(No Model.)

3 Sheets—Sheet 1.

# J. B. STEWART.

## ELECTRIC AUTOMATIC BLOCK SYSTEM SIGNAL.

No. 533,926. Patented Feb. 12, 1895.

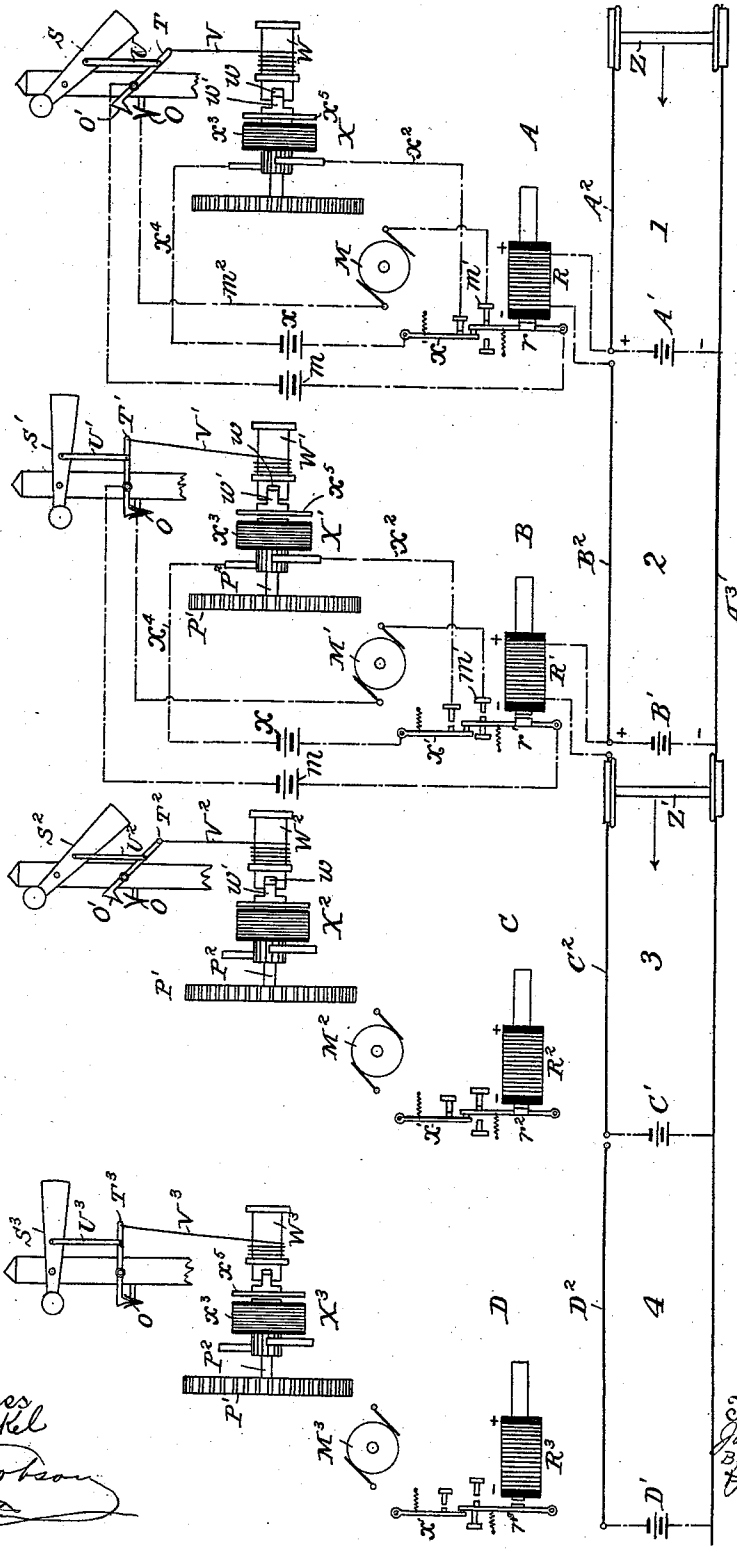

Fig. 1.

Witnesses
Jno. J. Hinkel
A. N. Dobson

Inventor
Jos. B. Stewart
By Foster Freeman
Attorneys

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# J. B. STEWART.

