

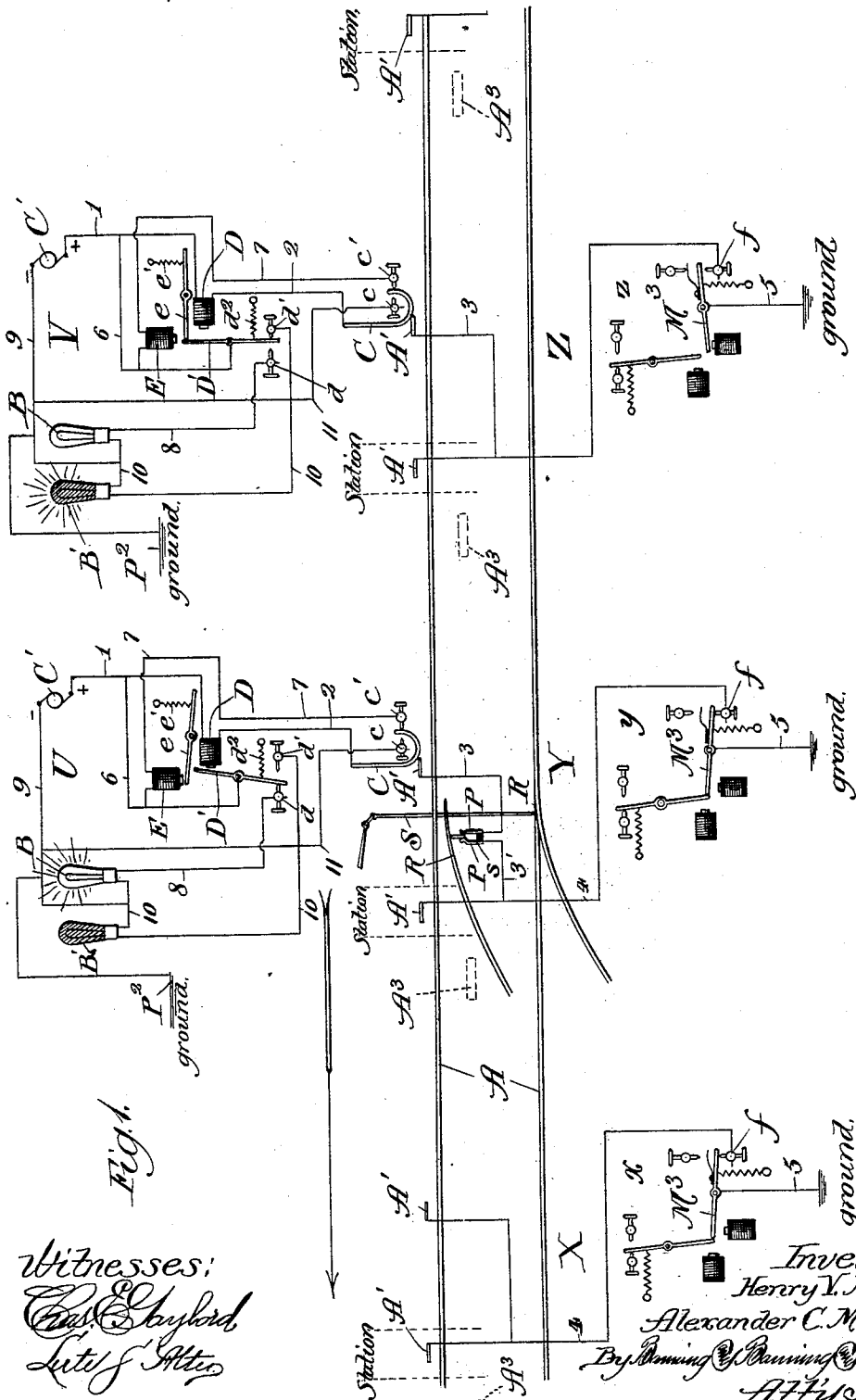
(No Model.)

2 Sheets—Sheet 1.

H. V. & A. C. MILLER.
ELECTRIC RAILWAY SIGNAL.

No. 539,529.

