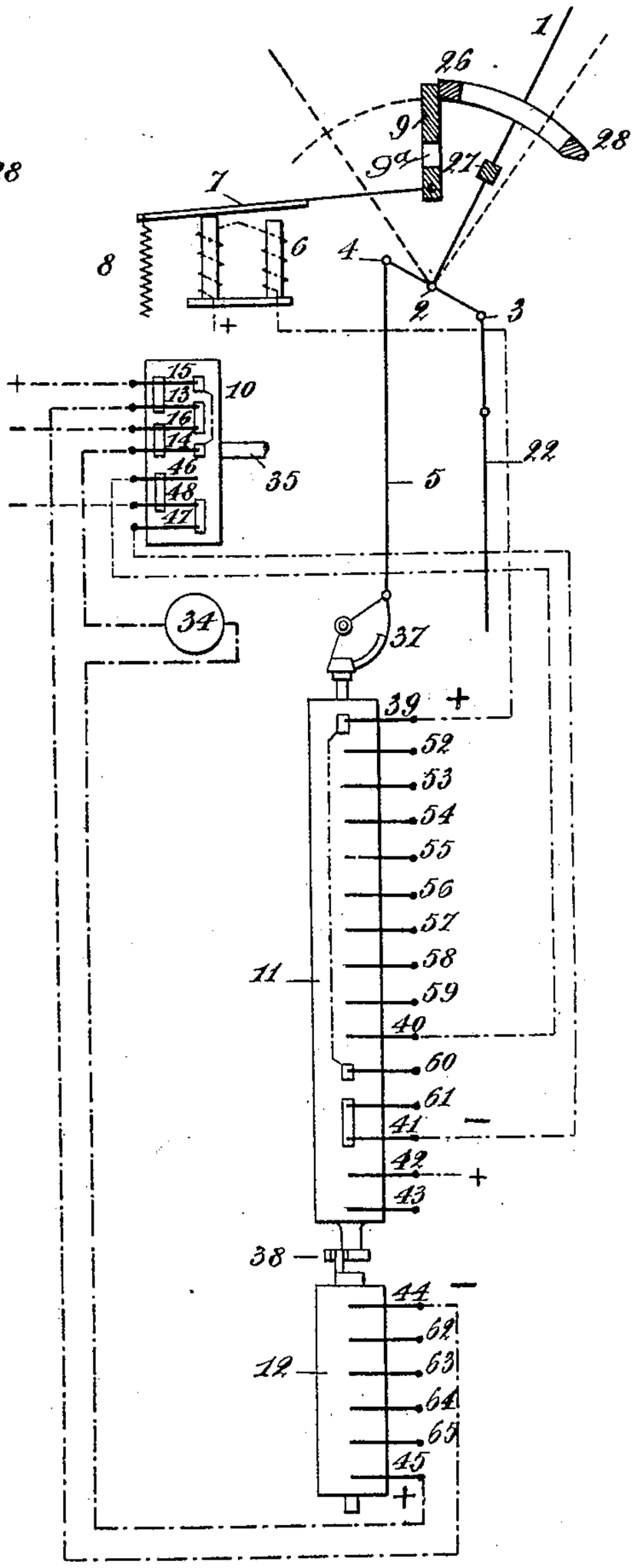


Fig. 6



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NO MODEL. 6 SHEETS—SHEET 5.

Fig. 7

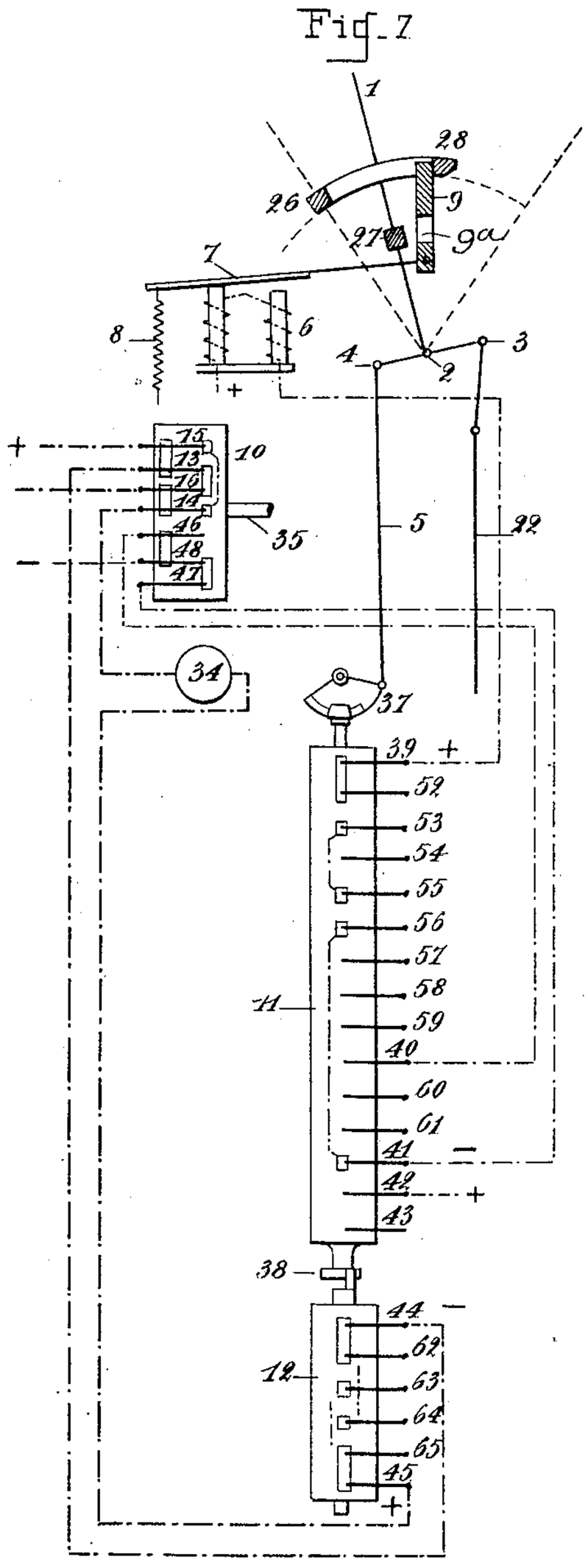
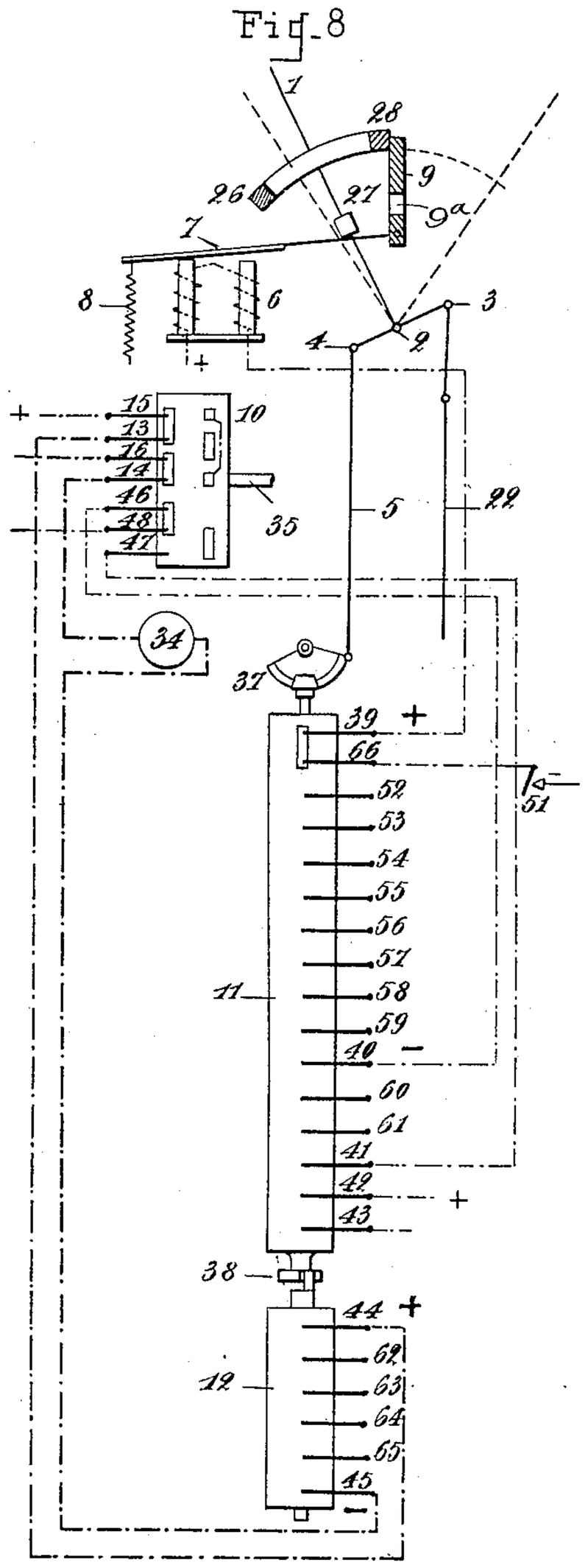