## ELECTRIC AUTOMATIC BLOCK SYSTEM SIGNAL.

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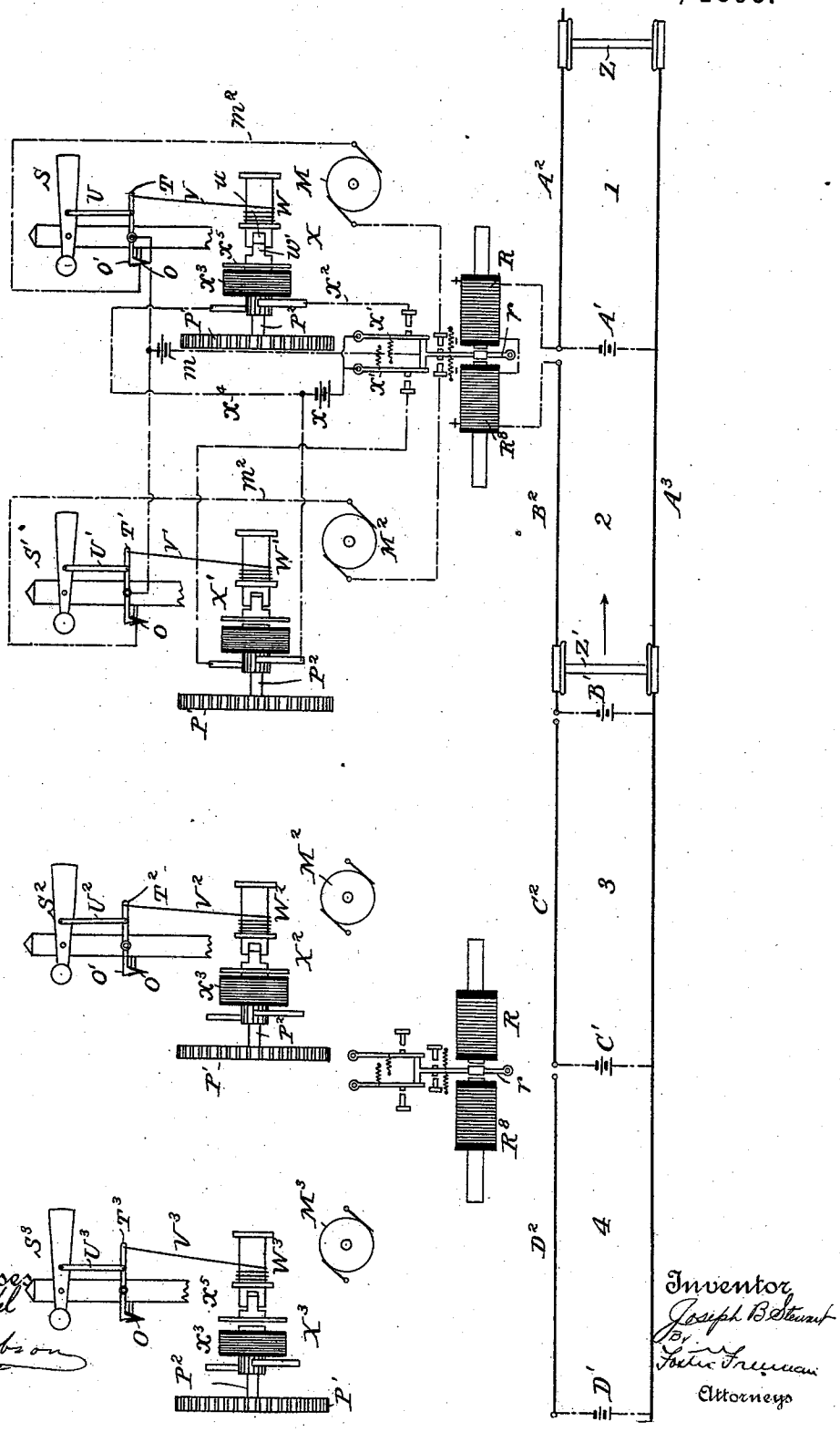

Fig. 2.

Witnesses
Jno. G. Hinkel
A. N. Dobson

Inventor
Joseph B. Stewart
By Louis Freeman
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 3.

# J. B. STEWART.

## ELECTRIC AUTOMATIC BLOCK SYSTEM SIGNAL.

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Fig. 3.