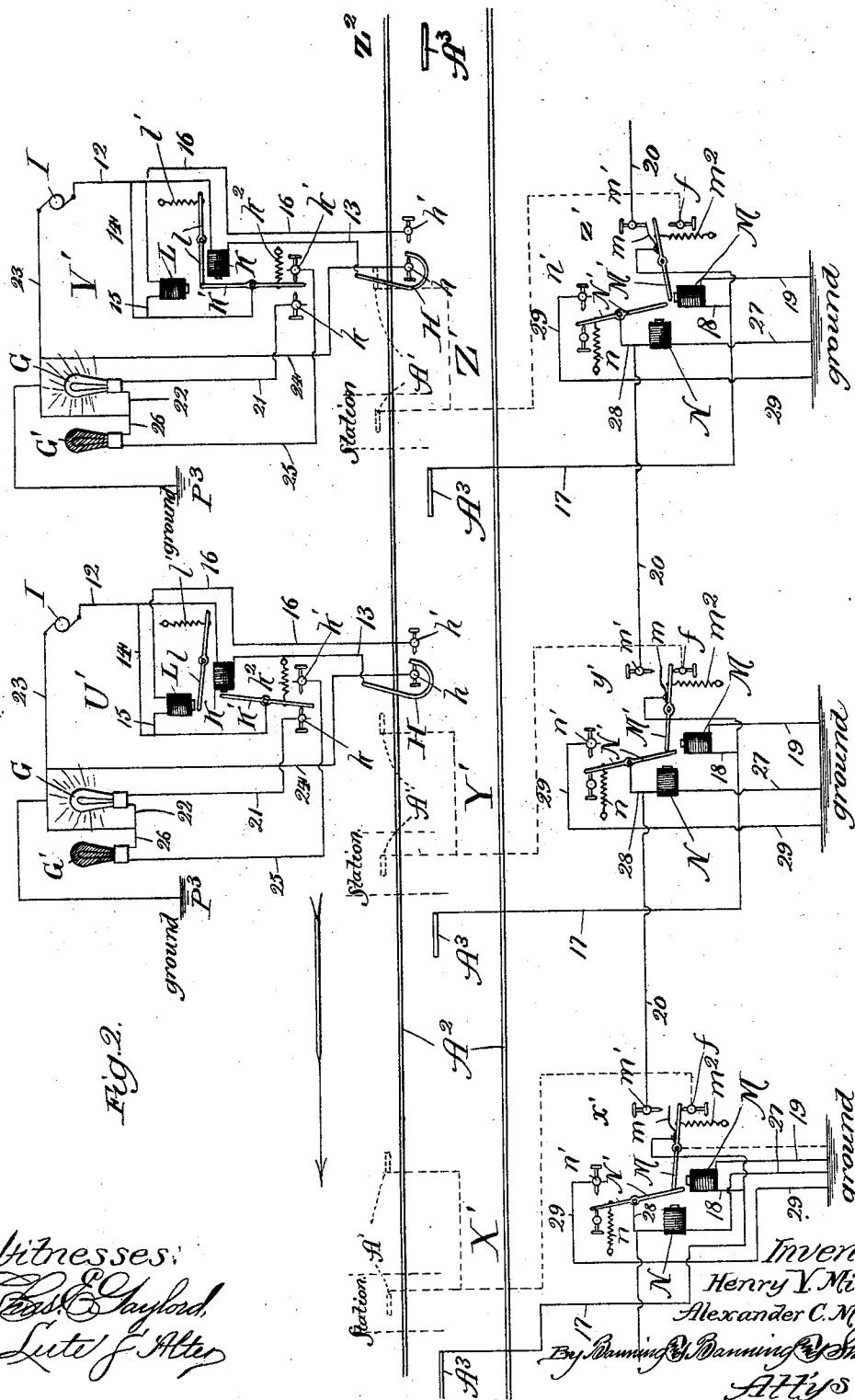
Patented May 21, 1895.



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Witnesses:
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UNITED STATES PATENT OFFICE.

HENRY V. MILLER, OF BLOOMINGTON, AND ALEXANDER C. MILLER, OF AURORA, ASSIGNORS TO THE MILLER INCANDESCENT RAILWAY SIGNAL COMPANY, OF CHICAGO, ILLINOIS.

ELECTRIC RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 539,529, dated May 21, 1895.

Application filed January 5, 1895. Serial No. 533,970. (No model.)

To all whom it may concern:

Be it known that we, HENRY V. MILLER, of Bloomington, and ALEXANDER C. MILLER, of Aurora, Illinois, have invented certain new and useful Improvements in Electric Railway-Signals, of which the following is a specification.