Fig. 8



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NO MODEL. 6 SHEETS—SHEET 6.

Fig. 9

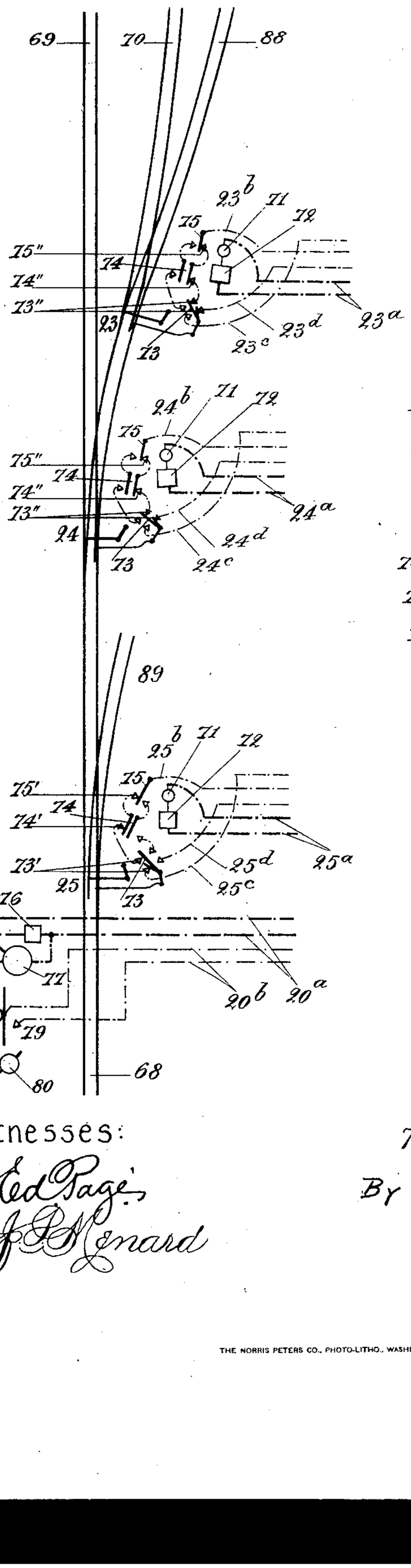
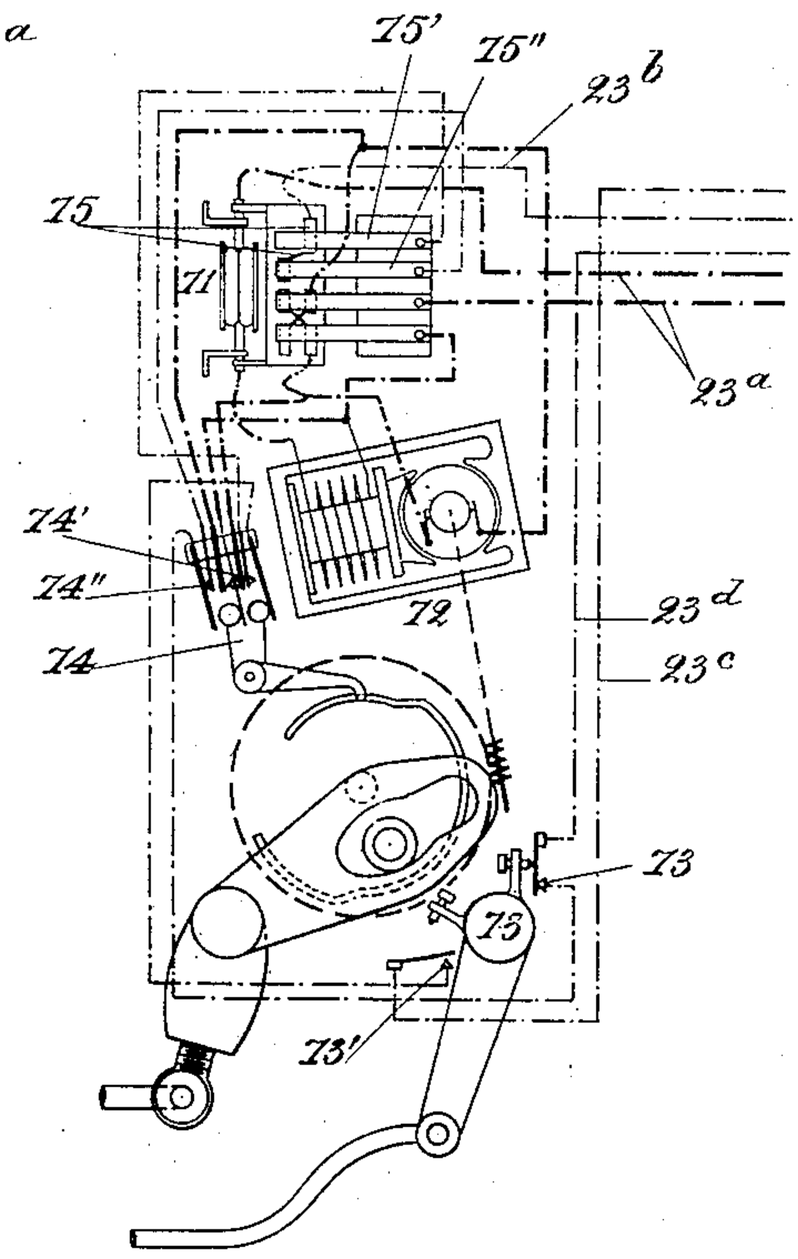


Fig. 10



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No. 749,255. Patented January 12, 1904.

UNITED STATES PATENT OFFICE.

GUSTAVE BLEYNIE AND THÉOPHILE DUCOUSSO, OF PARIS, FRANCE.

ELECTRIC INTERLOCKING SWITCH AND SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 749,255, dated January 12, 1904.

Application filed March 6, 1902. Serial No. 96,890. (No model.)

To all whom it may concern:

Be it known that we, GUSTAVE BLEYNIE and THÉOPHILE DUCOUSSO, citizens of the Republic of France, and residents of Paris, France, have invented certain new and useful Improvements in Interlocking Switch and Signal Systems, of which the following is a specification.

This invention has for its object means for directly controlling and operating a system of switches and signals on railways, and in particular to so arrange the connections between the switches and signals and the operating-levers at the station that all the switches and signals over a given route or itinerary may be operated by a single lever called the "itinerary-lever," and to provide one such itinerary-lever for every single route or itinerary over the section of track controlled by the station, in contradistinction to the arrangements at present employed, in which a single lever actuates but one apparatus, or at most a very limited number of apparatuses, and in which the same switch is always operated by one and the same lever, so that all the levers of the route or itinerary must be separately handled in order to clear such route and open the same for the passage of the train.