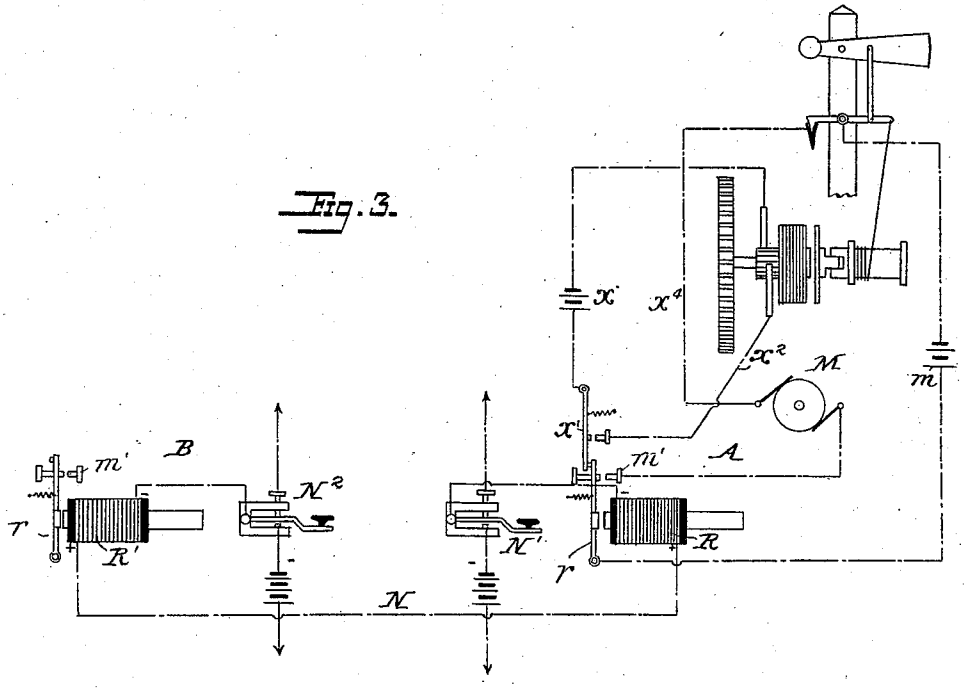
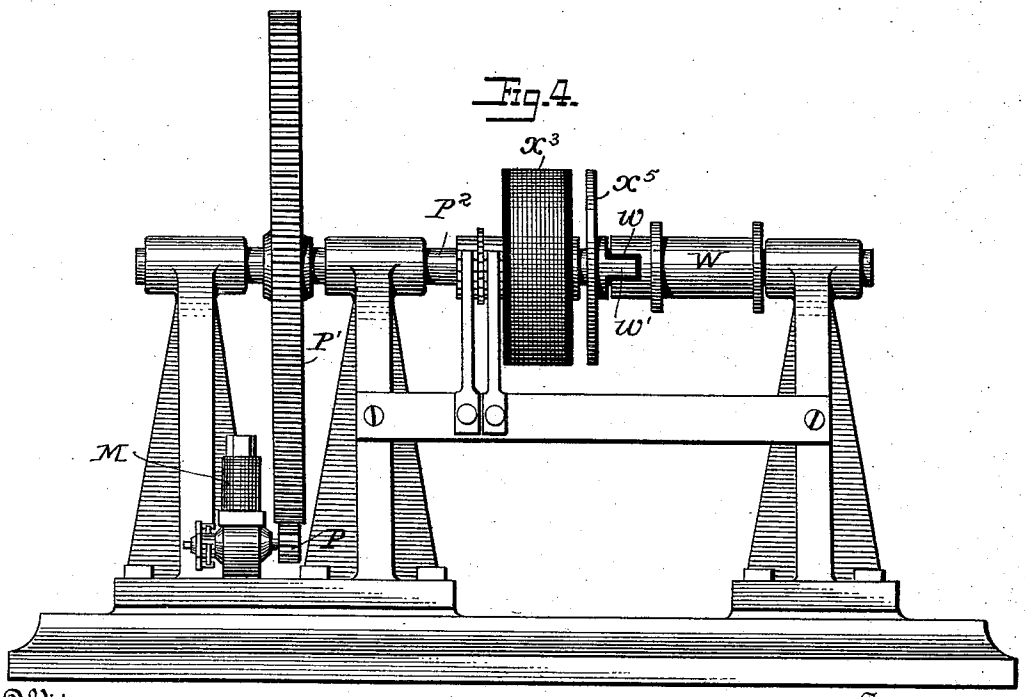



Fig. 4.




