No. 842,673. PATENTED JAN. 29, 1907.

L. KOTTMAIR & R. ZWACK.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

APPLICATION FILED JULY 3, 1903.

5 SHEETS—SHEET 1.

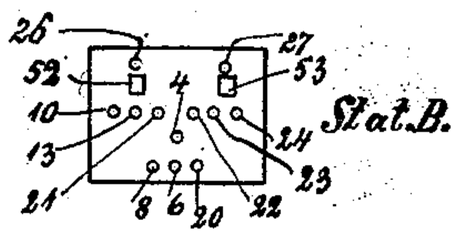


Fig. 1.

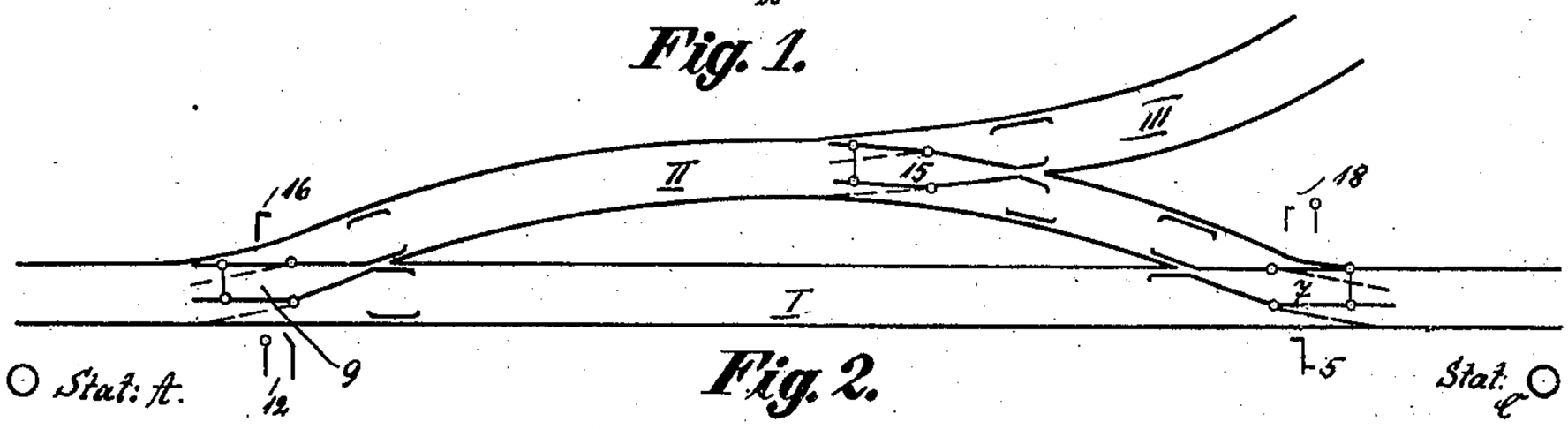


Fig. 2.

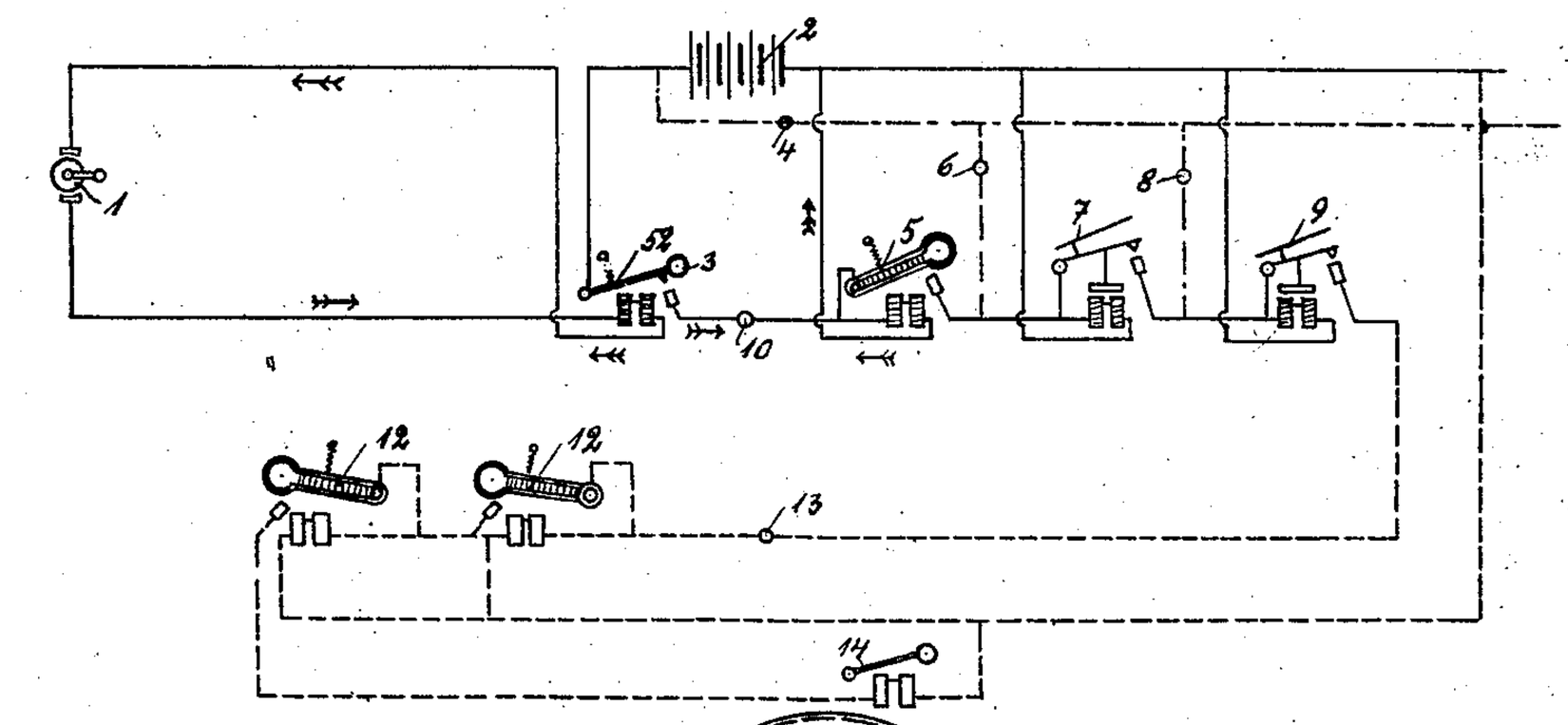
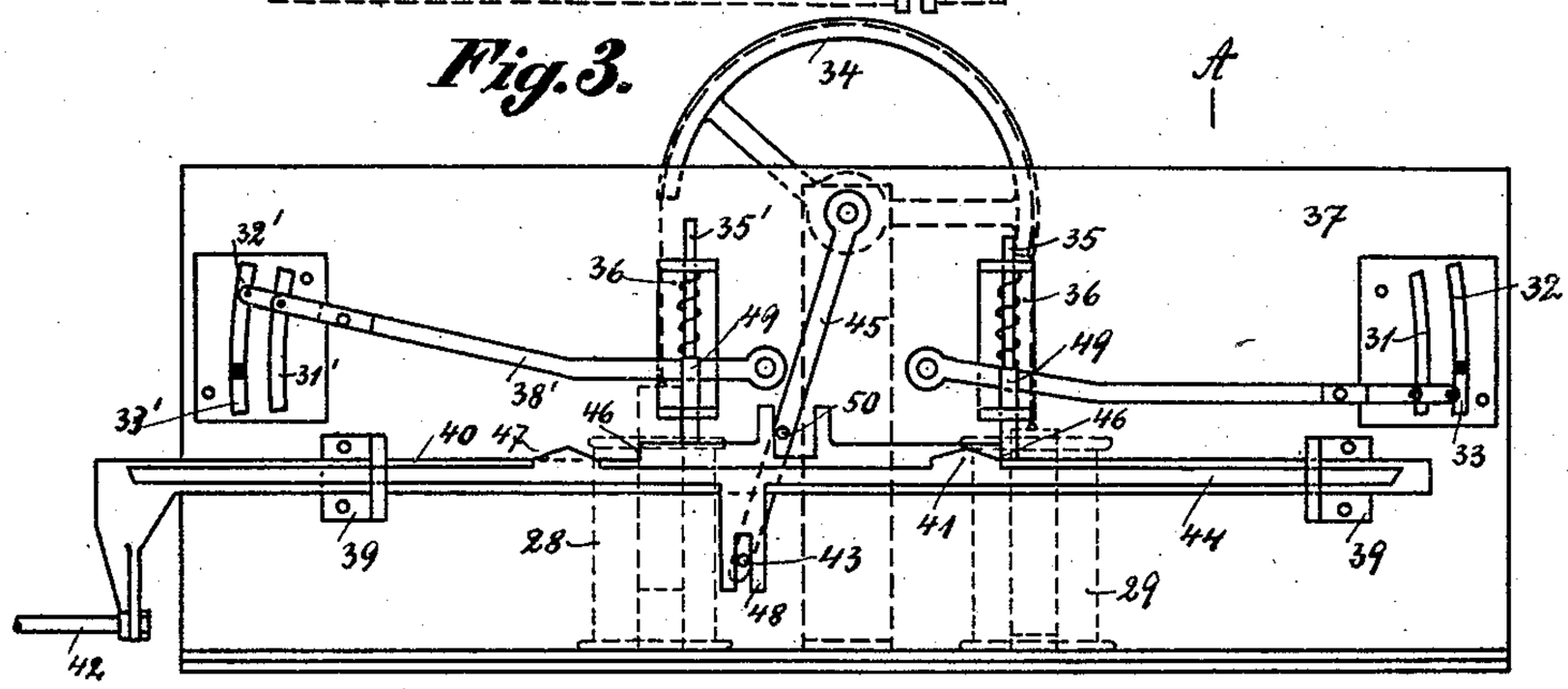


Fig. 3.