In the system which forms the present invention the operation of the means of transmission is distinguished by the peculiar arrangements of the itinerary-levers, which are adapted, as above stated, each to a particular route or itinerary for the section or track under control, but, on the other hand, each separate switch or signal is under the individual control of as many different levers as there are routes in which the said switch or signal is concerned. In order to enable such an arrangement to be carried out with as nearly as possible perfect security, so as with a minimum of manipulation to produce a perfectly safe and unfailing operation, our invention embodies several distinct parts, which may be summed up as follows: First, a series of itinerary-levers which are preferably arranged in a row like the levers now in use and each mark to be operated for a signal itinerary over the track; secondly, a locking device by which when one of said levers is being operated all the other levers which are concerned in any switches or signals in which the first-named lever is concerned are locked against movement, so that but one of the levers operating on any given switch or signal can be moved from its normal position at one time; thirdly, a series of operating motors for each of the switches or signals under control and proper means of transmission between these motors and the respective levers; fourthly, controlling devices operated by the respective itinerary-levers for working the proper motors in the proper direction at the proper times, and thereby causing the proper setting of the switches and signals; fifthly, a return-transmission means between each of said switches and signals and the station, and, sixthly, a system of interlocking controllers operated by said return-transmission means and so connected with each other of the said itinerary-levers that they cannot be moved to their final position to clear the signals over the itinerary or route until all of the switches have been actually set in their proper position and, conversely, cannot move the switches from these positions until after the signals have been again raised to block the itinerary.

The invention comprises, furthermore, means to permit a single lever to serve for two lines, differing from each other only in the direction in which they are traveled, means to prevent the operation of a lever when the corresponding line cannot be traveled by reason of certain service conditions not depending upon the central station, and, finally, means for permitting, in case of need, individual positioning of any switch or of any signal among the number of those which depend upon the controlling-levers in the central station.

As above described, in general any transmission and return-transmission means may be employed, and the use of any of the various powers known to the engineer—such as water, compressed air, steam, mechanical gearing, or electricity—is therefore contemplated in our invention; but in view of its greater flexibility and general adaptability to the purpose we prefer to employ electricity, and the embodiment herein more particularly described as an example is therefore confined to the use of this agency.

In the description which follows we will assume, for convenience, that the motive apparatus of the switches are of the type described and claimed in the application for patent of Ducousso and Rodary, filed in the United States Patent Office the 12th of March, 1901, Serial No. 50,858, and that the motive apparatus of the signals are of the type described and claimed in Patent No. 649,847 to Ducousso and Rodary.

To these ends our invention may be described as embodying more particularly and in the main a controlling apparatus operated by the itinerary-lever and provided with a series of electrical contact-pieces against which are pressed a series of brushes or spring-fingers, which are connected to the various circuits which enter into the apparatus. We arrange a series of transmission-circuits, each of which leads to the motor or operating device of a given single switch or signal, and there are therefore as many different transmission-circuits as there are switches and signals. When, therefore, the itinerary-lever is moved from its normal or closed into its open position, each of these transmission-circuits is caused to be closed in the proper manner to operate the proper switches for the itinerary in question. Moreover, each of the switches is provided with a return-circuit, and each of the return-circuits is likewise led to certain spring-fingers on the said controller and through it are connected with an electrically-operated locking device, which governs the motions of the itinerary-lever. This locking device remains across the path of the lever, so as to prevent it from completing its full swing until after the return-circuits are all automatically closed by the proper setting of the switches. When this is done, and then only, can the itinerary lever be thrown completely over, and in this position only can the signal or signals blocking the route over the said itinerary be cleared. Moreover, additional return-circuits are provided from the said signals to the said controller and are so arranged in connection with the said electrically-operated locking devices that on its return movement the swing of the said itinerary-lever is again blocked until the signal or signals have all been automatically raised again to block the itinerary, and the said switches are not operated to be returned to their normal positions until after the lever is permitted by the said locking device to complete its swing back to its said normal position again, and, as before mentioned, it is to be noted that until the itinerary-lever has been completely returned to its original position the entire system is blocked, not only with respect to this, but to all other itineraries concerned in the same switches, because of the locking device provided for the other itinerary-levers.

In the annexed drawings we have for the sake of example illustrated one embodiment of our invention, a detailed description of which will now be given in order to enable the nature of the same to be fully understood.

In the drawings, Figure 1 is a side elevation of a complete itinerary-lever apparatus. Fig. 2 is a general diagram showing the connections between an itinerary-lever and the various apparatus, switches, and signals to which this itinerary relates. Figs. 3, 4, 5, 6, and 7 represent diagrammatically the successive positions of working of the itinerary-lever apparatus, and Fig. 8 illustrates an electric interlocking device which may be in certain cases added to the apparatus, as shown in the other drawings. Fig. 9 represents the arrangement of the switches for travel from the track 68 to the track 88, the corresponding signal being open. Fig. 10 is a view, on a larger scale, of the arrangement of a switch-motor, showing the connections established between its various elements when the corresponding switch is in the reversed position.

The same numerals of reference denote like parts in all the figures of the drawings.

The lever herein termed the "itinerary-lever" by reason of the functions subserved by it hereinbefore pointed out, is indicated at 1 and pivoted at 2, and its lower end, as shown, is provided with T-shaped branches, forming pivots 3 and 4, to the former of which is connected, as shown, an interlocking rod 22, with which engages the interlocking device 87, operated by the other itinerary-levers which are concerned in the switches or signals of the same itinerary as the lever shown. The special form of these forms no part of our invention, as any suitable device may be used for this purpose, the only object in view being to prevent more than one of the levers from being moved from its normal position at once. To the pivot 4 is connected by an intermediary link 5 a gear-segment 37, which works a controller consisting of two contact-cylinders 11 and 12, each carrying a series of electrical contacts thereon, whose positions are diagrammatically illustrated in Fig. 2. Against the contacts on the cylinders 11 and 12 press a series of brushes or spring-fingers numbered 39, 40, 41, 42, 43, 52, 53, 54, 55, 56, 57, 58, 59, 60, and 61 in the case of the cylinder 11 and 44, 45, 62, 63, 64, and 65 in the case of the cylinder 12. The cylinder 12 is not rigidly connected to the cylinder 11, but only by a lost-motion coupling 38, permitting a free oscillation of the cylinder 12 through a certain arc without the accompanying movement of the cylinder 11.

The apparatus worked by the itinerary-lever 1 embraces a reverser or pole-changer 10, which is of the nature of a reciprocating block having two rows of contact-pieces thereon, as shown, (see Fig. 2,) against which press the extremities of spring-fingers 13, 14, 15, 16, 46, 47, and 48, this being operated by a rod 35,

which is connected to the end of the reversing-lever 31, of fan-shaped form, and pivoted on the same axis 2 as the operating or itinerary lever 1. The reversing-lever 31 is operated by a pair of pawls 29 and 30, pivoted to the handle of the lever 1, and the ends of which abut against rectangular notches 26, formed on the opposite extremities of the triangular portion of the lever 31, so that the reversing-lever is not moved in either direction until after the operating-lever has neared the end of its stroke in either direction.