Witnesses
Jno. G. Hinkel
A. N. Dobson

Inventor
Joseph B. Stewart
By Foster Freeman
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

JOSEPH B. STEWART, OF HAVERSTRAW, NEW YORK.

## ELECTRIC AUTOMATIC BLOCK-SYSTEM SIGNAL.

SPECIFICATION forming part of Letters Patent No. 533,926, dated February 12, 1895.

Application filed March 8, 1894. Serial No. 502,898. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH B. STEWART, a citizen of the United States, residing at Haverstraw, in the county of Rockland and State of New York, have invented certain new and useful Improvements in Electric Automatic Block-System Signals, of which the following is a specification.

My invention relates to electric automatic block-signal systems, and it has for its object to provide a system of signals adapted more especially for railways, which shall be automatic in its operation and which shall have all the advantages of the block-signal system, and which shall be simple in construction, certain in operation, and not liable to get out of order, and to these ends, my invention consists in the various features of construction and arrangement of parts, substantially as hereinafter more particularly set forth.

Referring to the accompanying drawings, Figure 1, is a diagrammatic illustration of my invention, showing an arrangement of track circuits and signal circuits for automatically blocking trains following each other, as well as for protecting trains running in opposite directions. Fig. 2, is a similar diagrammatic drawing, showing an arrangement of circuits and signaling devices adapted more especially for a single track blocking in front and in rear of the train. Fig. 3, is a diagrammatic arrangement showing how the signals may be controlled by operators between signal stations through suitable line wires; and Fig. 4, is a side view, showing one form of apparatus including a motor, a clutch, and means for operating the semaphores.

Heretofore many devices and arrangements of devices have been suggested for signaling purposes, and especially for controlling railway trains, in some of which the signals were operated automatically by the passing of the train, or otherwise, and without attempting to set forth the full state of the art, I will proceed to describe the essential features of my present invention.

In nearly all the prior automatic signal systems in use, all circuits are normally closed, it being considered that such an arrangement was the best, in that if any portion of the circuit failed, the signal would go to "danger." In my present system, all the circuits are normally open, and the signals are normally at "danger" position, and if any part of the system fails, the signal cannot be changed to "safety," and in this way I accomplish all the results of the ordinary systems, and at the same time save the consumption of battery material, as the batteries are in action only while the train is on the section, and I give much more reliable service, insuring that unless everything is in its correct and normal position, and operating satisfactorily, the "danger" signals will remain exposed.

In carrying out my invention, I make use of a track circuit which is normally open, there being one electrically continuous rail throughout the system, while the opposite rail is electrically continuous throughout a section, but is divided by proper insulation at each section or station. The battery of each section is located at the distant end of the section, that is farthest from the signal apparatus to be operated thereby, so that if a rail is broken, or through any other cause the system is not in working order, the current cannot flow through the rails, and the signal cannot be set to "safety," and this gives more protection than a normally closed track circuit and effects a great saving of battery material and labor. A train passing over a section short-circuits the current and prevents a following train, or one approaching in the opposite direction, from using the battery, to get a clear or "safety" signal.

I make use of permanently magnetized relays, arranged to control the circuits of the signals, and the means of operating them, and the object of using these relays is to prevent a train which has already passed a signal, drawing the current from a section in its rear, through the relay, and thereby energizing it and causing it to hold the signal in "safety" position. This depends upon the well-known principle of permanently magnetized relays, in which when the current enters the coils so as to increase the power of the magnet already more or less charged, the relay will be operated; while if the current enters and passes through the relay in the reverse direction or in opposition to the polarization of the permanent magnet, the armature will not be attracted, but will be repelled.

All the track batteries of the system are

connected similarly to the rails, that is, with their negative or zinc elements connected to the continuous rail, and their positive or copper elements connected to the insulated rail sections, and the relays are connected between the ends of two adjacent rail sections. The relays may be arranged to operate a single set of signals and signal-operating devices, or there may be two sets of contacts controlling two sets of signals and signal-operating devices extending in opposite directions, and this is particularly useful in single track service, and in addition to or separately therefrom, circuits may be arranged whereby the operators at the different stations may control the signals in front or in rear, and while I prefer to use the track circuit alone and operate the signals automatically thereby, it is evident that they can be controlled by the operators alone, or in connection with the track circuit.