B

Witnesses.
J. K. Brackwell.
Rud. J. Hoster.

Inventors.
Lorenz Kottmair.
Rudolph Zwack.
by Munn & Co
Attorneys

No. 842,673. PATENTED JAN. 29, 1907.

L. KOTTMAIR & R. ZWACK.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

APPLICATION FILED JULY 3, 1903.

5 SHEETS—SHEET 2.

Fig. 4.

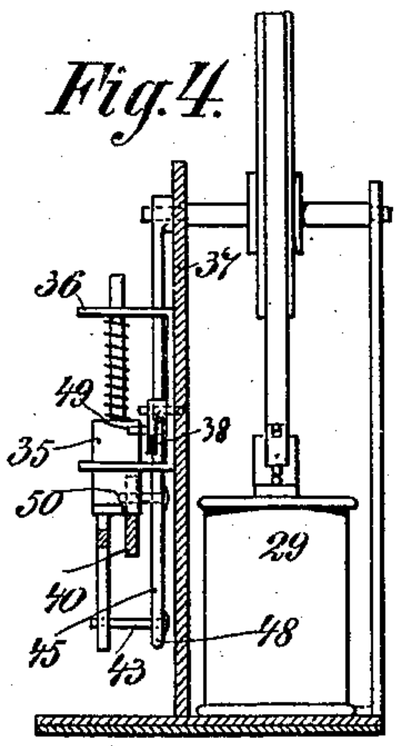


Fig. 5.

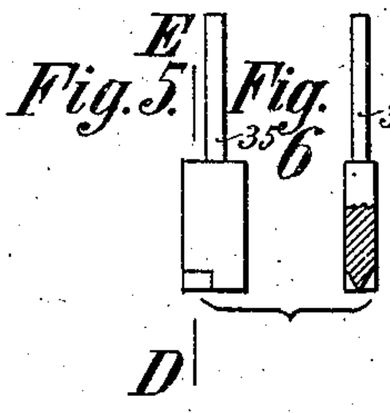


Fig. 6.

Fig. 7.

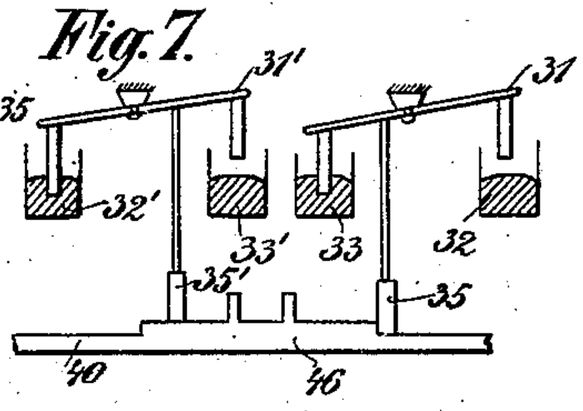
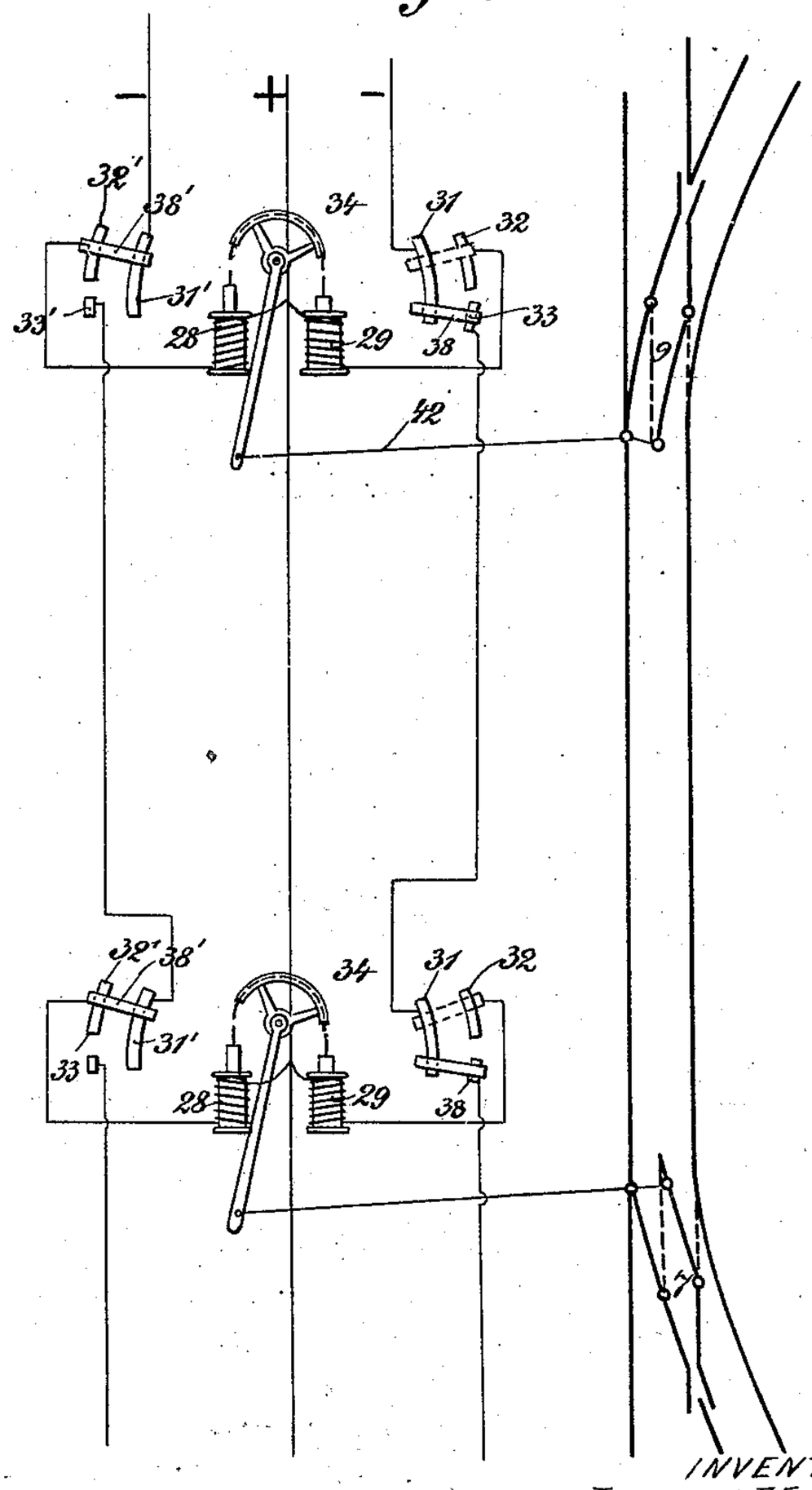


Fig. 8.



WITNESSES:

W. M. Avery

A. H. Davis

INVENTORS

Lorenz Kottmair

Rudolf Zwack

BY

Munn & Co

ATTORNEYS.

No. 842,673. PATENTED JAN. 29, 1907.

L. KOTTMAIR & R. ZWACK.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

APPLICATION FILED JULY 3, 1903.

5 SHEETS—SHEET 3.

Fig: 9.

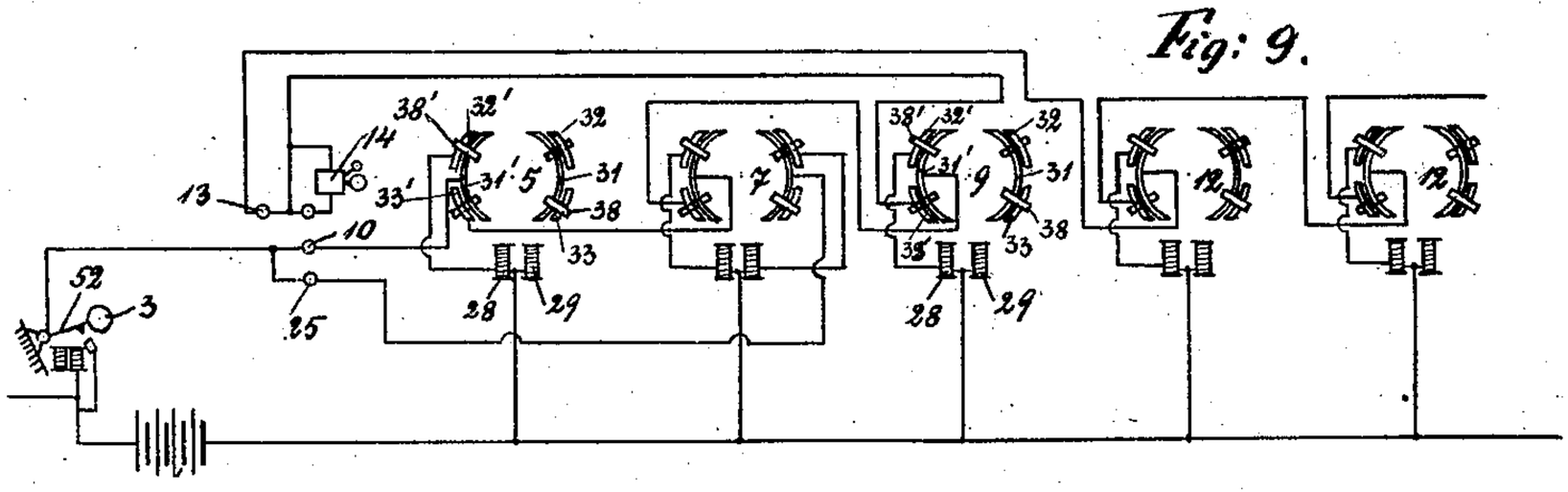


Fig: 11.