The mechanical interlocking devices for regulating the movements of the itinerary-lever comprise a vertically-reciprocating bolt 9, which is cut away near the center to form a notch 9^a, and co-operating with this bolt there are three catch-dogs or projecting lugs 26, 27, and 28, the first and last of which strike against the upper end of the bolt 9 when it is raised and pass over the same to permit the lever 1 to continue its movement only when the bolt 9 is depressed, while the center dog 27, on the contrary, is adapted to pass through the notch 9^a only when the bolt 9 is raised. To the bolt 9 is connected one end of the lever 7, which carries an armature on its lower surface and is fulcrumed on one pole of the electromagnet 6, while the bolt 9 is held resiliently in raised position by the spring 8, attached to the opposite end of the lever 7. According to the form shown in Fig. 2 the dog 28 is obliquely chamfered on its lower face, so as to ride over and depress the bolt 9, and it will be seen, therefore, that in its forward or opening movement the lever 1 requires two conditions—first, that the electromagnet 6 shall remain dead until after the dog 27 has passed the notch 9^a, and, second, that it shall be energized subsequently in order to permit the dog 26 to pass the upper end of the bolt 9, while on its return movement three conditions are necessary—first, the depression of the bolt 9 by the energy of the magnet 6; second, its relaxation, and, third, its depression again, so as to permit the three dogs 26, 27, and 28 to successively pass the bolt.

Referring to Fig. 2, we have represented in the center an itinerary-lever with its connections and on the left of the drawing a section of track 68 69, having branches 70, 88, and 89, the route over which is controlled by switches 23, 24, and 25, and, furthermore, by a signal, (indicated diagrammatically at 20.) Each of the switches 23, 24, and 25 is operated by a two-wire transmission-circuit, (designated, respectively, 23^a, 24^a, and 25^a and leading from the central station where the itinerary-levers are located.) In each of the transmission-circuits is placed a motor 72, connected operatively with a pole-changer or commutator, (indicated at 71.) The object of this arrangement is to provide for the movement of the commutator into one of its positions by a current in one direction through the circuit and to the opposite position by a current in the opposite direction. The object of introducing the commutator is due to the well-known fact that the mere reversal of the current in an electric motor does not reverse its direction of motion if the motor be a series or shunt-wire machine of the ordinary type, and therefore some commutating or pole-changing device 71 will be necessary to interchange the poles of the armature or of the field of the motor in order to cause, say, a positive current to rotate the motor in one direction and a negative current in the opposite direction. In the case of a motor of the type Ducousso and Rodary, taken here as an example, as indicated above, the reversal of direction of the current is effected in the transformer. Of course if the fields of the motor are separately-excited or permanent magnets the use of the commutator 71 would be unnecessary. Furthermore, besides the circuits 23^a, 24^a, and 25^a, which distribute the energy to the motive apparatus of the switches, the system under consideration comprises in order to control the position of these switches as well as their locking a special circuit established in the following manner: Each of the switches 23 24 25 controls an interrupter 73, co-operating with two contacts 73′ 73″, and the locking apparatus of each of these switches controls also an interrupter 74, co-operating with the two contacts 74′ and 74″. Finally, the distributer 71 of the energy to the motors 72 of the said switches controls an interrupter 75, co-operating with the two contacts 75′ 75″.

The interrupters, such as 75, are respectively connected to each of the wires 23^b 24^b 25^b, and the contacts 75′, 74′, and 73′ are connected to each other by the commutators 74 and 73 when the switch is in the normal position, while it is the contacts 75″ 74″ 73″ which are connected together when the switch is in the reversed position. On the other hand, the contacts 73′ are connected, respectively, to the wires 23^c 24^c 25^c and the contacts 73″ to the wires 23^d 24^d 25^d. In these conditions when each of the wires 23^b 24^b 25^b 23^c 24^c 25^c 23^d 24^d 25^d is connected to corresponding brushes located in the central station it will be easily understood that the branches of the circuits established by each switch apparatus may be grouped in series and that then by connecting one of the extremities of this general circuit to one of the poles of a source of electricity and the other extremity of the same circuit to the other extremity of the same source a general controlling-circuit will be formed which will only be closed when the commutators of each of the switch apparatus occupies the position corresponding to the closed position between the brushes corresponding to the wires of the said commutators of the branch of the principal circuit corresponding to this particular apparatus. Thus each of these apparatus will be furnished with two controlling-cir-

cuits—one for the normal position of the switch constituted by the wires, such as 23^b 23^c 24^b 24^c 25^b 25^c, and the other for the reversed position of the switch constituted by the wires, such as 23^b, 23^d, 24^b, and 24^d, 25^b, and 25^d. The two controlling-circuits corresponding to each of the switches are thus constituted by means of three wires (one of the three wires 23^b 24^b 25^b) serving for the two positions of the switches, while one of the two other wires (23^c 24^c 25^c) serves for the normal position, and the other (23^d 24^d 25^d) for the reversed position, of the said switch.

It is to be noticed that in Fig. 2 of the accompanying drawings the wire 25^d is not shown as connected to brush, because the example chosen corresponds to a line from the track 68 to the track 88, in which line the switch 25 remains constantly in normal position.

The signal 20, blocking the route over the itinerary, is likewise provided with a two-wire transmission-circuit 20^a and also a two-wire return-circuit 20^b, the former of which is provided with a motor 76 and a clutch 77 in parallel branches, and the signal 20 is further provided with a counterweight 80. It will be understood that the signal is normally held in raised position by the counterweight and only lowered when current is passed through the transmission-circuit to operate the motor. The normal position of the signal corresponds to its elevation under the action of the counterweight 80, and in this position the locomotive engineer must consider the corresponding line as not open. The electrically-operated clutch 77 consists of any device, such as a pawl and ratchet, to hold the signal in the position to which it is lowered by the motor so long as current passes through the transmission-circuit, but to release and allow the signal to drop as soon as the current ceases to flow. The motor 76 may of course be provided with an automatic disconnecting-switch for throwing it out of circuit whenever the signal is lowered. It will be observed that current passes through the circuit 20^a to the signal in only one direction, whereas it passes through the transmission-circuits 23^a, 24^a, and 25^a in alternately opposite directions. The return-circuit 20^b to the signal 20 likewise consists of but two wires, and in it is connected a cut-out switch 79, which is so connected to the mechanism of the signal as to close the circuit 20^b only when the signal is in raised position. The object of this is by suitable connections with the controlling mechanism of the itinerary-lever to prevent the latter from being thrown back to its normal position until after the signal has been again raised after being lowered to permit the passage of the train.

In the drawings we have illustrated but three switches and one signal, this being sufficient for the purpose of illustration; but it will be of course understood that in practice many more switches and signals will be attached to a single station, and each of these will be provided with the transmission and return circuits herein shown, and all the transmission and return circuits of all the switches are suitably brought up to properly-arranged terminals on a terminal board 17, located in the station, from whence they are led to the connections of the several itinerary-levers. It will of course be understood that each of the switches and signals will have the terminals thereof connected to the controllers of as many different levers as there are itineraries in which it is concerned. Furthermore, assuming that in the system under consideration the arrangement of all the switches of one line is controlled by the manipulation of a single element operated directly in the central station from which depends this line and that the manipulation of the said element permits the signal controlling the entrance of the corresponding line to be opened and that only, if all the switches of the line occupy the desired position and are securely locked in this position there is no need for any given line to consider the manipulation of more than one signal—to wit, that one which is placed before the first switch of the line in question. Thus in the case shown in Fig. 2 signal 20 will serve to control the entrance to the lines going from the track 68 to the tracks 69, 70, 88, and 89. Where the regulations require a distinct signal for each line, there will be disposed before the switch 25 four signals corresponding, respectively, to the said lines, and a manipulation of the lever corresponding to one of these lines will only operate the signal controlling the entrance to the line in question.