Our invention relates to electric railway signals adapted to be used on moving trains, and is intended to be an improvement upon the inventions shown and described in Letters Patent No. 493,935 and No. 494,111, granted March 21, 1893.

The object of our invention is to provide a simple, economical and efficient electric signal for railways adapted to be used on a moving train and give warning to the engineer or other train man that the system or section ahead of him is blocked, or a switch opened, and that the devices on the same block or system to the rear have operated and are in condition to give a following train the desired signal—or that it has failed to operate and that he must take all the necessary precautions.

The invention consists in the features and combinations hereinafter described and claimed.

In the accompanying drawings, Figure 1 represents a diagrammatic view of our improvement arranged to give a signal as to the condition of the block ahead of a moving train, and Fig. 2 represents a diagrammatic view of our improvement arranged to show the condition of the system or mechanism to the rear of the train.

Describing Fig. 1, A represents the ordinary or usual tracks of the railroad, and A' an auxiliary or supplementary contact rail laid adjacent to the ordinary rails in any desired position. This auxiliary rail may be constructed of any desired length of sections and arranged with regard to the ordinary rails of the track or system as desired—that is, the sections may overlap the different systems or blocks as may seem desirable or necessary.

For convenience in describing and illustrating our improvement, we have divided this diagram so as to show three sections, X, Y and Z, of a railroad system, with two trains, U and V, moving thereon.

At any suitable point in the cab of a locomotive or other car, we place an electric light circuit, embracing—preferably—two incandescent lights, B, B', of different colors—B a white or clear light, and B' preferably a red or danger light. The circuit further embraces a contact brush, C, which is attached to the engine or car at any suitable point to contact the auxiliary rail and complete a temporary ground connection, and is arranged to vibrate between two contact posts, *c, c'*, which are also embraced in the electric light circuit. This circuit embraces a suitable source of electric energy, which preferably consists in a dynamo, C', and two electro-magnetic circuit making and breaking mechanisms, which are hereinafter described. One magnet, D, is arranged at a suitable point in the circuit and connected preferably with the brush above referred to, and is provided with a make and break armature lever, D', which makes or breaks the electric light circuit, as hereinafter described. The opposite vibrating end of this lever vibrates between two contact posts, *d, d'*, and is held normally in engagement with the contact post, *d'*, by the action of a spiral spring, *d²*, as shown in train V. To lock this make and break armature lever in the position shown in train V, a second magnet, E, is provided, which also has a vibrating locking armature lever, *e*, whose spiral springs, *e'*, serve to hold it in its open position and inside the armature end of the armature lever, D', and prevent such armature lever from vibrating to the position shown in train, U, and thus giving a wrong signal. One point of this circuit should be connected with ground, as at P², through the framework of the engine or in any convenient manner.

Describing the action of the signal mechanism—which is located near the ground for making and breaking the ground connection. Suppose the train, U, to be moving in the direction indicated by the large arrow, its contact brush C—which should normally rest in engagement with the post *c*—is pushed over to the contact post, *c'*, and supposing the track, Y, to be clear, and its ground mechanism, *y*, to be in its normal position, current

will flow immediately as the brush contacts the supplementary rail, A', from ground, P², through wire 9 to dynamo, through wire 1, magnet D, wire 2, contact brush C, auxiliary rail, wires 3, switch contact points, P P, wires 3' and 4, contact post f, armature lever M³, and wire 5 to ground. A portion of the current divides on wire 1, flows through wire 6, magnet E, wire 7, contact post c', thence by contact brush, wires, &c., to the ground as above described. The completion of the ground circuit as above described energizes the above named magnets, so that the armature lever, e, is first pulled up against its magnet core, and the armature lever, D', is then permitted to be drawn over toward its magnet until it contacts the post d. As these magnets are of a high resistance, very little current flows through the same, or only sufficient to energize them, and as the sections ahead of the moving train are clear, the body of the current will then flow from the dynamo, through wires 1, 6, through armature lever D', contact post d, wire 8, clear lamp B, and wire 9 back to the dynamo, thus giving a clear signal and denoting that the section, Y, ahead of the train is clear. As the train, U, has passed off of section Z—by means of mechanism shown in Diagram 2, which will be hereinafter described—the electro circuit making and breaking mechanism, z, is so operated that its magnets are energized and its armature levers placed in the position shown in the diagram. The train, V, following and passing on to contact the auxiliary rails in the sections Z, its brush is pushed over so as to contact post c', but as the ground connection of the auxiliary rails is broken between contact post f and armature lever, M³, no current can flow to the ground. As no current can, therefore, flow through the magnets in the lamp circuit of the train to energize them, the armature levers in the light circuit of the train are left in their normal position, permitting the current to flow from dynamo, through wires 1 and 6, armature lever D', contact post d', wire 10, colored light B', branch wire 10', and back by wire 9 to the dynamo, thus igniting the red or danger lamp and showing that the section preceding is blocked or a train located thereon and warning the engineer to either stop or proceed cautiously until he obtains the white or clear signal.