Any desired form of signal device or semaphores may be used, and I have illustrated in the present case a conventional form, the essential feature being that in its normal position it will stand at "danger," and will only be moved to "safety" when all the parts of the system operate correctly. I have shown the signal as being operated by an electric motor, the circuit of which is controlled by the track circuit and relay, and this motor in turn operates a clutch mechanism, which is connected with the signal device and moves it to "safety," it being automatically moved to "danger" when released from the operating power of the motor, in any suitable way, as by being counter-weighted, or otherwise. It will be understood, however, that it may be operated differently and by different means controlled by the track circuit and relays, and various forms of motors and connecting devices may be used in carrying out the broad principles of my invention. I have, however, in this case adopted an electric motor and an electric magnetic clutch device as being a simple, effective, quick, and accurately operating mechanism for controlling the position of the signal. I also arrange the parts so that when the signal has been brought to "safety" position, the circuit operating the signal or operating the motor controlling the operation of the signal will be automatically broken, so that the current operating the motor is used only during the time the signal is being moved, and is cut out and saved during the time the signal is held to "safety," by a small current energizing the magnetic clutch, and of course, is cut out when the signal is normally standing to "danger," so that the minimum amount of current is used in operating the signal.

With this general statement as to the main features of my invention, I will now proceed to describe the embodiment thereof illustrated in the drawings.

Referring more particularly to Fig. 1, 1, 2, 3, 4, &c., represent the track sections, and A, B, C, D, &c., the signal-operating devices at the respective signal stations. $A^2$, $B^2$, $C^2$ $D^2$, &c., represent one of the rails of each section, it being an electrically continuous rail throughout the section, but insulated from the adjoining sections, while $A^3$, represents the other electrically continuous rail, extending throughout the system.

A', B', C', D', &c., respectively, indicate the track batteries arranged between the extremities of one of the rail sections and the continuous rail, the negative pole of each of the batteries being connected to the continuous rail, and the positive pole of each battery being connected to the insulated section-rail.

R, R', $R^2$, $R^3$, &c., represent the polarized relays, the coils of which are connected to the adjacent terminals of two insulated track sections, and their armatures $r$, $r'$, $r^2$, $r^3$, &c., are arranged in the usual way between the stop devices, being biased by a spring or otherwise, so that they normally rest on their back or open contacts.

The signal devices S, S', $S^2$, $S^3$, &c., are shown in the form of weighted semaphores, which are arranged to normally assume a "danger" position and to retain such position until positively moved to a "safety" or clear signal position, and in the present instance, I have shown the semaphores connected to levers T, T', $T^2$, $T^3$, &c., by means of links U, U', $U^2$, $U^3$, &c., and to these levers are connected the cables, chains or similar devices V, V', $V^2$, $V^3$, &c., by means of which the semaphores are operated. In the present instance, I have shown drums W, W', $W^2$, $W^3$, &c., around which the cord or cable V, is wound to draw the signal down to "safety" position, and these drums are connected to suitable clutch devices X, X', $X^2$, $X^3$, &c., by means of which connection is made to a suitable motor, in this instance an electro-magnetic motor M, M', $M^2$, $M^3$, &c., by means of which the signals are operated. In this figure, the parts are shown displayed for the purpose of clearness in illustrating the various circuits.

The motor circuit includes a battery $m$, or other source of electric energy, which is connected by suitable conductors to the armatures $r$, and to the back contact $m'$, which in turn is connected to the brush of the motor M, while the other brush is connected by a circuit $m^2$ to the other pole of the battery, and includes a switch O. This switch as at present shown, comprises a socket-piece connected to one portion of the circuit $m^2$, and a finger or attachment O', secured to the lever T, arranged to fit into the socket when the lever is in its normal position, and to make sliding contact therewith, until just before the lever reaches its lowermost position, when it will break contact with the socket, thereby breaking the circuit of the electric motor.

The clutch mechanism is shown in the present instance as an electro-magnetic clutch

controlled by a separate circuit, in which there is a battery $x$, connected to an armature $x'$, controlled by the armature of the relay at each station, and thence through the conductor $x^2$, is connected to the electro-magnet or magnets $x^3$, mounted on the shaft of the motor, in the manner hereinafter described, and thence by the conductor $x^4$, leads to the battery or generator $x$. The clutch device also includes an armature $x^5$, shown in the form of a disk, which is loosely mounted on the shaft of the motor or other shaft propelled thereby, and which is attracted to the magnet or magnets $x^3$, so as to rotate therewith when the magnets are energized. This armature forms one member of the clutch device, and engages the drum W, and causes it to rotate when the armature is attracted, and rotated by the magnet.