In the present case we have illustrated the itinerary-lever only which governs the itinerary from the track 68 to the track 88, and we will therefore describe how the several switch and signal circuits are connected to the controller of this lever. Let it first be premised for a clearer understanding of the general method of connection that the cylinder 11 is properly the circuit-controlling cylinder, since through it are governed the connections of the return-circuits, which in turn govern the movements of the bolt 9 through the electromagnet 6, while the cylinder 12 is the transmission-circuit cylinder, since through it are governed the connections of the transmission-circuits of the several switches, although the signal or signals are operated from the cylinder 11, as will be hereinafter explained; further, that the reverser or pole-changer 10 serves two different functions, one of which relates to the transmission-circuit and is performed by the spring-fingers 13, 14, 15, and 16 and their connections, while the other relates to the return-circuits governed by the spring-fingers 46, 47, and 48 and their connections. Those connections, which are

marked, respectively, + and — in the diagram, ending abruptly are supposed to be, respectively, the positive and negative poles of sources of electric energy, such as a dynamo or accumulator in the case of the transmission-circuits and a primary battery, if desired, in the case of the interlocking circuits. It may be observed first that the principal poles of the transmission-generator are connected to the spring-fingers 15 and 16, and from these, through the contacts of the reverser 10, the current is conveyed to the spring-fingers 44 and 45 of the cylinder 12, the current being either positive or negative, according to the position of the pole-changer 10, as will be seen.

In the main circuit leading between the finger 14 and the finger 45 is shown an electromagnetic blow-out arrangement 34, which extends over the contacts of the reverser 10, being merely intended to quench the arc formed by reversing the position of the reverser in the ordinary manner.

In the present case, the route being from 68 to 88, as stated, the switches 23 and 24 must be in closed position, while the switch 25 remains in its open position. As therefore the switch 25 is not concerned in the movements of this itinerary, the transmission-circuit thereof is not connected to the brushes of the controlling-cylinder 12, and therefore, so far as the illustration is concerned, ends abruptly at the terminals 49 on the terminal board 17. The terminals of the other transmission-circuits 23^a and 24^a are, however, connected, respectively, to the brushes 62, 63, 64, and 65 of the cylinder 12, the connection being such that when the reverser is in the position shown the current will pass from the brush 44 through the row of contacts shown on the cylinder 12 to the brushes 62 and 64, thence through the commutators 71 and motors 72, returning through the brushes 63 and 65 to the brush 45. In so doing it will operate the motors 72 to close the switches 23 and 24.

When the pole-changer at 10 is in reversed position, as it will be on the return swing of the lever 1, the brushes 44 and 45 will be reversed in polarity, and the reversed current being sent through the respective transmission-circuits the switches 23 and 24 will be opened again.

It will be observed that the transmission-circuits are arranged, preferably, to be connected in parallel to the source of current. This, however, is only for the sake of convenience, as they might be connected in series, if desirable. The several return-circuits from all the different switches are, on the contrary, necessarily connected in series in the main controlling-circuit with each other and with the electromagnet 6, because it is our object to have the circuit closed for the energization of the magnet 6 only when each and every one of the return-circuits of the switches 23, 24, and 25 have been closed through the operation of the circuit-closers 73, 74, and 75 at each switch. To these ends therefore the several terminals of the return-circuits of the several switches 23, 24, and 25 are brought down to the brushes of the cylinder 11 in the manner shown—that is to say, as follows: The brush shown at 39 is connected directly to the positive pole of the circuit through the electromagnet 6. The next three brushes 52, 53, and 54 are connected through the terminal board 17 to the respective terminals of the return-circuit 23^b from the switch 23. The next three brushes 55, 56, and 57 are likewise connected to the several terminals of the return-circuit 24^b from the switch 24. The next two brushes 58 and 59 are connected to the positive and one of the negative wires only of the return-circuit 25^b, because the other negative wire (relating to the closed condition of the switch) is not concerned in the present itinerary. The terminals 40 and 41 are alternately connected to the negative pole of the controlling-circuit through the brushes 46 and 47 of the reverser 10 and the brush 48, to which the negative pole of the circuit is directly connected, the brushes 46 and 47, and hence the brushes 40 and 41, being alternately live or dead, according to the position of the reverser. The object of this arrangement is, as will be hereinafter seen, to close the interlocking circuit through one series of contacts on the cylinder 11 when the lever 1 is on its advance movement and through a different series when it is on its return movement. The brushes 60 and 61 are connected to the return-circuit from the signal 20, while lastly the brushes 42 and 43 relate to the closing of the transmission-circuit 20^a of the signal 20, the brush 42 being connected directly to the positive pole of the generator, (the same, for instance, as the brush 15 of the reverser 10,) while the negative terminal of the transmission-circuit 20^a on the board 17 is likewise connected to the negative pole of the generator, as indicated by the sign "—" in the drawings.

The positive terminal of the transmission-circuit 20^a of the signal is connected to the brush 43 of the cylinder 11, but the circuit has inserted therein between the brush 43 and the terminal 49 a cut-out switch 50, regulated by an oscillating handle 18, the object of this being to enable the transmission-circuit to be opened to raise the signal at any time when proper caution or any unlooked-for emergency require it. We will show later why this auxiliary handle has been provided in the system and the advantage gained thereby; but it must be understood now that if there were substituted a fixed connection for the connection made by this handle in the position indicated in dotted lines in Fig. 2 the manipulation of the controlling-lever 1 would produce a series of successive effects which would be

absolutely the same as the series of successive effects described hereinafter. This is one of the very important points of the invention, and the description will clearly show that the system under consideration permits effectively by the manipulation of its single element, actuated directly in the central station, the production of the following successive effects: First, control of the placing in the desired position of the switches comprised in the line determined upon; second, control of the correct position and of the locking of all the switches comprised in said line; third, opening the signal controlling the entrance to the said line; fourth, closing the said signal immediately after the passage of the train; fifth, controlling the closing thereof; sixth, replacing in normal position the switches previously displaced; seventh, control of the normal position of the said switches and of their locking in this position.

The controlling-cylinder 11 is, as shown, provided with six points or lines of contact, designated, respectively, 81, 82, 83, 84, 85, and 86, in the order in which they are used, the points 81 and 84 being the starting and finishing points of the advance movement of the handle 1, while the points 85 and 86 relate to its return movement. The contact-pieces are arranged on these several points or lines of contact, as shown in Fig. 2, and illustrated in their several positions in Figs. 3 to 7, consecutively; but it may be noted that the point 82 of the controlling-cylinder is shown blank in Fig. 2, as not being used, this point relating only to the electric interlocking device, which will be hereinafter described in connection with Fig. 8.

The transmission-circuit cylinder 12 has but one line of contact, this being that shown in Fig. 2, and it may be here noted that the amount of lost motion or play allowed by the coupling 38 is exactly equal to the arc between the points 83 and 86 of the revolution of the cylinder 11, so that the engagement of the line of contacts on the cylinder 12 shall be contemporaneous with the engagement of the line of contacts 83 on the cylinder 11 on the advance movement of the lever 1 and contemporaneous with the engagement of the line of contacts 86 with the brushes on the return movement of the lever.