While the contact brush, C, in a measure controls the direction of the circuits, the lights will still retain the condition that obtains when they were on the auxiliary tracks, even though the contact brush changed its relation with the contact posts after passing off of the auxiliary rails, so that if an engineer has a red signal on passing off one of the sections of auxiliary rails, that signal cannot be changed until he comes on to the next auxiliary rail and a ground connection is made. This is a decided advantage, in that the engineer can always tell what was the con-

dition of the block ahead of him when he left the auxiliary rail or station.

Supposing the train lamp circuit to be in the position shown in train V, and the contact brush in engagement with the post, c'. As it leaves this section of the auxiliary rail the contact brush will spring back and engage the contact post, c; but as there is no ground connection, the magnet E cannot be energized, and the armature lever, e, will be held in its normal position by spring e', thus preventing armature lever D' from breaking contact with post d', to close the white lamp circuit, and current flows from dynamo, through wires 1 and 6, armature lever D', contact post d', wire 10, colored lamp B', wires 10' and 9 to dynamo.

Supposing the train U, with the sections clear ahead of it, to pass off (either section of auxiliary rail, the contact brush, C, changes from post c' to post c. The current ceases to flow to the ground, but sufficient current continues to flow through wire 1, magnet D, contact brush C, contact post c, and wires 11 and 9 back to the dynamo, thus keeping the magnet D sufficiently energized, so that its armature lever is kept in the position shown in the train U, to allow the greater part of the current to flow, as hereinbefore stated, through wires 1 and 6, armature lever D', contact post d, clear light B, and wire 9 back to dynamo, thus showing that the track is clear ahead. It will thus be seen that it is not essentially the position of the contact brush that regulates the signal, but the condition of the electro-magnetic making and breaking devices in the track sections which make or break the ground connection.

It is often desirable to know whether a switch is open improperly or otherwise—as, for instance, that a train is ahead and in the same block. We have, therefore, devised means whereby the fact that such switch is open will be signaled to the engineer as follows—see section Y, Diagram 1: P P represent contact points interposed between wires 3 and 3'. R R represent switch points of switch rails, and S the rod which connects them. One switch is provided with a contact point or plug, s, adapted to be inserted between the contact points, P P, as shown in the diagram. In their normal position, the switch is set for the main track, so that a train will keep to such track and the contacts will be closed—as shown in Fig. 1—but when the switch is moved over to set it for the siding, the plug, s, will be disengaged from the contact points, so that the circuit between the auxiliary rail, A', to the right, will be broken between it and the ground; and, no current flowing from the dynamo to the ground, the red or danger signal will be given the engineer, as above described.

In order to actuate the electro magnetic circuit making and breaking mechanism on the track sections near the ground, and notify the

engineer that such contacts have been made or broken to the rear of his train so as to give the desired signal to an engineer following, each cab or train is provided with a second light circuit—see diagrammatic view of Fig. 2—of exactly the same general structure as described in trains U and V of diagram 1, with the exception of course that the lights should be of different colors. Inside of the usual rails, A^2 , which form the track proper, is a second auxiliary contact rail, A^3 , which is connected with the ground electric circuit hereinafter described. For convenience also in describing this diagram, the track is divided into three sections, X' , Y' and Z' , of a railroad system, with two trains—identically the same as in diagram 1—U and V', moving thereon. The light circuit in the cab embraces as before two incandescent lights of suitable colors, G, representing the clear light, and G' the colored or danger light. This electric circuit, as in Fig. 1, embraces also a contact brush, H, which vibrates between two contact posts, h and h' , but is normally in contact with the post h . I represents the source of electric energy—preferably a dynamo. K is the magnet which makes and breaks the electric circuit of the white light through its armature lever K' , whose opposite free, vibrating end vibrates between the two contact posts, k and k' , and whose spring, k^2 , serves to keep it normally in contact with the contact post k' . L represents the locking magnet, and l its armature lever; l' , the spiral tension spring which serves to keep such locking lever in its open position, as shown in train V'.