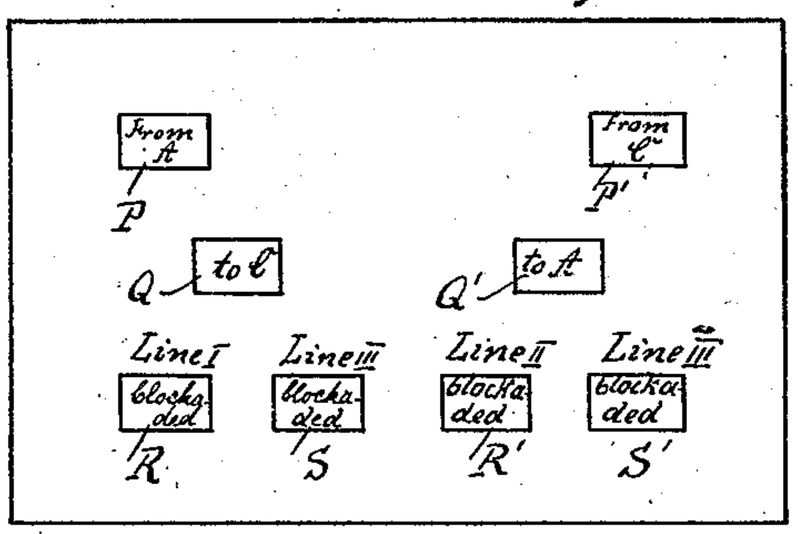


Fig: 12.

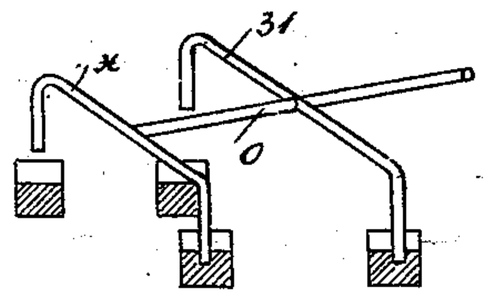


Fig: 13.

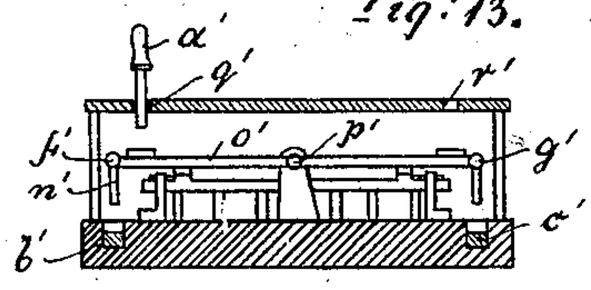


Fig: 14.

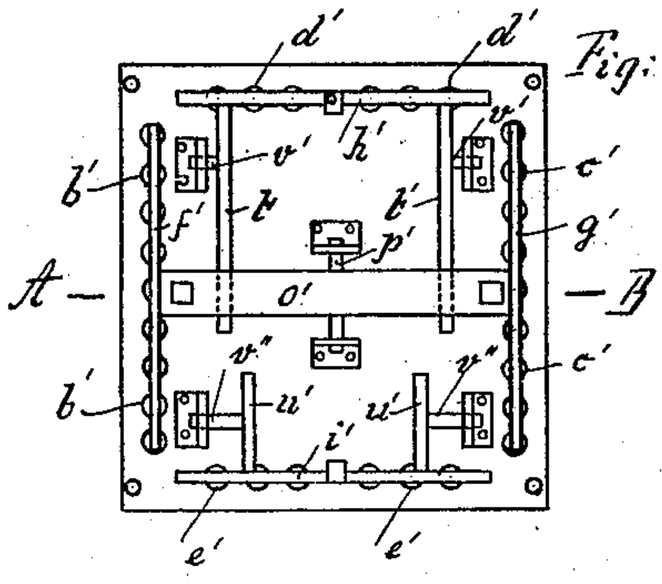
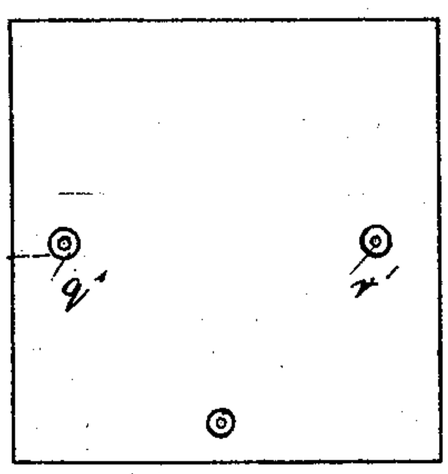


Fig: 15.



Witnesses.
J. K. Brachvogel
Rud. J. Hoster

Inventors:
Lorenz Kottmair:
Rudolph Zwack.

by Munn & Co.
Attorneys.

No. 842,673. PATENTED JAN. 29, 1907.

L. KOTTMAIR & R. ZWACK.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

APPLICATION FILED JULY 3, 1903.

5 SHEETS—SHEET 4.

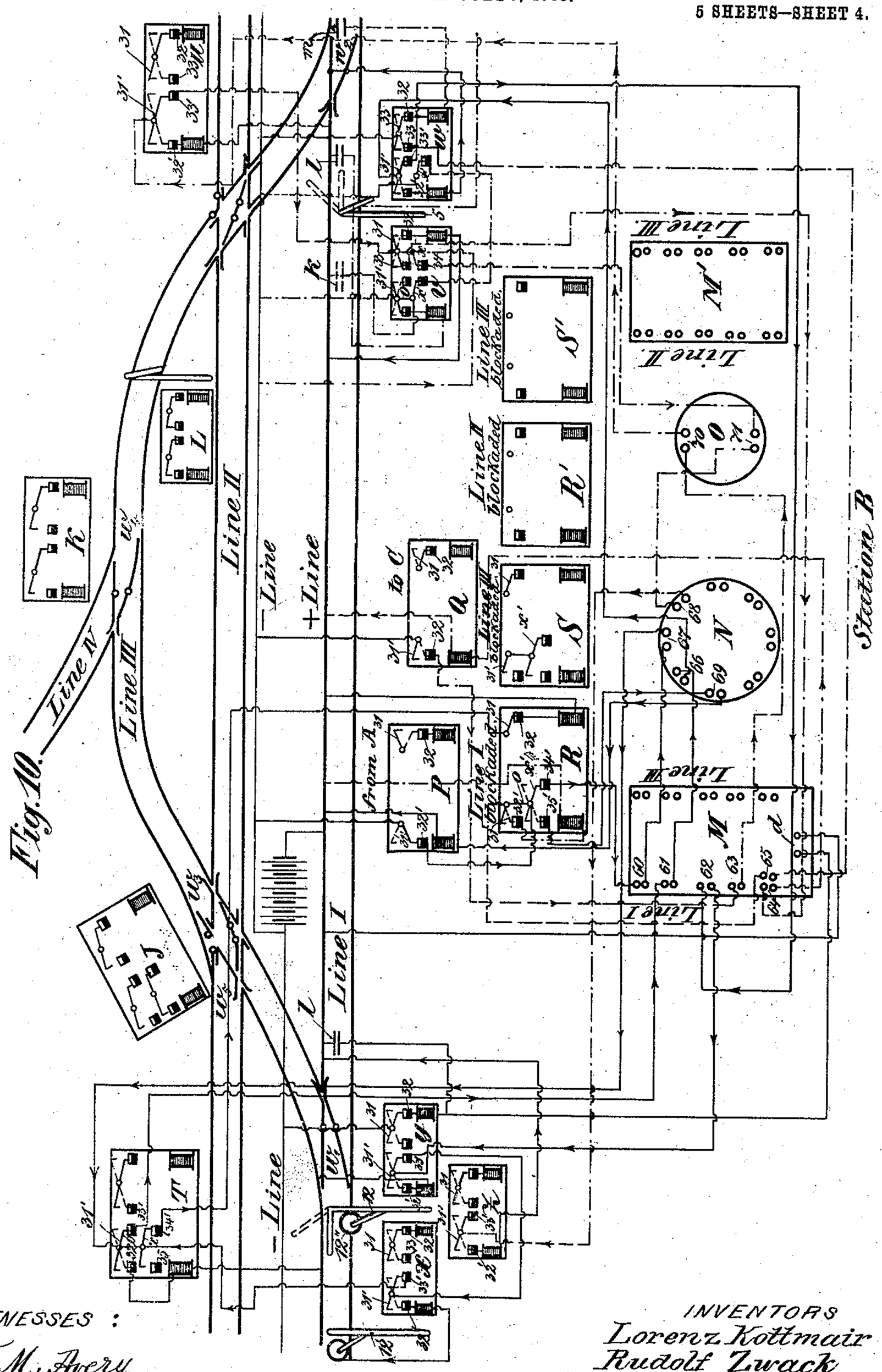


Fig. 10.

WITNESSES:

W. M. Avery

A. H. Davis

INVENTORS

Lorenz Kottmair

Rudolf Zwack

BY

ATTORNEYS.