Having thus described the general construction of the apparatus and the electrical connections, we will now proceed to illustrate the successive steps which are performed in the throwing of the lever, as illustrated in Figs. 3 to 7. At the start the lever will necessarily be in its normal position—that is to say, thrown back, as shown in Fig. 3, to the limit of its movement—and in this position the controlling-cylinder 11 will be at the point 81, in which all the circuits governed by the brushes of the cylinder are open, and the same will also be the case with the cylinder 12. The reverser will be also in the position shown—that is to say, at the right-hand limit of its movement. When the lever 1 is seized and swung forward, the dog 28, by reason of its inclined lower face, will pass over the bolt 9, and the latter will then be resiliently raised by the spring 8, so as to permit the dog 27 to pass through the notch 9^a thereof, and the lever will first be brought to a stop by the dog 26 striking against the bolt 9, as shown in Fig. 4. In this position the controlling-cylinder 11 will be at the point 83, as shown, the point 86 having been passed in its forward movement without completing the controlling-circuit, because the negative pole of this circuit is connected to the brush 40, which has no contact-piece at the point 86. The motion of the cylinder 11 will, by reason of the loose coupling 38, cause the cylinder 12 to be carried with it and its line of contact-pieces to be likewise brought into contact with the brushes of that cylinder at the same time that the contact-pieces on the line 83 are connected with the brushes of the cylinder 11. The transmission-circuits of the several switches involved in the itinerary are therefore closed in the positive direction, and the motors of these switches will therefore operate them to move them to the closed position. This motion, with the accompanying motion of the switch-locking devices and the commutators 71, will also close the return-circuits of the switches which are connected, respectively, to the brushes 53 and 54, 56 and 57, 58 and 59. The controlling-circuit will be then closed on a circuit comprising the following points: +6, 39, 53, 23^b, 23^d, 54, 56, 24^b, 24^d, 57, 58, 25^c, 25^b, 59, 40, 46, 48. (See Figs. 9 and 4.) This circuit will, however, only be closed after the switch-motors have been actually operated to close the switches, and only in this case will the magnet 6 be energized to retract the bolt 9, so as to permit the lever 1 to pass. This having been accomplished, the lever reaches the limit of its movement, as shown in Fig. 5, and in this position the controlling-cylinder 11 is at the point 84, the point 85 having been passed over on open circuit by reason of the negative terminal-brush 40 not being connected thereto. The final movement of the lever causes the reversal of the reverser 10 by reason of the pawl 30 striking against a suitable notch of the reversing-lever 31. At the point 84, the switches governing the itinerary having been already thrown and locked in position, the signal is ready to be cleared, and this is done by the single contact-piece illustrated, which connects the brushes 42 and 43 of the cylinder 11. Supposing the cut-out 50 to be closed, the transmission-circuit of the signal is energized, which operates the motor 76 to lower the same and the clutch 77 to hold it in its lowered position. In order to cover the rear of the train as soon as the locomotive has passed and without waiting until the itinerary has been com-

pletely crossed, the signal 20 is raised by opening the hand-switch 50, which breaks the transmission-circuit, thereby releasing the clutch 77 and enabling the counterweight 80 to raise the signal again. It is very important to notice that the commutator 50 can be replaced by a fixed connection without changing the operation of the system. In effect, from the commencement of the backward movement of the lever 1 the generatrix 84 of the cylinder 11 moves away from the two brushes 42 43, and the transmission-circuit to the signal-motor being interrupted the latter is free to move under the action of this counterweight, which closes it automatically.

The block having been cleared and the train having passed, the itinerary-lever is now ready to be returned to its normal position, which takes place by the following series of steps: The lever is first brought to a stop upon its return movement by the dog 26 striking against the bolt 9, which is now raised by reason of the controlling-circuit being open. In this position the controlling-cylinder will be at the point 85, in which the return-circuit 20^b is connected in series with the controlling-circuit, and therefore the lever 1 cannot be moved farther until this is closed. As the transmission-circuit of the signal is now in any case broken, in whatever position the handle 18 may be the signal will if the apparatus is in proper order be raised, thus closing the return-circuit 20^b through the switch 79. In the position shown in Fig. 6 the interlocking circuit will then be closed through the magnet 6 from the brush 39 to the brush 60, thence through the circuit 20^b and the brush 61, thence to the negative pole or brush 48 through the brushes 41 and 47. If then the signal has actually been raised, and only on this condition, the controlling-circuit is closed, which causes the magnet 6 to be energized and the bolt 9 to be withdrawn from the dog 26, thus permitting a further movement of the lever 1. As soon as the contact-point 85 of the cylinder 11 has been passed the controlling-circuit is broken again, being not closed on the return movement at the contact-point 83 by reason of the brush 40 being now dead, because of the pole-changer 10 having been reversed. The bolt 9 is therefore released and raised by the spring 8, thus permitting the dog 27 to pass through the notch 9^a thereof and the lever 1 to arrive at the position shown in Fig. 7, in which the rear face of the dog 28 strikes against the bolt 9. In this position the cylinder 11 will be at the contact-point 86, as shown, and meantime the loose coupling 38 will have caused the cylinder 12 to move back, so that the line of contacts thereof are connected with the brushes in the same manner as before. The transmission-circuits of the several switches will therefore be energized, but by reversed currents, because of the reversed position of the reverser 10, and thus the switches 23 and 24 will be opened again. The line of contacts 86, which operates the controlling-circuit, has connections similar to the line of contacts 83, but arranged so as to permit the establishment of a closed circuit through the following points, + 6, 39, 52, 23^c, 23^b, 53, 55, 24^c, 24^b, 56, 41, 47, 48, (see Figs. 2 and 7,) in such a way as the controlling-circuit will not be closed until after the commutators 71 have been reversed, the switches actually opened, and the locking devices actually operated to lock the switches, which series of movements throws over the respective circuit-closers 75, 73, and 74 to the opposite side, closing, as just stated, the circuit 25^b of the switch 25 being skipped in this instance, because assurance as to the switch 25 will be unnecessary, it having remained in open position during the entire operation. Supposing, therefore, the apparatus to have properly worked, the controlling-circuit will be closed through the magnet 6 from the brush 39 to the brush 52, thence through the return-circuit 23^b and from the brush 53 to the brush 55, thence through the return-circuit 24^b from the brush 56 to the brush 41, and thence to the negative terminal through the brushes 47 and 48 of the reverser. The bolt 9 will thus again be withdrawn by the action of the magnet 6, and the lever 1 will be returned to its normal position, as shown in Fig. 3, in which all the transmission and return circuits are open. By the final movement of the lever 1 also the reversing-switch will be again actuated to shift the reverser 10 into the position shown in Figs. 2 and 3 ready for the subsequent operation of the lever 1.

Should the lever 1 by mistake be partially thrown over and then returned to its original position before the reversing-switch has been again thrown, this would lead to mistakes and complications, owing to the fact that the switches would be operated in the forward motion of the lever, but would not be operated on the return motion, and therefore would be left in their closed instead of open positions when the lever 1 has been returned to its normal position. In order to avoid this, we provide the device shown in Fig. 1, which consists of a strong compression-spring 36, mounted on a rod 36^a, pivoted at its upper end to a lug 36^b of the reversing-lever and depending therefrom, while its other end carries a collar 36^c. The two ends of the spring 36 are attached to two collars 36^d, which slide freely on the rod 36^a, and abut, respectively, against the upper and lower end thereof, the upper end having a shoulder formed thereon for this purpose, as shown. This spring is normally held compressed by a pair of pivoted catch-rods 32 and 33^a, the latter of which is connected with a pivoted dog 33, so as to cause it to operate in the reverse sense from the dog 32. The upper ends of the dogs 32 and 33 are arranged in proximity to the pawls 29 and 30

and have their ends slightly projecting above the arc forming the upper surface of the lever 31 at its center. The ends of this upper surface of the lever 31 are slanted upwardly, as shown, so as to carry the pawls 29 and 30 freely over the dogs 32 and 33 without operating them. In case now the lever 1 is thrown partially over—that is to say, into the position of Fig. 4, in which it is caught by the bolt 9 and the switches of the itinerary are closed—the pawl 29 will fall in front of the dog 32, and should the lever 1 now be returned to its normal position without completing its cycle its first action will be to trip the dog 32, and thus release the upper end of the spring 36, the force of which will then cause the reversing-lever to be automatically thrown, so that the controlling-circuit will be thrown into operation when the cylinder 11 reaches the point 86 on its way back, thus preventing the return of the itinerary-lever until the switches have been again returned to their initial positions. In this case in completing its return movement the dog 29 will strike the notch 26 and depress the upper collar 36^d until it is again caught by the lower end of the dog or catch-rod 32. Similarly, in case the lever 1 should be stopped after having only partially completed its return movement and again be thrown forward the pawl 30 will strike the dog 33 and release the lower end of the spring 36, thus automatically reversing the lever 31, so as to cause the switches to be properly set before the lever 1 can be returned to the forward end of its stroke.