Describing the action of these signals, and the circuits which control them—we will suppose that the train, U', is moving in the direction indicated by the large arrow, which has been to the right of the second auxiliary rail in the track section, z' , its contact brush striking the auxiliary rail is moved into contact with the contact post h' . Supposing the mechanism, z' , in such section to be in its normal position—as shown at y' —and that the apparatus in the section to the rear has worked all right, so that there is a ground connection with the auxiliary rail, current will flow from ground p^3 , through wire 23, dynamo I, wire 12, magnet K, wire 13 to contact brush H. In flowing through wire 12 from the dynamo, a portion of the current divides and flows in parallel through wires 14 and 15, magnet L, wire 16 to contact post, h' , and brush H. Current then flows from the brush through the auxiliary rail, A^3 , wires 17 and 18, magnet M, wire 19 to ground. Such current then energizes magnet M, to bring its armature lever, M' , toward it, so that the spring contact m , which is insulated from the lever, engages with the contact post m' , when the current will continue to flow through wire 17, spring contact m , post m' , and wire 20 to the ground through the connection at the rear, which is instantly closed, as hereinafter described.

The second magnet, N, as hereinafter described, is arranged adjacent to a magnet, M, so that when magnet m draws its armature lever down, the armature lever, N' , of the magnet N—by the action of its spiral springs, n —is vibrated outward into the position shown in electro magnetic mechanism z' , to lock the first named armature lever in its own position, and prevent it from becoming disengaged until the train reaches the next block, as hereinafter described.

The current in flowing from the dynamo, as above described, through the magnets which are set in multiple, through succeeding wires and contact brushes, has not developed sufficient magnetic force in magnets, K and L, to overcome the force of the armature springs. The moment, however, that magnet M draws its armature lever down, so that its spring is in contact with contact post m' , a direct current is set up between it and the ground by means of the electro magnetic closing devices hereinafter described, with only the resistance of the wires interposed, so that sufficient current flows through the magnets to draw the armature levers in the light circuit up against their cores. The armature lever, L' , is then drawn up against its magnet, allowing the lever, K' , to be drawn over until its opposite end contacts the post, k . The current then divides as follows: From dynamo, through wires 12 and 14, through armature lever K' , contact post k , wire 21, clear light G, and wires 22 and 23 to dynamo, thus showing that the mechanism in such section has operated. As the train passes off of such section, it is still necessary to show the white light, in order that the engineer may be notified of the fact that the section behind him has operated properly. The contact brush will then return to its normal position, as shown in train U', so that current will flow from dynamo I, through wire 12, magnet K, wire 13, brush H, contact post h , wires 24 and 23 to dynamo, sufficiently energizing the magnet K to keep its armature lever in the position shown. The current dividing, and running partially parallel, will leave wire 12, flow through wire 14, armature lever K' , contact post k , wire 21, clear light G and wires 22 and 23 to dynamo, thus indicating that everything so far is blocked behind.

The electro magnetic make and break mechanism at ground—to the right—is left in the position above described, and as shown at z' , would indicate to a train following—see description of Diagram 1 relating to section z —that there was a train ahead, and that it would be dangerous to proceed unless extreme caution was used. Supposing the train following, as in V', which had passed off of the auxiliary rail A^3 in a section Z^2 to the right of Diagram 2, and no circuit has been formed between such auxiliary rail and the ground, the electro-magnetic make and break mechanism in the lamp circuit would be left in its normal position, and the contact brush, H, in