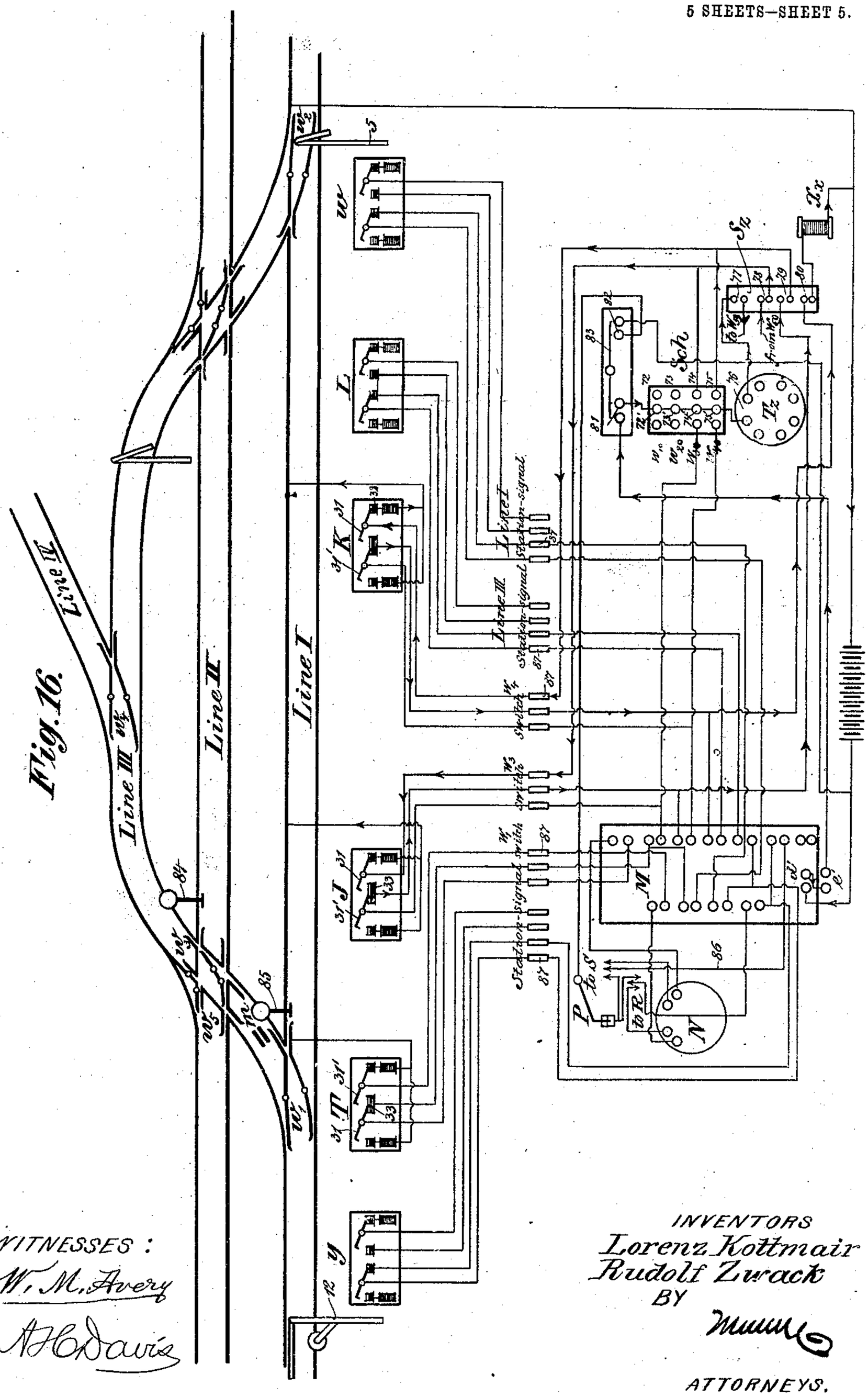
No. 842,673. PATENTED JAN. 29, 1907.

L. KOTTMAIR & R. ZWACK.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

APPLICATION FILED JULY 3, 1903.

5 SHEETS—SHEET 5.



WITNESSES:
W. M. Avery
A. H. Davis

INVENTORS
Lorenz Kottmair
Rudolf Zwack
BY
Munn & Co
ATTORNEYS.

UNITED STATES PATENT OFFICE.

LORENZ KOTTMAIR AND RÜDOLF ZWACK, OF MUNICH, GERMANY.

ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS.

No. 842,673. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed July 3, 1903. Serial No. 164,205.

To all whom it may concern:

Be it known that we, LORENZ KOTTMAIR, manufacturer, residing at 14 Knöbelstrasse, and RÜDOLF ZWACK, property owner, residing at 86 Lilienstrasse, both in Munich, in the Empire of Germany, subjects of the Emperor of Germany, have invented certain new and useful Improvements in Electrical Apparatus for Setting the Points and Signals on Railways, of which the following is a specification.

This invention relates to an apparatus for setting the points and signals on railways by means of electric actuating devices in such a manner that these actuating devices act upon the separate points and signals in succession, so that when an electric switch belonging to a line is closed each actuating device after being properly set closes the circuit of the next. In this manner the whole or a portion of the actuating devices belonging to a track are automatically set. In addition to this not only is interdependence between the points and the signals of a track produced, so that a signal can only be actuated when all the points upon the track are properly set, but there is also a direct dependence of the separate points one upon the other, so that succeeding points can only be set over when the preceding points are properly placed. By this means it is possible to secure an efficient control with a single return-annunciator without the employment of troublesome and long line connections or special contacts on subsidiary line-wires.

In order that upon the actuation of points belonging to several tracks the actuating device for these points may not close the circuit of several actuating devices dependent upon it and which belong to other tracks, which cause not only the proper actuation of the points upon a track, owing to the closing of the electric switch belonging to this track, but also the displacement of a portion of the points upon several other tracks, special provision must be made. It is therefore necessary that the line-wires between each pair of actuating devices for the circuits which are to be closed after the correct setting of the preceding actuating device for the time being shall be led wholly or in part over interrupters situated on the switchboard. These interrupters are preferably grouped together in such a manner that the interrupters of the actuating appliances belonging to one and the same track are united, an assemblage which is known *per se* for other methods of electrical connection. For each track either a common or several separate groups may be formed, which may lie upon different switchboards. The contact device for closing the interrupters may be in connection with the switch for the track in question.

A special group of interrupters may be constituted for each track, over which interrupters the line-wires of all or of a portion of the actuating devices for this track may be led in succession. As the actuating devices are connected in series, one actuating device is only able to influence that following it, the interrupter of which is closed. In other words, only the points and signals of that track can be acted upon for which the contact device or switch is closed. All other tracks remain unaffected, because the interrupters on the line-wires of their actuating appliances prevent the formation of circuits.

The contact devices employed for closing the interrupter groups may be of any suitable construction. For example, they may be constructed like railway-pushes as now usually provided in the arrangement in which the separate point-switches of a track are in parallel with each other. The interrupters described above are not, however, in any way similar to the interrupters of actuating devices arranged in parallel to be closed by railway-pushes, as the interrupters of these latter correspond in their character and purpose with the railway-switch in combination with those interrupters of the actuating appliances of this invention, which must be closed by the preceding actuating device for the time being of the track whereby the current effecting the displacement is produced. These are therefore a special kind of interrupter, which are arranged in series with those interrupters which correspond to the interrupters in parallel arrangements.

In the case of several tracks which are run over in the same direction it is of importance that the signals and also the points should return to their position of repose or initial position when the officials after using one track desire to make ready a second. This return of the signals and points must take place during the time in which the official releases the switch of one track and adjusts that of the second. To this end it is essential that two interrupter groups should be

provided for each track. Over the interrupters of one of these groups the line-wires situated between each pair of actuating devices of a track are conducted, in which the circuits are formed upon the setting of the (for the time being) preceding actuating device, by means of which circuits the track is made ready. Over the interrupters of the other group, on the other hand, are led the line-wires lying between two actuating devices, in which wires by the actuation of the preceding actuating apparatus for the time being such circuits are formed as produce a displacement of the appliances in the opposite direction. The contact devices of the two interrupter groups must therefore be connected in such a manner that upon the closing of the first the second, which is normally closed, is opened, and vice versa, as with a simultaneous closing both of the actuating devices placed in circuit would be strained in both directions.

It is not necessary to conduct the line-wires of all the actuating devices in the first group over the second group of interrupters. Such points as are already in their normal position when the line is made ready may be omitted. In some cases it is not necessary to lead the line wires of the point-actuating devices over the second interrupter group at all, but only the line-wires of the signal-actuating devices. The essential point in all cases is that the actuation should be successive, one actuating device closing the circuit of the next.

In order to attain security in operation and insure the appliances keeping in order for a long period, it is important that the connection between the separate contact devices should be a positive one. In the case of the two interrupter groups belonging to one track, referred to above, this may be effected by placing each contact device at the extremity of a beam or balance, the pivot of which is situated between the two. It is, however, preferable to arrange the contact device for the group serving to make ready the track upon a rocking arm, under which on this side of its pivot a rocking arm of the contact device for the second group of interrupters engages, by which means the latter is lifted and its contact interrupted when the first descends. This arrangement presents the advantage that a contact device serving for making ready a second track may be arranged upon the other end of the first arm and that under this portion of the arm also an arm connected with the second contact device may be caused to engage. There are therefore also conducted over the interrupters belonging to the second contact device those line-wires which serve for returning the points or signals, which in some cases may also be partly necessary for the first track.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 shows diagrammatically three stations A B C. Station B lies between stations A and C. In order to render the description of the principle of the invention more clear, a simple through-track I is here considered, upon which the trains run in both directions. II is the lay-by for station B, and III is a branch line proceeding to another station. Fig. 2 illustrates the principle of the electrical connections. Fig. 3 is a front elevation of the points-actuating apparatus. Fig. 4 is a vertical section on the line A B of Fig. 3. Fig. 5 is a plan view of a bolt of the points-actuating apparatus. Fig. 6 is a section on the line E D of Fig. 5. Fig. 7 illustrates diagrammatically another constructional form of the switching device. Fig. 8 shows the manner in which the line-wires are led between two actuating appliances. Fig. 9 shows how the wires are conducted between the actuating appliances of a track. Fig. 10 shows the connections with the interrupters for several tracks when the novel actuating appliances are employed. Fig. 11 is a view of the switchboard used in Fig. 10. Fig. 12 is a detail view showing a modification of the actuating appliance represented in Fig. 7. Fig. 13 is a section through the line-selector on the line A B of Fig. 14. Fig. 14 is a plan view of the line-selector with cover removed. Fig. 15 is a plan view of the cover, and Fig. 16 shows a simplified form of electrical connections for a two-track line.