We have thus far described the operation of a system in which every single route or itinerary is governed by a separate lever—that is to say, in which the lever 1 is adapted to govern only the route from the track 68 to the track 88, so that another and separate lever would be necessary to govern the route over the same track in the opposite direction. However, it will be desirable in most cases to arrange the lever 1 to operate not only the itinerary from the track 68 to the track 88, but also the reverse itinerary from the track 88 to the track 68, and this may be done in the following manner: It will of course be necessary to have upon the track 88 a second signal similar to the signal 20 and operated in the same manner, and the transmission-circuit of this second signal is connected in precisely the same way to the terminal brush 43 of the controlling-cylinder 11. However, in this case we form the switch 50 as a double-throw or change-over switch—that is to say, we provide it with a second pair of contacts located in the transmission-circuit of the second signal, and in this case when it is desired to close the latter circuit the handle 18 will assume a position inclined to the right, but otherwise symmetrical to the position shown in dotted lines in Fig. 2, in which position the transmission-circuit of the second signal will be closed. Therefore the direction of the itinerary given by the throw of the lever 1 depends upon the position of the switch 50, so that when inclined to the right, as in Fig. 2, the itinerary will be from 68 to 88; but when inclined to the left it will be in the reverse direction. Moreover, in order to regulate the controlling-circuit by means of the return-circuits of the signals it is merely necessary to arrange another pair of brushes for the second signal immediately below the brushes 60 and 61 and another contact-bar so arranged that when the cylinder 11 is at the point 85 the two return-circuits will be in series. Consequently the itinerary-lever is locked until both signals have been returned to their normal positions.

As thus far described, the operation of the several itinerary-levers at the station is subject to no other condition than that all the levers except the one concerned with the switches of a given itinerary shall be thrown back; but in somewhat frequent cases it is desirable to arrange the levers to be locked from a distant point pending the compliance with one or more other conditions—such, for instance, as the closure of a drawbridge, the special control of a superintendent or engineer in charge of the service, or the like. In this case we use the arrangement shown in Fig. 8, by which means are provided for subjecting the control of any or all of the levers 1 to the compliance with any given condition or any series of conditions which may be desired. In this case the dog 28 in place of being beveled on the end is cut square in the same manner as the dog 26, so that it cannot pass the bolt 9 unless the electromagnet 6 is excited, and in addition the contact-line 82 of the cylinder 11 is brought into requisition by the provision of an additional brush 66, which is connected with the brush 39, leading to the electromagnet 6, by the special contact-piece (shown in Fig. 8) and located on the line of contact 82, so as to close this circuit when the dog 28 abuts against the bolt 9. The brush 66 may now be connected with a special electric circuit, whose other end is connected to the negative pole of the controlling-circuit, and which has interposed therein one or more cut-outs 51, which are so arranged that they are closed either manually or automatically only when the predetermined desired conditions are complied with. It is evident that any number of such cut-outs may be interposed in the circuit series, so that only when all the conditions connected with the respective cut-outs are complied with can the controlling-circuit be closed and the magnet 6 be energized to permit the operation of the lever 1.

As thus far described the system requires a separate itinerary-lever with controlling-cylinders, magnets, a reverser, and other apparatus for every single itinerary or pair of itineraries that can be produced; but in some

cases it is desirable to be able to produce special itineraries for which no levers are provided, because it would ordinarily be too expensive and cumbersome to provide a separate set of apparatus for every possible itinerary, whereas only a few, perhaps, of the possible number are in ordinary use. We provide, therefore, means which render possible the completion of all the itineraries which the many combinations of position of the switches congregated at one station permit by providing simple means whereby each of the switches or signals may be separately operated in either direction as the conditions may require. Referring to Fig. 2, there is located upon the terminal board 17 a special pair of generator-terminals, 49ª, with which are connected by a flexible cord the posts of a double plug 19, which posts are adapted to fit into a suitable pair of sockets formed at the proper distance in the respective terminals of each of the transmission-circuits of the switches and signals. By now inserting the double plug 19 successively into the sockets of the different transmission-circuits whose switches are to be opened or closed, the proper motions of these switches are effected, after which the plug 19 is inserted into the sockets of the terminals 49 of the signal 20, thus energizing the transmission-circuit thereof and lowering said signal. When it is desired to open the itinerary again, it will be necessary first to remove the plug 19 from the terminal sockets of the transmission-circuit of the signal before it can be inserted into the sockets of the switch transmission-circuits to alter the same, and in so doing the signal must necessarily be raised again before the position of the track-switches can be altered. All this arrangement being for use in accidental cases, the terminal board 17 may be inclosed in a closed chamber and sealed in such a way that the use of it requires certain precautions or formalities.

In conclusion we desire to be understood that the arrangement, form, dimensions, members, and accessory parts of this apparatus may be varied according to the nature of the transmitting agency employed, (electricity, water, compressed air, or the like,) and any suitable materials may be employed for their construction.

While we have shown in the accompanying drawings the preferred form of our invention, it will be understood that we do not limit ourselves to the precise form shown, for many of the details may be changed in form or position without affecting the operativeness of our invention, and we therefore reserve the right to make such modifications as are included within the scope of the following claims or of mechanical equivalents thereto.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. An interlocking switch and signal system adapted to be operated from a central station by means of a single member in the said station, all of said switches governing a determined itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal the control of proper position and locking of all the said switches governing the said itinerary and the raising of the signal to block this same itinerary; the said system embodying: means at the said single member in the station, to establish proper distribution of energy to the motors of said switches which must be carried to inverse position, the said distribution being established during the first part of the throwing of the single member manipulated in the station; means to control the proper position of all of the said switches governing the itinerary, the said means permitting the said member to reach the limit of its throwing only when all the said switches are in proper position; means to permit the said single member in the station to establish proper distribution of the energy to the motor of the signal governing the entrance of the itinerary and to clear the said signal; means to raise the said signal again, as soon as the train is completely engaged over the itinerary; means to control the said raising, the said means permitting the said single member in the central station, to return to its normal position only when the said signal is raised again; means to permit the single member in the central station, to establish proper distribution of energy to the motors of switches beforehand reversed, the said distribution being established during the first part of the raising of the single member in the central station and carrying to normal position the said switches; means to control the normal position of the said switches, the said means permitting the single member in the central station to terminate its raising only when the said switches are in normal position, the return of the single member to its initial position having thus broken up the whole of the effects successively produced during its throwing, substantially as described.

2. An interlocking switch and signal system adapted to be operated from a central station and by means of manipulation of a single member in the said station, all the said switches governing a determinate itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal the control of proper position and locking of all the said switches governing the said itinerary and the raising of the signal blocking this same itinerary; the said system embodying for a determinate itinerary: a lever (itinerary-lever) 1 directly manipulated in the central station; a combinator 12 properly operated during the first part of the throwing of the lever 1; contact-points disposed on the combinator 12 to coact with brushes terminat-