contact with post *h*. Current would then flow from the dynamo, and having no ground connection would flow through wires 12 and 14, armature lever *K'*, contact post *k'*, wire 25, danger light *G'*, and wires 26 and 23 to dynamo, thus indicating that the mechanism behind had not worked to give the succeeding train the danger signal, so that if such train—which is in the lead—should stop at any time, it would be necessary to send back the train man with a danger signal. This danger signal would still continue, no matter what relation the contact brush, *H*, had with regard to its contact posts. As the train, *U'*, advances—so that its contact brush, *H*, comes into contact with the auxiliary rail, *A*³, in section *Y'*—current will flow from the dynamo through wire 12, and dividing flow in parallel, as above described. It will thus reach contact brush *H*, where it will flow through auxiliary rail, *A*³, in section *Y'*, wires 17 and 18, magnet *M* and wire 19 to ground. A current will then energize the magnet *M* to such an extent that it will draw the armature lever, *M'*, down until its spring contact, *m*, contacts the posts, *m'*. The larger portion of the current will then continue to flow through wire 17, spring contact *m*, post *m'*, back by wire 20, to magnet *N*, where it will flow through magnet, *N*, and wire 27 to ground. This current energizes magnet *N'* to such an extent that it pulls forward its armature lever, *N'*, against the action of its spiral spring, *n*, until its opposite free vibrating end contacts post, *n'*, when it will find a short circuit through wire 28, armature lever, *N'*, contact post, *n'*, and wire 29 to ground. This action releases the armature lever, *M'*, so that its spiral spring, *m*², will vibrate it and its spring contact, away from contact post *m'*, thereby breaking that circuit, and, as above described, give a clear light in the lamp circuit *U'*. Should the current be insufficient to energize the electro-magnetic mechanism in either of the mechanism boxes, *Y'* or *z*, insufficient current will flow to the ground; and, as stated in relation to the lamp circuit *V'*, the danger light would be ignited, thereby notifying the engineer or train-man that the mechanism to the rear had not operated properly.

The first set of auxiliary contact rails are located preferably in pairs, so that the last one is at the station, as indicated; while the second auxiliary rail is beyond the station, so that a succeeding train does not get a clear signal until the preceding train has proceeded at least half a mile from a station, though this arrangement may be modified to suit circumstances.

From the foregoing description, it will be evident that when the white or clear lights are burning, the devices are in order and no danger ahead to be indicated by this mechanism; and that the devices to the rear of the train have operated satisfactorily; but, when either of the clear lights go out and the colored light or lights burn, it is evident to the

train man or engineer that the system ahead is blocked, or a switch opened, and that the devices to the rear—which form the ground connections—have not operated satisfactorily. Further, should all of the lights go out, it is evident that the source of electric energy has dissipated.

Although we have described our improvements with more or less minuteness, and as being embodied in precise forms, we do not desire to be limited thereto unduly. On the contrary, we contemplate all proper changes in form, construction and arrangement, the omission of immaterial parts and the substitution of equivalents, as circumstances may suggest or necessity render expedient.

We claim—

1. A railway signal comprising a source of electric energy, an electro-magnet connected therewith, a make and break armature lever for such magnet connected with the source of electric energy and vibrating between two contact posts, a clear light electrically connected with one of such posts and the source of electric energy, a colored or danger light connected with the other post and source of electric energy, a vibrating movable ground contact piece electrically connected with the magnet and arranged to move between two contact posts, both of which are connected with the source of electric energy so that when the movable piece is in contact with one of such contact posts a circuit may be formed between the source of electric energy and the ground and when it is in contact with the other post an electric circuit may be formed from the source of electric energy to the magnet and by a return wire to the source of energy, substantially as described.

2. A railway signal comprising a source of electric energy, an electro-magnet connected therewith, a make and break armature lever for such magnet connected with the source of electric energy and vibrating between two contact posts and normally in engagement with one, a clear light connected with one of such posts and the source of electricity, a danger light connected with the other post and source of electricity, a movable ground contact piece electrically connected with the source of electricity through the magnet and arranged between two contact posts, both of which are connected with the source of electric energy so that when the movable piece is in contact with one of such contact posts a circuit may be formed from the source of electric energy through the magnet to the ground, and when it is in contact with the other post an electric circuit is formed from the source of energy, through the magnet, and by a return wire to the source of energy, and a second electro-magnet electrically arranged in multiple to the first named electro-magnet between the source of electric energy and the ground, with a locking lever arranged to lock the make and break armature lever in its normal position when such magnets are de-energized and to

release such make and break lever when the magnets are electrically energized, substantially as described.