12 is the arrival-signal with the distant signal for trains running from station A to station B.

5 is the departure-signal from station B toward station C. In the same manner 18 is the home and distant signal for trains coming from station C, and 16 the departure-signal from station B toward station A.

The home and distant signals 12 and 18 consist each of a distant or preliminary signal and a main home or arrival signal, of which the distant signal is intended to give the locomotive-engineer notice whether the main or home signal is open or closed—that is, when the home signal indicates "stop" then the distant signal is set likewise to stop, and as the distant signal usually consists of a pivoted disk the disk appears transverse to the track for a stop position—that is, the disk faces the engineer. When the main signal is set to "road free," then the distant signal is similarly set—that is, the disk appears lengthwise to the track and edgewise to the view of the engineer. The distant signal is not a stop-signal and may be slowly passed by the engineer, but in foggy weather or on sharp curves it serves to indicate to the engineer how the home signal is set.

9, 7, and 15 are the switch-points which

according as they are set send the trains on to different lines.

The switch-table at station B is represented in a simple manner. 52 and 53 are the alarm or annunciator devices of known kind actuated by induction-current, 52 being actuated from station A and 53 from station C. 10 22 13 23 serve for the arrival of a train coming from A or C into the station B. 21 and 24 serve for the departure of a train which has arrived from station A or station C from the station B.

Each of the alarm or annunciator devices 52 or 53 is provided with a disk 3, (see Fig. 2,) which appears on the switchboard of station B as soon as the official at station A actuates the inductor 1. When this takes place, the armature-arm of the device 52 (or 53) is attracted by its electromagnet, and the disk 3 in moving with the said arm appears, thus giving the alarm to the official at station B. After the train has passed the station the official can return the alarm 52 or 53 to normal position, or an automatic device may be employed for the purpose. Instead of this visible alarm a bell or like sounding device may be employed.

In explaining the operation it is assumed that a train is traveling from station A to station C. It will run on the track I. Before the train leaves station A the official at station A will rotate the handle of the inductor 1, thus actuating the bell 52 in station B. When the bell rings, it closes a circuit in which a second interrupter 10, situated upon the switchboard of station B, lies. If the official closes this interrupter 10 by the insertion of a plug, the circuit will be formed and the departure-signal 5 brought from the position of repose to "stop." This departure-signal closes a circuit which sets over the points 7, which closes another which brings the points 9 into the proper position. By closing a contact the points 9 may either directly bring the arrival-signal 12 to safety position (in which case the arrangement is preferably such that the distant signal is set at "danger" by the home signal) or the official must when the points 9 have been set close a special contact, for example, by means of the plug 13.

In the practical working of the device it is immaterial whether the plugs 10 and 13 are inserted simultaneously or successively. It is understood that the home signal is first set, and in doing so it closes a circuit connected with the distant signal for setting the latter correspondingly. By this means the signals 12 are actuated, and during this actuation or when it has been properly effected an audible or visible return-annunciator is operated in station B, which shows that the track I has been properly made ready. The train is then able to travel without hindrance up to the stopping-signal 5.

It is understood that the official at station A only gives the inductor 1 a few turns whenever a train is to be despatched from the station A, and by the action of the inductor 1 the official at station B is now notified of the fact that a train leaves station A, as the arm of the alarm 52 is attracted and the disk 3 appears. The official at station B now proceeds at his switchboard, as above described, to clear track I for the passage of the train from station A. It is not necessary for the official at station B to know when called up by the official at station A how the switch-points are set at stations A and C, as the official at station A has to see that his switches are set correctly and the official at station C is notified from the official at station B that a train is going to leave the station A, and hence the official at the station C has sufficient time to correctly set his switch-point and signals. It is understood that at the station B is an inductor 1, the same as on station A, and hence when the official at the station B actuates his inductor 1 then the same action takes place at station C as occurred previously at station B and at the time the official at station A actuates his inductor 1.

The normal position of the signals is the stop position, in which the signal-arms stand horizontally, and when the arms are swung upwardly about forty-five degrees then the signal is set to "safety" or clear track. A position of rest may also be given to the signal-arm by swinging the latter downward into a vertical position.

Fig. 2 shows diagrammatically in what manner the separate circuits are formed. 2 is the source of current at station B. 1 is the inductor of station A. If this inductor-handle is rotated, the induction-current will energize the electromagnets of the signal 3 in station B. The signal is drawn down and closes the contact shown. When the contact 10 is closed, the electromagnets of signal 5 will receive current, this signal goes to "danger," closes a contact, and thereby sets over the points 7, which act upon the points 9. The latter set the arrival-signal 12. If the setting of this arrival-signal is to be dependent upon the special consent of the official, he will have to employ a further special contact 13. The signals are operated in succession and the last of them actuates the signal 14, by which the official sees that the line has been properly made ready. The appropriate connection is shown in dotted lines in Fig. 2. If the train is now to leave the station B, the official uses the plug 21 for the departure-signal 5. This signal is thus caused to occupy the starting or safety position by an electric setting device, such as shown in Fig. 3. The arrangement may also be such that the points 7 are not set at the time the official of station B allows the train coming from station A to enter his station, as previously ex-

plained; but the points 7 may be correctly set by the official of station B whenever this official clears the track for the train to leave station B toward station C. The insertion of plug 21 causes a similar action, as previously described in reference to the other switch-points and signals, and hence further detailed description of this action is not necessary. Before the official at B has inserted the plug 21 he will have advised station C by rotating his inductor-handle and consequently placed station C in a position for maving ready. Provision must also be made permitting each of the points of a station being set separately in order that shunting may be carried on. For this purpose special contact devices will be necessary. These are indicated on the switchboard by 4 8 6. Fig. 2 shows the connections for the same in dotted lines. The contacts 8 6 are arranged in parallel. All three are, however, in series with respect to contact 4. If 4 is closed and thereupon 8 or 6 closed by means of a plug which cannot be utilized for a track-contact, the respective points will be operated.

The path of the current for each case is readily visible. If, for example, the contacts 4 and 6 are closed, the current proceeds from the source of current 2 over 4 and 6 through the electromagnet of the points 7 and back to the other pole of the circuit. By this means the points are set over.

The method of connection shown between the signals and points is merely a diagram explanatory of the principle adopted. In point of fact, the connections will be somewhat different, as both the signals and points must be capable of being set over in both directions. In the arrangement shown as long as the track is made ready current will flow through the line-wires.

In order to permit of setting over the points and the like in both directions and so as to use the current only at the moment at which the operations are effected, special actuating devices and connections are necessary, which also effect a locking of the points.

Figs. 3 and 4 illustrate two views of one form of the device. The rod 42 is connected with the points or the signal and is reciprocated by means of another rod 40 moving in guides 39, whereby the points are set in one direction or the other. Upon the frame 37 are fixed guides 36, in which the parts 35 35′ are reciprocated. These latter are constantly depressed by means of springs. The rod 40 is provided with projections 46, having sharp vertical edges. It will be apparent that the rod 40 may be displaced in either direction, according to the position of the bolts 35 and 35′. In the position shown the right-hand bolt is in the locking position, so that the points are locked. If the right-hand bolt is raised, the rod 40 may be displaced toward the right hand. When the setting over has been effected, the left-hand bolt 35′ falls into the locking position, and the points are again locked. The lifting of the left or right hand bolt is effected as required, and at the same time the points are set over by electromagnetic means. To this end the iron cores of the two electromagnets 28 29 are connected, by means of elastic bands, with a stationary wheel-segment. According as current traverses one or other of the two coils, one or other of the cores will be drawn into its coil and the wheel-segment will be rotated. A lever 45 is fixed upon the wheel-segment shaft. A pin 50 upon this lever is able to displace the rod 40, while another pin 43 serves to displace an unlocking-rod 44, mounted in front of the rod 40 in the same guide-blocks 39. This rod 44 is provided with two inclined projections 41 and 47, by which one of the two bolts 35 or 35′ is lifted and the points consequently unlocked. The unlocking must be completed before 40 is displaced. This is attained by causing the pin 50 to effect an idle travel during the unlocking operation. When the setting over has been effected, a similar reversal of the switch must be effected, so that the next actuating device may be connected with the source of current and the current of the motor itself again switched off. To this end two contact devices are provided—one on each side of the stand 37. Each contact-piece 31 or 31′ is opposite to two others 32 33 and 32′ 33′. All three are insulated one from the other.

The movable contact-arms 38 and 38′ produce a contact either between 31 and 32 or 31′ and 32′, or 31 and 33 or 31′ and 33′. The reversal of the contact devices takes place at the same time as the displacement of the bolts 35 and 35′, as the levers 38 and 38′ are attached to the same by means of pins 49.

The connection between two actuating devices—for example, of the points 9 and 7—is shown in Fig. 8. The end of the wire marked + comes from the positive pole of the battery, passes by all devices, and makes two shunts at each—one round the magnet 29 to the contact 32 and the other round 28 to the contact 32′. The other pole (marked — wire) proceeds to the contact 31 or 31′. The contacts 33 and 33′ of the first actuating apparatus are connected with the contacts 31 and 31′ of the next apparatus and so on.

Assuming that the points 9 and the points 7 both occupy the positions indicated in dotted lines and are to be brought into the position represented, the contacts 38 will also occupy the position shown in dotted lines, (38′ are below.) If now the official closes the contact for the position of the points in question, the current passes from the + wire through the coil 29 to the contact 32 and passes over 31 to the — pole. On the left hand, on the contrary, is a double inter-

ruption, because 38′ is situated below and because the proper contact in the station is not closed.