While various means of connection may be employed, I have shown the drum as loosely mounted on the shaft, and as having notches $w$, into which one or more teeth $w'$, connected to the armature engage and slide. It is evident that they need not be entirely disengaged from the notches, but are so arranged that the armature will move freely.

In Fig. 2, I have shown a similar arrangement, more especially adapted for single track service, and for operating the signal ahead as well as in the rear, the track circuits, the motor and magnetic clutch devices being the same as in the double track or simple rear block system. The relay R, however, is provided with a double set of coils, permanently magnetized, and the armature $r$, is supported between the poles of the relay, and is provided with two springs so as to hold it normally out of contact with any of its contact points, but so that it can be drawn either to the right or the left as either coil R or $R^3$ of the relay is energized by a current in the proper direction, and there are two sets of signal devices, practically the duplicates of each other, connected to be operated by the armature as it is moved to the right or to the left, respectively, and these signal devices extend in front and to the rear, to control the approach of a train in either direction.

In Fig. 3, I have illustrated diagrammatically how the operators at the stations can control the signals, they being arranged so that the operator at one station cannot operate his own signal, but he must signal the operator at another station, who must in turn from his station operate the signal at the station of the first operator. In this case, the signal, the motor, the clutch and the drum are the same as before, and the relays R and R′, control the signals in the same manner, the only difference being that there is a line circuit N, extending between the relays, and having a double contact-key N′ or $N^2$, at each station, one contact being connected to ground directly, and the other to a battery and thence to ground, the batteries preferably being arranged with like poles to line, and the circuits are so arranged that the battery at one station, as at A, will not operate the polarized relay at that station, but will operate the relay at the opposite station, and vice versa. The battery at station B, will not operate its own relay, but will operate the relay at the opposite station, depending, of course, upon the direction of the current from the respective batteries through the polarized relays, so that in one case it adds to the strength of the relay, and in the other neutralizes the relay and tends to repel the armatures. Thus it will be observed that normally the line N, is without battery connection at either end, both ends being normally connected directly to ground, and the batteries are so arranged that when the key is closed at one station, the relay at that station will not be operated by the current from the battery at that station, but the relay at the distant station will be operated. Thus, suppose for instance, a train is approaching station A, and the operator depresses his key N′, connecting the line N to ground through the battery at station A, the current will flow from the minus pole of the battery through the key N′, through the relay R, in a direction to prevent its affecting its armature $r$, but through the relay R′ in a direction to operate its armature $r$ at station B, and thence through the key $N^2$ to ground. The operator at station B will receive the signal, and then depressing his key $N^2$, if the block is clear, it will connect the battery at station B to line, which passing through the relay R′ in the direction indicated will not affect its armature, but it enters the relay R in a direction to attract its armature $r$ passing thence to ground at station A. This will operate the armature $r$ at station A, closing the motor circuit and the clutch circuit as before, and this allows the motor to operate and put the signal to safety, where it will remain until the operator at station A, moves his key to break the circuit, or the operator at B opens the circuit, either of which will open the line circuit N, through the relay R, and allow the signal to go to safety. It will be understood that the keys N′, $N^2$, remain in whichever position they are placed until moved by the operator.

In Fig. 4 I have shown on an enlarged scale an arrangement of motor, clutch and drum device for operating the signals, such as I preferably make use of in my system, in which the motor M, is mounted in a suitable framework, and is provided with a pinion P, on its armature shaft, engaging a gear-wheel P′, mounted on the shaft $P^2$, to which the electro-magnets $x^3$, of the clutch are secured, so as to rotate therewith, the current being supplied to the clutch by suitable brushes, permitting the rotation of the magnets, and sliding loosely on the shaft $P^2$ is the armature $x^5$, of the clutch, engaging, by means of lugs and notches $w'$, $w$, the drum W, which is loosely mounted on the shaft, and while this is a simple and convenient arrangement, any other

equivalent construction and arrangement may be used, which will operate in substantially the same manner and produce substantially the same results.

Having thus described with sufficient clearness, the general construction and arrangement of parts necessary to the carrying out of my invention, I will proceed to describe its operation, under different conditions.