3. In electrically actuated railway signal systems, a ground connection adapted to be used in connection with an electrically actuated signal and comprising an auxiliary contact rail, an electro-magnet interposed between it and "ground," a make and break armature lever for such magnet provided with an insulated contact portion, the lever or its insulated portion being electrically connected with the auxiliary rail, two contact posts between which the make and break armature lever vibrates, one of which is adapted to be electrically connected with the ground when contacted by the make and break armature lever, the whole so constructed and arranged that when current flows from the auxiliary rail to the ground the magnet is energized to draw down its make and break armature lever to form a ground connection of low resistance, substantially as described.

4. In electrically actuated railway signal systems, a ground connection adapted to be used in connection with an electrically actuated signal, comprising an auxiliary contact rail, an electro-magnet interposed between it and "ground," a make and break armature lever for such magnet provided with an insulated contact piece which is electrically connected with the auxiliary rail, two contact posts between which the make and break lever with its contact piece vibrates, one of which is adapted to be electrically connected with the ground when contacted by the make and break armature lever, so constructed and arranged that when current flows from the auxiliary rail through the magnet to the ground, the make and break armature lever with its contact piece is vibrated to close a ground connection of low resistance, and means for locking such make and break lever in its down position, substantially as described.

5. In electrically actuated railway signal systems, a ground connection adapted to be used in connection with an electrically actuated signal, comprising an auxiliary contact rail, an electro magnet interposed between it and "ground," a make and break armature lever for such magnet provided with an insulated contact piece which is electrically connected with the auxiliary rail, two contact posts between which the make and break lever with its contact piece vibrates, one of which is adapted to be electrically connected with the "ground" when connected by the make and break armature lever, so constructed and arranged that when current flows from the auxiliary rail through the magnet to the ground, the make and break armature lever with its contact piece is vibrated to close a ground connection of lower resistance, and a second electro-magnet provided with a vi-

brating armature lever for locking the make and break armature lever when such magnet is de-energized and release the make and break armature lever when such magnet is energized, substantially as described.

6. A railway signal system, comprising a source of electric energy and a primary set of electrically actuated signals arranged on a movable car and provided with a contact piece to close the electric circuit or circuits, a primary auxiliary contact rail arranged to be contacted by the primary contact on a movable car, a make and break armature lever provided with an insulated contact portion, the lever or its insulated portion being directly connected with "ground," a contact post electrically connected with the auxiliary rail and arranged to be contacted by one part of the make and break armature lever to form a circuit between the auxiliary rail and ground, so arranged that when such armature lever is resting in contact with its contact post a circuit is formed from the primary signal mechanism to the ground to actuate its clear signal, and when such ground connection is broken and the contact piece of the car is in engagement with the auxiliary rail current ceases to flow to the ground and the danger signal in the car is actuated, a second set of electrically actuated signals provided with a source of electric energy arranged adjacent to the primary set and provided with a second contact piece arranged to contact an auxiliary rail and close their circuits, a second auxiliary contact rail arranged to be contacted by the second contact piece, an electro-magnet interposed between such second auxiliary rail and ground to actuate the make and break armature lever, a wire connecting the second auxiliary rail and the portion of the make and break armature lever which is connected with ground, a second contact post arranged adjacent to the make and break armature lever and adapted to be electrically connected with the ground when contacted by the make and break armature lever to form a ground circuit of low resistance between the auxiliary rail and ground, so that when current flows from the second set of signals in the car to the ground the clear signal is actuated to indicate that the make and break armature lever has operated, and when such connection is broken current ceases to flow in sufficient volume to the ground and the danger signal in the car is operated, and a second electro-magnet provided with an armature lever to lock the make and break armature lever in its closed position when such magnet is de-energized and release it when such magnet is energized, substantially as described.

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Witnesses:

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THOMAS F. SHERIDAN.

Corrections in Letters Patent No. 539,529.

It is hereby certified that in Letters Patent No. 539,529, granted May 21, 1895, upon the application of Henry V. Miller, of Bloomington, and Alexander C. Miller, of Aurora, Illinois, for an improvement in "Electric Railway-Signals," errors appear in the printed specification requiring correction, as follows: In line 76, page 3, the word "own" should read *down*, and in line 58, page 5, the word "connected" should read *contacted*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 11th day of June, A. D. 1895.

[SEAL.]

JNO. M. REYNOLDS,
Assistant Secretary of the Interior.

Countersigned:

JOHN S. SEYMOUR,
Commissioner of Patents.