It is understood that the switch-points can be set in either of two positions and for each position a separate plug-hole is required, and in order to avoid mistakes different plugs are preferably used; but a single plug may be employed.

The points 9 are set over, and the contact thereby passes to the fully-extended position, By this means, however, the next circuit is closed, the current passes through the + wire, through the coil 29 of the point 7, over 32 through the contact 38 (shown in dotted lines) and through 31 to the battery. In this manner these points are set over also, and so on. It is quite immaterial if the points 7 already occupy their proper position. In this case they will not be reversed, and the current passes directly to the next actuating device.

In setting the points over in the opposite direction the procedure is the same in using the contacts 38′.

Fig. 9 shows diagrammatically the arrangement illustrated in Figs. 1 and 2 and the connections indicated in Fig. 8—that is, the line-wire connects the contact-points 32′, 31′, and 33′, as required, for setting the signals 5 and 12 and the switches 7 and 9 at the time the plug 10 is inserted, and it is desired to bring the said signals and switches in safety position for the train to pass over track I. By the use of a second plug 25 the switch 7 is moved into position opposite to the one obtained by the insertion of the plug 10, and in order to accomplish this result connection is made between the plug 25 and the contact 31 of the switch 7. From switch 7 lead connections to the other devices to be reversed from the switch 7 in the same manner as the device 9 is connected to switch 7 on the insertion of plug 10. For the sake of simplicity the several devices 5, 7, 9, and 12 are shown in Fig. 9 one next to the other to permit of showing the connections with as few lines as possible. If the official at the station A closes the contact at 3 by turning the handle of the inductor 1 and the official at station B inserts the plug 10 to clear the track I, then the current passes from the battery 2 to the closed contact of 52 to the contact 10, contact 31′, and contact 32′ of the device 5 and bridged by contact 38′, to the spool 28 of the device 5 back to battery 2. The device 5 is now, as previously described, changed to the required position, and the current now passes from contact 31′ to 33′, (now bridged by contact 38′ as the latter has reversed,) then to contact 31′ of the device 7, in which the same action takes place as above described relative to the device 5. In case the device 5 on inserting the plug 10 was already in the proper position with the contact 38′ bridging the contacts 31′ and 33′, then the apparatus 5 is not actuated, and the current goes direct to the device 7. The switch 9 and the signal 12 are successively actuated in the same manner.

As shown in Fig. 9, the connection from the contact 33′ of the device 9 is once more returned to the switchboard by way of plug-contact 13, interposed between the device 9 and the signals 12. The current to the setting devices of the signals 12 is rendered active as soon as the official closes the contact 13 and then the signals move into action.

In Fig. 2 is shown a visible alarm 14, while in the present construction an alarm-bell is substituted and placed in parallel series with the main circuit, the bell 14 sounding until the signal devices 12 are reversed, as the circuit is broken as soon as the contact 38′ of the device 12 passes from the contact 32′ to the contact 33′. In the present case by bridging either the contact 10 or the contact 13 two tracks can be set into proper condition; but it is evident that any desired number of such contacts can be used for a number of tracks by successively switching the devices to be set with the corresponding contact—for instance, connecting the device 5 direct with the device 9 or connecting first the device 9, then the device 5, then the device 7, &c.—as required by the arrangement of the tracks and switches.

If the departure-signal is to assume three positions—"rest," "stop," "proceed"—two actuating devices must be employed for this signal. One moves it from the rest to the danger position, while the other displaces it from this latter to the proceed position.

In order that a safe contact may invariably be formed, the actuating devices are provided with mercury contacts, as shown in Fig. 7. The contacts 32 and 33 are mercury-bowls and 31 is a rocking lever, which is operated by the bolt 35.

Figs. 10 to 16 illustrate the manner in which the interrupters are inserted on the line-wires between two actuating devices. The departure-signal is adapted to assume three positions—position of repose, stop position, and proceed position—for which purpose two actuating devices are employed.

In many of the actuating devices it is necessary in complicated tracks to effect another modification, which is shown in Fig. 12. This consists in one or more so-called "insulating-contacts" x x'. These are levers of conducting material which exactly correspond with the levers 31 31′ and are mounted upon the same spindle o as these latter and operate in the same manner as shown in perspective in Fig. 12. A considerable number of insulating-contacts may be provided for one lever 31 or 31′. These are all insulated one from the other and from the lever 31 or 31′ and are so arranged

that they are always displaced at the same time as the lever 31 or 31′. In the same manner as the lever 31 or 31′ they are provided with mercury-basins into which they can dip.

Fig. 12 shows, besides the lever 31 on the shaft O, another isolating-lever X. In Fig. 10 the isolating-levers (indicated by X and X′) are for the sake of clearness shown below the levers 31 31′, it being understood, however, that besides the lever X (shown in Fig. 10) another lever X′ is employed.

In Fig. 10 there are two tracks I and II with a crossover-track III and a branch line IV. T is the actuating device for the points w', U for the points w^2, X for the distant signal 12′, Y for the arrival-signal 12, Z for the departure-signal 12″ arranged upon this latter. V and W serve to bring the departure-signal 5 into its two positions, W into its stop position, and V into its proceed position.

The switch-table, Fig. 11, for station B is intended to indicate to the official the position of his section of the line. The setting of the indicators is effected on this table by means of actuating devices P Q R S P′ Q′ R′ S′.

P is in connection with the annunciator apparatus (inductor) of station A. If the official at this station operates his inductor, the usual red plate is shown and calls attention to the fact that a train is on its way from A. In the same manner P′ is in connection with station C. Q becomes operative when a train is signaled to C. A corresponding sign then appears on the switchboard. R appears and remains so long as the track I in the station is occupied, S the same as long as the track III is occupied. P′ Q′ R′ S′ serve the same purpose for trains coming from station C.

The only appliances which the official at station B has to operate and which carry out all functions by his merely pressing upon them in the prescribed order are M N O M′. M and M′ are the line-selectors, M for the trains traveling from A to C, (or to any other stations which branch off from the track I and lie in the same direction of running,) and M′ for the trains proceeding from C to A. They consist of several series of basins of mercury or other contacts insulated one from the other, of which two always go together. The special construction is hereinafter described. As many series of basins of mercury are provided as there are tracks which may be traversed in one direction and the whole series which is used is closed by a common plug. Thus, for example, the left-hand series of contacts consisting of the contacts 60–65 is for the track I, the right-hand set for the track III. In the same manner series of contacts might be provided for a large number of tracks. The plug consists of pins attached to a common cross-bar of the same number as there are holes in the respective series, and the pins are so connected one with the other that the interrupters are always closed by the plug at 60 61 62 63.

N is the arrival-button, which is provided with contact-holes in exactly the same arrangement as M. By actuating it the train is given "line clear" for the arrival.

O is the departure-button, actuating the departure-signal and also points, if necessary.

In the first place it should be briefly stated what the operation is when a train is to travel from A to C, stopping at B. A rings up, and thereby actuates the apparatus P, which, as already described, results in closing a contact, whereby it is first rendered possible for the officials at station B to make ready their tracks. It is now possible for station B to give "line clear" to tracks I or III by placing on the line-selector M either the left-hand or the right-hand contact series. Assuming that he does the first, he then presses upon the arrival-button N, whereupon all the points and the arrival-signal 12 are properly set, and, further, R acts so that he knows and sees that track I is occupied. This displacement of R also shows him whether all the points and signals are properly set. The train is now able to proceed to the departure-signal 5. If the departure-signal is to be given after the official has rung up, he presses the button O, thereby setting the departure-signal.

If it is desired to permit the train on the line to pass right through when setting the line-selector, the official has only to press simultaneously on N and O, so that the distant departure-signal 12″ is also displaced, if he has previously notified this.

The path of the current for a train traveling from A over the track I will now be described. The line connections through which current will be caused to pass, owing to pressure on the arrival-button N, are shown in continuous lines. The others are in dotted lines. A rings up and by means of his inductor-current brings the apparatus P into the position shown with uninterrupted line, so that the apparatus indicates "Train from A." (See table, Fig. 11.) The inductor 1 is shown in Fig. 2, and the connection is so arranged that the inductor-current passes around the right-hand spool of the apparatus P, so that the levers 31 31′ pass into the positions shown in Fig. 10. The station official who has thus been notified moves his line-selector M and in this case to the left-hand part marked "Line I" and presses upon the arrival-button N. Thereupon the current passes from the negative conductor over the lever 31′ and mercury-basin 32′ of the apparatus P, through the insulating-contact x' and the basin 34′ of the apparatus R, (lever x'