Referring to Fig. 1, Z, represents a train entering section 1, and the result thereof is that the battery A′, of this section is short-circuited through the wheels of the train, and the circuit of battery B′, of section 2, is closed through the rail circuit $B^2$, through the relay R, rail circuit $A^2$, train Z, and back to the battery through the continuous rail $A^3$, and the relay R, at station A is energized, causing its armature $r$ to close the contact $m'$ of the motor circuit, energizing the motor and rotating the shaft $P^2$, connected therewith and rotating the magnets of the electro-magnetic clutch. At the same time, the movement of the armature $r$, allows the contact $x'$, to close with its contact point, closing the circuit of the battery $x$, energizing the magnets $x^3$, which causes the armature $x^5$ to be attracted and to rotate with the shaft $P^2$, thereby causing the drum W to rotate and wind up the cord or cable V, drawing down the lever T, and with it moving the signal S, to "safety." As soon as the lever T, has been drawn down to its proper position, the contacts O and O′, of the motor circuit, will be broken, and the motor stopped, thereby saving battery power of the motor, and holding the drum in its proper position.

It will be observed that the circuit of the clutch remains closed as long as the track circuit through the relay R, is closed, thereby holding the signal in "safety" as long as the track is clear. As soon, however, as the circuit of relay R is broken, from any cause, its armature falls back, breaking the clutch circuit, and allowing the counter-weighted arm or other means to automatically restore the signal to "danger," the drum W, loosely rotating on the shaft $P^2$.

If the track circuits remain in proper condition, the signal will be held at "safety" until the train Z, passes station A, and runs into section 2, and as soon as this occurs, the circuit of battery B′, will be shunted or short-circuited through the train, releasing the relay armature, and breaking all contacts, demagnetizing the clutch and releasing its armature, so that the signal will immediately go to "danger."

It will be observed that as long as the train Z, is on section 2 of the track, a train following or entering on section 1, cannot get a clear signal, as the battery A′ of section 1, is short-circuited through the train, and the battery B′ of section 2 is short-circuited through the train in that section, and the signal will remain at "danger," and the train in section 2, is protected from the rear.

In order to better illustrate this action, we will assume that Z′, represents a train just entering section 3, and it will be seen that it short-circuits battery C′ of that section, which is necessary to operate the relay R′, to get a clear signal to the train entering section 2, as the batteries C′ and B′ will each be short-circuited by the trains in their respective sections.

It will further be observed that this same signal will protect a train entering any section from a head-on collision with a train running in the opposite direction, as for instance, if a train enters section 2, at its battery end, the battery B′ will be short-circuited, and the signal at station A will be held at "danger" and cannot be operated or set to "safety" by the train Z, entering section 1 from the opposite direction. This, of course, will give protection from head-on collisions to a certain extent, and sufficient for double track railways, but in order to use my invention on a single track railway, and protect both ahead and the rear of the train, I make use of the double relay shown in Fig. 2, having the armature between them and double contact points, and with this arrangement it will be seen that the train Z, entering section 1 will short-circuit the battery A′, and energize the coils of the relay R, through the current from battery B′, and cause the signal S to be set to "safety" in the usual way, the coils of the relay $R^8$ being so wound that the current from battery B′ will not energize it to operate the armature. If, however, a train should enter section 2, at its battery end, the battery B′ would be short-circuited and signal S would go to "danger," and if it entered section 2, before the train entered section 1, of course, the train on section 1 could not get a clear signal. The train entering section 2 at B, would close the circuit of battery A′, through the relays R, $R^8$, track section $B^2$ and track $A^3$ and as the current would flow through the coils of the relay R, in a direction opposite to that before, its magnet would not be energized to attract the armature, but the coils of relay $R^8$ would be energized and operated to set the signal S′. It will thus be seen that a train entering either section, would protect itself in front by preventing a train entering the opposite end of the next adjacent section getting a clear signal, and of course, as it enters the section, it protects its rear; as for instance, as soon as a train Z′, going in the direction of the arrow, passes from section 2, into section 1, it short-circuits battery A′, and energizes relay R, from battery B′, setting the signal S to "safety" and holding the armature in such a position that the train following and entering section 2, at its battery end cannot get a clear signal at S′, as the battery B′ is short-circuited by said train,

and the battery A′ is short-circuited by the train in section 1. It will thus be seen that under no circumstances can the trains be nearer than one section without passing a "danger" signal.