ing the circuits which operate the distribution of energy to the motors of the switches which must be carried to inverse position; a pole-changer 10 operated by the lever 1 to command the time of the said distribution; connections established by contact-points of the combinator 12 and by the pole-changer 10 between the motors of the switches being to be operated and the source of energy, to carry the said switches to reverse position; circuit-closers 73, 74, 75 operated respectively by the switches, the locking devices of the switches and the distributers of energy to the motors of the said switches; a combinator 11 properly operated during the throwing of the lever 1; contact-points disposed on the combinator 11 to coact with brushes terminating the circuits which control the position and the locking of all of the said switches governing the itinerary; connections established by the circuit-closers 73, 74, 75 and by the contact-points of the combinator 11 to connect in series the control-circuits of all the said switches governing the itinerary and a magnet 6; a control-pawl 9 lowered by magnet 6 when this latter is energized; a dog 26 disposed on the lever 1 to strike against the pawl 9 when the control-circuit of proper position of all the said switches is not closed, a connection established by a contact-point of the combinator 11 at the end of the throwing of the lever 1, between the motor of the signal governing the entrance of the itinerary and the source of energy, to clear the said signal and to enable the raising of the same by the counterweight 80 as soon as the lever 1 is manipulated upon its return movement, the said lever operating suitably the combinator 11 to break the said connection; a pawl 30 disposed on the lever 1 to coact with the lever 31 operating the pole-changer 10 at the end of the throwing of the lever 1; a circuit-closer 79 operated by the signal governing the entrance of the itinerary, and establishing, with contact-points of the combinator 11, a control-circuit passing through the magnet 6 when the signal is raised again and thus enabling the pawl 26 to pass over the pawl 9; connections established by contact-points of combinator 12, operated by the lever 1 during the second part of its return movement, and by pole-changer 10, between the motors of the switches beforehand carried in reverse position and the source of energy, to carry them to normal position; connections established by circuit-closers 73, 74, 75 and by the pole-changer 10 to connect in series the control-circuits of the position of the said switches with magnet 6; a pawl 28 disposed on the lever 1 strikes against the pawl 9 when the said switches are not in normal position; a pawl 29 disposed on the lever 1 to coact with the lever 31 operating the pole-changer 10 at the end of the return movement of the lever 1, substantially as described.

3. In an interlocking switch and signal system adapted to be operated from a central station and by means of the manipulation of a single member in the said station, all of the said switches governing a determinate itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal the control of proper position and locking of all the said switches and of the raising of the said signal to block this same itinerary; the establishment in the central station of as many single members manipulated in the said station as there are distinct itineraries controlled from this station; means to impede the simultaneous manipulation of two of these members while the itineraries which correspond to them cannot be traveled together without danger; means to impede the manipulation of the member corresponding to a determinate itinerary, while the traveling of this is impossible because of service conditions which are independent of the central station controlling the said itinerary, substantially as described.

4. In an interlocking switch and signal system adapted to be operated from a central station and by means of a single member in the said station, all the said switches governing a determinate itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal the control of proper position and locking of all the said switches and of the raising of the said signal to block this same itinerary; the establishment, in the central station, of as many itinerary-levers 1 as there are distinct itineraries controlled from the said station; an interlocking rod 22 operated by each of the levers 1 to coact with an interlocking device 87, and prevent thus more than one of the levers being moved from its normal position at once while switches or signals of the said levers are concerned in the itinerary corresponding to the manipulated lever, the said levers being released by the final movement of the lever manipulated, while it is returned to its normal position; a pawl 28 disposed on each of the levers 1 to coact with the pawl 9 and prevent the manipulation of the said lever while the circuit energizing the magnet 6 is opened; a connection established by a circuit-closer 51 operated outerly from the station, and by a contact-point of the combinator 11, the said connecton closing a control-circuit energizing the magnet 9 while the traveling of the itinerary corresponding to the lever manipulated is compatible with the service condition depending upon the location of the circuit-closer 51, substantially as described.

5. In an interlocking switch and signal system adapted to be operated from a central station and by means of a single member in the said station, all the said switches governing a determinate itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal

the control of proper position and locking of all the said switches and of the raising of the said signal to block the same itinerary; the establishment in the central station of as many single members manipulated in the said station as there are distinct itineraries controlled from the station; means to impede the simultaneous manipulation of two of these members, while the itineraries which correspond to them cannot be traveled together without danger; means to impede the manipulation of the member corresponding to a determinate itinerary, while the traveling of this is impossible because of service conditions which are independent of the central station controlling the said itinerary; means to permit one of said members manipulated in the station to serve for two itineraries traveled over the same route but only in reverse directions, the said means embodying two signals disposed respectively at each one of extremities of the said itinerary; an auxiliary member operated in the station to distribute energy to the motor of the one or the other of the said two signals; connections established by the said auxiliary member and by the member whose manipulation corresponds to the itinerary, to effect the opening of the signal after proper setting in position of all the switches of the itinerary and after control of the position and of the locking of the said switches, the said setting and control being effected by the manipulation of the member corresponding to the itinerary, quite in the same manner as in the case where the said member is affected in a single itinerary, and the rest of its movement producing also the same effects as in the said case, substantially as described.

6. In an interlocking switch and signal system adapted to be operated from a central station and by means of manipulation of a single member in the said station, all the said switches governing a determinate itinerary and to clear the signal over the said itinerary, the manipulation of the said single member permitting therewithal the control of proper position and locking of all the said switches and of the raising of the said signal to block this same itinerary; the establishment in the said station of as many itinerary-levers 1 as there are distinct itineraries controlled from this station; an interlocking rod 22 operated by each of the levers 1 to coact with an interlocking device 87; a pawl 28 disposed on each of the levers 1 to coact with the pawl 9; a connection established by a circuit-closer 51, operated outerly from the station, and by a contact-point of the combinator 11, to close a control-circuit energizing the magnet 9; means to permit a single lever 1 to serve for two itineraries traveled over the same route but only in reverse directions, the said means embodying two signals disposed at each one of extremities of the said itinerary; an auxiliary handle 18, operated directly to effect the distribution of energy to the motor of the one or the other of the said two signals; connections established by the handle 18 and by the combinator 11 to effect the opening of the signal after proper setting in position of all the said switches of the itinerary and after control of this position and of the locking of the said switches, the said setting and control being effected by the manipulation of the lever 1 corresponding to the itinerary, substantially in the same manner as in the case where the said lever is affected in a single itinerary, and the rest of its movement producing also the same effects as in the said case, substantially as described.

7. In an interlocking switch and signal system adapted to be operated from a central station and by means of the manipulation of a single member in the said station, all of said switches governing a determinate itinerary and to clear the signal over the same, the manipulation of the said single member permitting therewithal the control of the proper position and locking of all the said switches and of the raising of the said signal to block this same itinerary; the establishment in the central station of as many single members to be manipulated as there are itineraries frequently traveled and controlled from the said station; means to constitute from this station secondary itineraries accidentally traveled, the said means permitting the use of the same motors and the same connections to effect the distribution of energy to the said motors as those which are already used in the command by means of single members manipulated and established as before described, and the said means permitting this to effect the proper setting in position of the switches adapted to constitute a secondary itinerary, and also to clear the signal over this itinerary, and finally to raise again the said signal and to set in normal position the switches operated before to constitute the secondary itinerary, substantially as described.

8. In an interlocking switch and signal system adapted to be operated from a central station and by means of manipulation of a single member in the said station, all the said switches governing a determinate itinerary and to clear the signal over the same itinerary, the manipulation of the said lever permitting therewithal the control of proper position and locking of all the said switches and of the raising of the said signal to block this same itinerary; the establishment in the central station of as many itinerary-levers 1 as there are itineraries frequently traveled and controlled from this station; a terminal board 17 receiving the wires of each of the circuits operating the distribution of energy to the motors of all the said switches and signals depending upon the central station; a double plug 19 with two posts connected to the poles of a source of electricity and adapted to be

inserted into the sockets of the board 17 to close determinate circuits whose switches are to be operated, and the circuit whose signal is to be cleared over the itinerary constituted by individual setting in position of switches depending upon the whole controlled by the central station, the said switches being successively carried into normal position, after traveling of the secondary itinerary thus constituted, by means of inserting plug 19 into the corresponding sockets of the board 17 but its posts being then in position reversed of that corresponding to setting switches in reverse position, substantially as described.

In witness whereof we have hereunto set our hands in the presence of two witnesses.

GUSTAVE BLEYNIE.
THÉOPHILE DUCOUSSO.

Witnesses:
EDWARD P. MACLEAN,
JULES LAYOLLET.