is in the position shown,) over the contact 60 from line-selector M, over contact 67 from arrival-button N, to the points-actuating device T over 31′ 33′, (or over 31′, 32′, and coil to the positive conductor, when the apparatus is otherwise situated, in which T is in the requisite position indicated and the points are therefore properly set over to the left hand,) over contact 61 in the line-selector M, over contact 66 in the arrival-button N, to the actuating device W for the departure-signal, and thus through the lever 31′ (which occupied the position in dotted lines) and basin 32′ through one coil of the apparatus to the positive pole of the conductor. By this means the apparatus W is set in the position shown, and the signal 5 passes from the rest position into the (dotted) horizontal stop position. Owing to the reversal of the lever 31′, a fresh current is formed over 33′ of apparatus W, over contact 62 of line-selector M, to the apparatus Y for the arrival-signal, over its lever 31′, which remains in the position indicated in dotted lines, through a coil to the positive pole of the battery. By this means the apparatus Y is displaced into the position shown, and the arrival-signal 12 is consequently moved into the arrival (dotted) position. Owing to the reversal of the apparatus, a new path for the current is formed through the basin 33′ to the apparatus X for the distant signal through 31′ and the one coil to the positive conductor-pole, whereby the apparatus X, and consequently the distant signal 12′, are set in the arrival position. By this means a fresh path for the current is formed over the basin 33′ of X to the actuating device T through the insulating-contact x' of this latter, through the basin 34′ (instead of this the conductor might be carried from the apparatus X to the line-selector and through a special interrupter of the same) to the switchboard apparatus R, into its lever 31, (which stands in the position shown,) over 32 and coil to the positive conductor. By this means the apparatus R is set in the position indicated in dotted lines and the signal "Line I occupied" appears. By this means a further contact is formed as the lever x' of the apparatus R enters the basin 35′. Current therefore flows from the negative pole of the conductor over the lever 31′ and basin 32′ of the apparatus P, over x' and 35′ of apparatus R, through contact 69 of the arrival-button N, and through the left-hand coil of the apparatus P. This latter is thereupon returned to the position shown in dotted lines, and the circuit is again interrupted, so that the official at A is able to signal a fresh train. (If from the track I, either before or after the departure-signal a special track branches off to station D, the same apparatus P, the same apparatus R, and the same line-selector M are used. The only difference is that a fresh apparatus Q must be provided for station D.) When the train leaves, station B rings up station C by rotating its inductor. By this means its apparatus Q is simultaneously actuated and assumes the position shown in dotted lines with the visible indication "Towards C." The official then presses upon his departure-button O. A path for the current is thereby formed from the negative-conductor pole to the apparatus Q through the lever 31′, basin 32′ to the line-selector M over contact 63, to the departure-button O over contact 70, to the points-actuating apparatus U for the points w_2. If these occupy the position shown in broken lines, the current will first of all pass through the lever 31′, basin 32′, through the coil to the positive-conductor pole. By this means the apparatus is reversed in order to properly set the points w_2. The current then passes over the basin 33′ to the second actuating device V for the departure-signal 5 by way of the lever 31, (which stands in the position shown in dotted lines,) basin 32, and coil to the positive-conductor pole. By this means the departure-signal is brought to "Start," and the train is able to start. By the reversal of the apparatus V a fresh circuit is formed. The current passes through the basin 33 to the line-selector M through contact 64 to the apparatus Q, through one coil of which it proceeds to the positive conductor, so that Q is again reversed, the indication "Towards C" disappears, and the circuit is interrupted.

When it is desired to give a train leave to pass through station B, the official, as already stated, after he has arranged his line-selector for the proper track, presses the arrival-button N and departure-button O simultaneously. By this means if he has in the meantime rung up C the procedure is exactly the same as before. The departure-signal 5 is therefore brought to the closed position and also forms a new path for the current from the negative-line wire to the actuating apparatus V, through the insulating-contact x of this latter (which is set over into the position shown) through the basin 34 to the departure-button O, over the contact 71 of this latter to the arrival-button N, over its contact 68 to the actuating apparatus Z for the distant departure-signal 12″, (the lever of this latter occupies the position shown in dotted lines,) through the lever 31′ and basin 32′ to the coil to the positive-conductor pole. By this means the apparatus Z is set in the position shown, and thus operates the distant departure-signal 12″. At the same time by the emergence of the lever 31′ from the basin 32′ the current is interrupted. Obviously it is possible to obtain a return-signal from this last apparatus Z to station B, for which purpose it is only necessary to utilize the lever 31 in the manner already shown. If the train overruns the con-

tact 1 of the points w_1, it brings the signal to the stop position. If m is overrun, it is brought to the rest position.

From what has been stated the importance of the line-selector M in this direct method of connection from one actuating apparatus to the next will be readily understood. On complicated lines a simple and safe method of connection could not be obtained. If it is desired to complete the conductor for the arrival of the train—that is to say, the conductor shown in Fig. 10—for track III also in an exactly similar manner as represented for track I, the conductor must proceed directly from the basin 32′ of the apparatus to the insulating-contact x' of the apparatus S and then to the interrupters on the line-selector "Line III."

The interrupters 60 61 62 of the line-selector through which each of the conductors is carried are of the greatest importance, as by their means the actuating appliances may be separated one from the other either singly or in groups, so that only such actuating appliances become operative in series as are rendered interpendent by common plugging of the interrupters.

In the construction of this line-selector M special care must be taken that when a track is plugged the official cannot from oversight effect the same operation for another even with a different plug. This security is given by the special construction of the line-selector, as shown in Figs. 13, 14, 15.

b' c' d' e' are rows of contact-holes, which may be filled with mercury, of which contacts in accordance with the diagrammatic arrangement of M in Fig. 10, b' and c' serve for lines I and III, while d' is a special row, the operation of which is hereinafter explained, and e' is used for shunting. f' g' h' i' are contact-beams, each of which is provided with conducting-strips n', corresponding in number with the number of the contact-holes. f' and g' are connected by means of a common arm o', which is capable of rocking on its pivot p'. It will be readily understood that as soon as the official depresses the beam f' with his plug, and thereby closes the track I, the track III to be plugged by the depression of the beam g' can then only be closed if he withdraws the same plug a' from the hole q' and plugs the hole r' with it. As the beam f' is always raised when the other, g', is depressed, and vice versa, simultaneous contact-closing can never take place, even if there are several plugs a' to hand. The depression of f' or g' also results in the lifting of the beam h', which was previously immersed, so that the holes d' are no longer connected one with the other when the holes b' or c' make contact. The beam h' is provided with two arms t and t', which are rotatably mounted on the pivot v' and engage beneath o'. It is obvious that as soon as the arm o' is depressed in one direction or the other the arm t or t' will also be depressed, which produces the lifting previously mentioned.

The beam o' only affords the possibility of shunting, as is hereinafter described, and in its movement it is independent of the other beams.

The contact series d', which is always closed when neither of the two tracks I and III is plugged, serves the following purpose: As shown in Fig. 10, one contact-hole d' is connected with the positive pole of the battery, the other leads over the actuating appliance Y and the right-hand coil to the basin 32. The lever 31 is connected with the negative pole. If d' is bridged over, it follows that the arrival-signal (or the arrival-signals if these are arranged in direct dependence one upon the other) again returns to its old position "Stop." If the official has erroneously placed his plug in q' or r' and these tracks are free, it is only necessary for him to withdraw it in order to produce the return of the signal. It is obvious that what serves for the arrival-signal may be utilized, with a suitable number of contact-holes d' and connections, in order to bring the whole of the points of the line in question (or, as will hereinafter be seen, shunting groups) back into their normal position, already described.

We have now to consider how the lines are led over the interrupter groups in practice, when regard is had to the fact that different tracks must be made ready and separate points and also whole groups of points in combinations required for shunting must be employed. In this attention must of course be paid to the fact that when a track is made ready shunting shall not be possible upon this track, and vice versa.

In Fig. 16 a practical system of conductors of this kind is represented. The representation of the track only differs from that in Fig. 10 owing to the fact that the points w^4 run in the other direction. Tracks I and III are here considered. The corresponding actuating appliances are designated by the same reference-signs as in Fig. 10, and in the points-actuating appliances T J K the simplification is effected that the two middle basins 33 33′ constitute a common contact 33, so that one line-wire is dispensed with. This is permissible because one of the bolts—for example, the bolt 31—invariably leaves its basin first, after which the other, 31′, is immersed.

87 represents binding-screws on the switchboard. In order to facilitate the control, they are arranged in groups in accordance with the separate appliances to which they belong. The rails again represent the continuous conductor for closing all appliances. From each points-actuating appliance only three line-wires lead to the switchboard; from each signal appliance, four. The appli-

ances R and S are not shown, as the connection remains exactly the same as in Fig. 10. On the right hand of Fig. 16 the shunting-board is shown, which may either be attended to by the station official at B himself or by a special shunting superintendent outside the signal-cabin. 83 is a contact-beam which rotatably pivoted at its middle point (in the same manner as the line-selector) closes either the contact 81 or the contact 82. If 82 is closed when station A has rung up station B, the official B is able to make the track ready in the manner already explained. This is, however, not possible if 82 is open, as this latter interrupts the battery-circuit before the current proceeds to the apparatus P. If 81 is closed when the official closes his shunting contact e', shunting may be carried on. Preferably e' is in series arrangement with the interrupter d', from which it follows that d' must always remain closed and the plug a' must be inserted in q' or r' of Fig. 15 if the circuit is to be closed. The same plug a' is used for plugging e'. *Sch* is a switchboard for separate points which is provided with double the number of line-interrupters that there are points. The interrupters are designated W_{10} W_{20} according to the points w_1 w_2 they relate to. The contact-holes 72 73 74 when closed produce the displacement of the corresponding points toward the right hand and 72′ 73′ 74′ toward the left hand.

Tz is a press-button of the same kind as M. These two appliances serve in common for setting over whole groups of points. In the present case it is assumed that a train is traveling on the line II from the right and is to pass on line III onto line IV. A number of group-selectors Sz may be provided, each of which is in series arrangement with an interrupter of the press-button Tz, so that the group of points corresponding to the proper Sz is actuated when this Sz and the button Tz are closed.

Of course return-annunciators Xz of the known kind may be used for each separate points and for the groups of points, these devices indicating whether the desired displacement has been effected.

Assuming that, for example, the points w_4 are to be actuated by themselves by the officials, the following will be necessary: The contact e' must be closed with the plug a'. Then the contact 83, which 82 previously bridged over, is depressed upon 81 and simply bridges 75 or 75′, thus displacing the points w_4 either to the right or left hand. The current flows from the battery through d' over e', through 81, through 75 to the lever 31 of the apparatus K, through the basin 32 over the right-hand coil to the battery. If the train is on line II and vehicles are to be shunted on to line IV, after the contacts e' and 81 have again been closed the group-selector Sz is plugged and the press-button Tz depressed. The current then flows from the battery over d', e', 81, contact 76 of Tz, 77 of Sz, to the points w_5, (the actuating appliance for these is not shown, for which reason the line-wire is interrupted,) over contact 78 to the actuating appliance J, over bolt 31, through the coil to the pole, whereupon lever 31 is reversed; after this through the basin 33, over contact 79 to apparatus K, which is reversed, then through the basin 33 over contact 80 to the return-annunciator Xx, thus making ready the line.