From this general description of the operation it will be seen that my invention can readily be applied to a single or a double track, and that it is automatic in its operation, and constitutes a practical block system; that the circuits are normally open and are only closed when actually used to control and hold a signal to "safety," thus requiring a minimum amount of battery power. Further than that, it will be seen that the signal at one station is operated by a battery at the extreme end of the next preceding section, and if the track is not in condition, from any cause, a clear signal cannot be obtained.

It is evident that some of the features of my invention may be used separately or in connection with other equivalent devices, and that they may be arranged and combined by those skilled in the art, to meet the exigencies of any particular system of tracks and still embody the essential features of my invention, and accomplish the objects aimed at to a greater or less extent, and I do not, therefore, limit myself to the precise construction and arrangement of parts herein set forth, they being given as illustrative of the principles of my invention.

What I claim is—

1. In an electric automatic block signal system, the combination with the normally open track section circuits, of batteries, one at the end of each track section circuit, and polarized relays, one terminal of each relay being connected to one track section circuit at the end most distant from its battery, and the other terminal being connected to the end of the adjacent track section circuit at a point opposite its battery, and all the batteries being arranged with their like poles in the same direction and the connections being such, substantially as described, whereby the polarized relays operate only from the circuit from the battery at the next station ahead, substantially as described.

2. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of normally open circuits controlling the signal devices, normally open track section circuits, a battery at the end of each track section circuit, all the batteries having like poles in the same direction, a polarized relay controlling the signal circuits, one terminal of which is connected to one track section circuit at the end most distant from its battery, and the other terminal being connected to the end of the adjacent track section circuit at a point opposite its battery, and all the batteries being arranged with their like poles in the same direction and the connections being such, substantially as described, whereby the polarized relay operates only from the circuit from the battery at the next station ahead, substantially as described.

3. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of normally open track circuits including the rails of the track sections, batteries arranged at the ends of the track sections, polarized relays connected between the adjacent ends of the rails of the track sections the arrangement of the batteries and circuits being such that the relay at any station cannot be operated by the battery at that station, but as soon as a train reaches the section it short-circuits the battery of that station and operates the relay through the battery from the next preceding station, and when the train passes the first station it short-circuits the battery of the next section preventing the relay being operated until it has passed out of the second section, substantially as described.

4. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open circuit comprising an electrically continuous rail, a series of electrically continuous section-rails, the sections being insulated from each other, and batteries interposed between the continuous rail and each section, the like poles of the batteries being connected to the continuous rail, substantially as described.

5. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open circuit comprising an electrically continuous rail, a series of electrically continuous rail sections, the sections being insulated from each other, a series of batteries having like poles connected to the electrically continuous rail and their other poles connected to one end of a sectional rail, and a relay connected to the adjacent ends of two sectional rails, substantially as described.

6. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open circuit comprising an electrically continuous rail, a series of electrically continuous sectional rails insulated from each other, batteries having their like poles connected to the continuous rail and their other poles connected at one end to a sectional rail, and a polarized relay connected at the other end of the sectional rail and to the next adjacent sectional rail, substantially as described.

7. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open rail circuit comprising an electrically continuous rail, a series of electrically continuous sectional rails insulated from each other, batteries having like poles connected to the continuous rail and connected to one

end of a sectional rail, relays connected at the other end of the rail section and to the adjacent end of the next rail-section, and signal devices controlled by said relays, the arrangement being such that a train entering one section will short-circuit the battery of that section and operate the relay by the battery at the far end of the next section, substantially as described.

8. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open rail circuit comprising an electrically continuous rail, and a series of electrically continuous sectional rails insulated from each other a battery connected at one end of each section of the circuit, and a polarized relay connected between the adjacent ends of two sections, the arrangement being such that the relay will be operated by the battery at the distant end of a rail section, but will not be operated by the battery at the adjacent end of the section, substantially as described.

9. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open circuit comprising a series of sections and a battery for each section, a double polarized relay connected between the adjacent ends of two sections, and two sets of signal devices connected to be operated by said relay, the arrangement being such that one set will be operated on closing the circuit of one section and the other set by closing the circuit of another section, substantially as described.

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

JOSEPH B. STEWART.

Witnesses:

GEO. W. WEIANT,

IRVIN KINNEY.