The common press-button T_z may also be used for setting the separate points if a plug is employed for closing the corresponding interrupter.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. A switch and signal apparatus for railroad-tracks, comprising actuating devices for the track switches and signals, and electrical means for actuating the said actuating devices in one direction for making the line ready and for causing a return movement of the actuating devices, the said electrical means having electric switches one for each actuating device, each electric switch when set closing the circuit for another actuating device.

2. A switch and signal apparatus for railroad-tracks, comprising actuating devices for the track switches and signals, and electrical means for setting the actuating devices, provided with a switchboard having interrupters arranged in groups corresponding to the tracks to be made ready, and contact devices for closing the interrupters and adjustable simultaneous with the track-switch so that the same actuating device may be used in any desired order and direction of displacement for making ready different tracks.

3. A switch and signal apparatus for railroad-tracks, comprising actuating devices for the track switches and signals, and electrical means for setting the said actuating devices, the said electrical means including a switchboard provided with two groups (b' and d') of interrupters for each track and of which the group b' serves for actuating the said actuating devices in one direction for making the line ready, and the other group d' serves for causing a return movement of the actuating devices.

4. A switch and signal apparatus, comprising actuating devices for the switches and signals of a station, an alarm-circuit from one station to another, a main circuit for each station and having circuit-closers for successively connecting the main circuit with the said actuating devices, and a circuit-closer for closing the main circuit from the said alarm-circuit.

5. A switch and signal apparatus comprising an alarm-circuit from one station to another, a main circuit at a station, each adapted

to be closed by the said alarm-circuit, actuating devices for the switches and signals at the track-section for a station, and circuit-closers in the said main circuit, for connecting the main circuit to an actuating device on closing the main circuit by the alarm-circuit, the connected actuating device controlling the circuit-closer for the next actuating device, to successively set the several switches and signals.

6. A switch and signal apparatus comprising an alarm-circuit from one station to another, a main circuit at a station, each adapted to be closed by the said alarm-circuit, actuating devices for the switches and signals at the track-section for a station, circuit-closers in the said main circuit, for connecting the main circuit to an actuating device on closing the main circuit by the alarm-circuit, the connected actuating device controlling the circuit-closer for the next actuating device, to successively set the several switches and signals, and a switchboard at a station for the said circuits and interrupters in the switchboard.

7. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, and circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second actuating device of the series.

8. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second actuating device of the series, and a second interrupter in the main circuit, between the last actuating devices of the series.

9. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second actuating device of the series, and an alarm in the main circuit, after the last actuating device of the series.

10. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, and circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second actuating device of the series, the first actuating device controlling the stop-signal, the latter controlling the stop-signal switch adjacent to the stop-signal, the stop-signal switch controlling the entrance-switch and the latter controlling the arrival-signal.

11. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second actuating device of the series, the first actuating device controlling the stop-signal, the latter controlling the stop-signal switch adjacent to the stop-signal, the stop-signal switch controlling the entrance-signal and the latter controlling the arrival-signal, and a second interrupter in the main line between the entrance-switch and the arrival-signal.

12. A switch and signal apparatus for railroad-tracks, comprising an alarm-circuit from one station to another, a main circuit at a station, adapted to be closed by the said alarm-circuit, an interrupter in the said main circuit, a series of actuating devices for the switches and signals of the station, circuit-closers for connecting the main circuit with the said actuating devices, the closing of the main line by the interrupter actuating the circuit-closer for the first actuating device of the series, to set this first actuating device, and the action of the latter controlling the next circuit-closer, to actuate the second

actuating device of the series, the first actuating device controlling the stop-signal, the latter controlling the stop-signal switch adjacent to the stop-signal, the stop-signal switch controlling the entrance-switch and the latter controlling the arrival-signal, and an alarm in the main circuit after the arrival-signal.

13. A switch and signal apparatus for railroads, comprising a main circuit at a station, adapted to be closed by the next station, a series of circuit-closers in the said main circuit, and actuating devices for the switches and signals of the station, connected with the said circuit-closers, the closing of the main circuit causing a closing of the first circuit-closer of the series, to set the corresponding actuating device, the latter controlling the next following circuit-closer.

14. A switch and signal apparatus for railroads, comprising a main circuit at a station, adapted to be closed by the next station, a series of circuit-closers in the said main circuit, actuating devices for the switches and signals of the station, connected with the said circuit-closers, the closing of the main circuit causing a closing of the first circuit-closer of the series, to set the corresponding actuating device, the latter controlling the next following circuit-closer, and an interrupter in the main circuit, in advance of the first circuit-closer of the series.

15. A switch and signal apparatus for railroads, comprising a main circuit at a station, adapted to be closed by the next station, a series of circuit-closers in the said main circuit, actuating devices for the switches and signals of the station, connected with the said circuit-closers, the closing of the main circuit causing a closing of the first circuit-closer of the series, to set the corresponding actuating device, the latter controlling the next following circuit-closer, an interrupter in the main circuit, in advance of the first circuit-closer of the series, and an alarm in the circuit, after the last circuit-closer of the series.

16. A switch and signal apparatus for railroads, comprising a main circuit at a station, adapted to be closed by the next station, a series of circuit-closers in the said main circuit, actuating devices for the switches and signals of the station, connected with the said circuit-closers, the closing of the main circuit causing a closing of the first circuit-closer of the series, to set the corresponding actuating device, the latter controlling the next following circuit-closer, an interrupter in the main circuit, in advance of the first circuit-closer of the series, an alarm in the circuit, after the last circuit-closer of the series, and a second interrupter between the last two circuit-closers of the series.

17. A switch and signal apparatus for railroads, comprising a main circuit at a station, adapted to be closed by the next station, a series of circuit-closers in the said main circuit, actuating devices for the switches and signals of the station, connected with the said circuit-closers, the closing of the main circuit causing a closing of the first circuit-closer of the series, to set the corresponding actuating device, the latter controlling the next following circuit-closer, and shunting means in the said main circuit, for controlling each actuating device separately.

18. A switch and signal apparatus for railroads, provided with a main circuit, actuating devices for the switches and signals, each actuating device having a pair of solenoids, a lever controlled by the solenoids and connected with the switch-points or signal-arms to be actuated, and current-controlling devices actuated by the said lever, to control the current of the main circuit relative to the solenoids of the several actuating devices.

19. A switch and signal apparatus for railroads, provided with a main circuit, actuating devices in the said main circuit, for controlling the switches and signals, each actuating device comprising a pair of solenoids connected with the main circuit, a lever oscillated by the said solenoids, a slide controlled by the said lever and connected with the switch-points and signal-arms to be actuated, locking-bolts for the said slide, an unlocking-bar controlled by the lever and controlling the said bolts, sets of fixed contacts, and a contact-lever for each set of contacts and controlled by one of the locking-bolts.

20. A switch and signal apparatus for railroads, provided with a main circuit, actuating devices in the said main circuit, for controlling the switches and signals, each actuating device comprising a pair of solenoids connected with the main circuit, a lever oscillated by the said solenoids, a slide controlled by the said lever and connected with the switch-points and signal-arms to be actuated, locking-bolts for the said slide, an unlocking-bar controlled by the lever and controlling the said bolts, sets of fixed contacts, and a contact-lever for each set of contacts and controlled by one of the locking-bolts, a contact of each set being connected with a corresponding solenoid, another contact in the set being in the main circuit and the third contact being connected with a contact of the next actuating device.

21. A switch and signal apparatus provided with an actuating device for a switch or signal, comprising a pair of solenoids having their movable cores connected, a lever oscillated by the said connected cores, a contact-arm controlled by the said lever, and a set of contacts formed of three insulated contacts, the said contact-arm being in contact at all times with one of the contacts and alternately with the other two contacts.

22. A switch and signal apparatus pro-

vided with a switchboard having a line-selector comprising two series of contacts, a beam mounted to rock and having two sets of contact-pins for alternate engagement with the said series of contacts, and a plug for engaging the beam at either side of its fulcrum, to impart a swinging motion to the beam, to move one set of contact-pins into engagement with one of the series of contacts and the other set of pins out of engagement with its series of contacts.

23. A switch and signal apparatus provided with a switchboard having a line-selector comprising two series of contacts, a beam mounted to rock and having two sets of contact-pins for alternate engagement with the said series of contacts, a plug for engaging the beam at either side of its fulcrum, to impart a swinging motion to the beam, to move one set of contact-pins into engagement with one of the series of contacts and the other set of pins out of engagement with its series of contacts, a third series of contacts at angles to the said two series of contacts, and a rocking beam for the said third series of contacts, controlled by the other beam.

24. A switch and signal apparatus provided with a switchboard having a line-selector comprising two series of contacts, a beam mounted to rock and having two sets of contact-pins for alternate engagement with the said series of contacts, a plug for engaging the beam at either side of its fulcrum, to impart a swinging motion to the beam, to move one set of contact-pins into engagement with one of the series of contacts and the other set of pins out of engagement with its series of contacts, a third series of contacts at angles to the said two series of contacts, a rocking beam for the said third series of contacts, controlled by the other beam, a fourth shunting series of contacts, and a beam carrying contact-pins for engagement with the said fourth series of contacts, the last-mentioned beam being independent of the other two beams.

In testimony whereof we have hereunto set our hands, in presence of two subscribing witnesses, this 22d day of June, 1903.

LORENZ KOTTMAIR.
RÜDOLF ZWACK.

Witnesses:
ANNI LUTHER,
GEORG KÖNNER.