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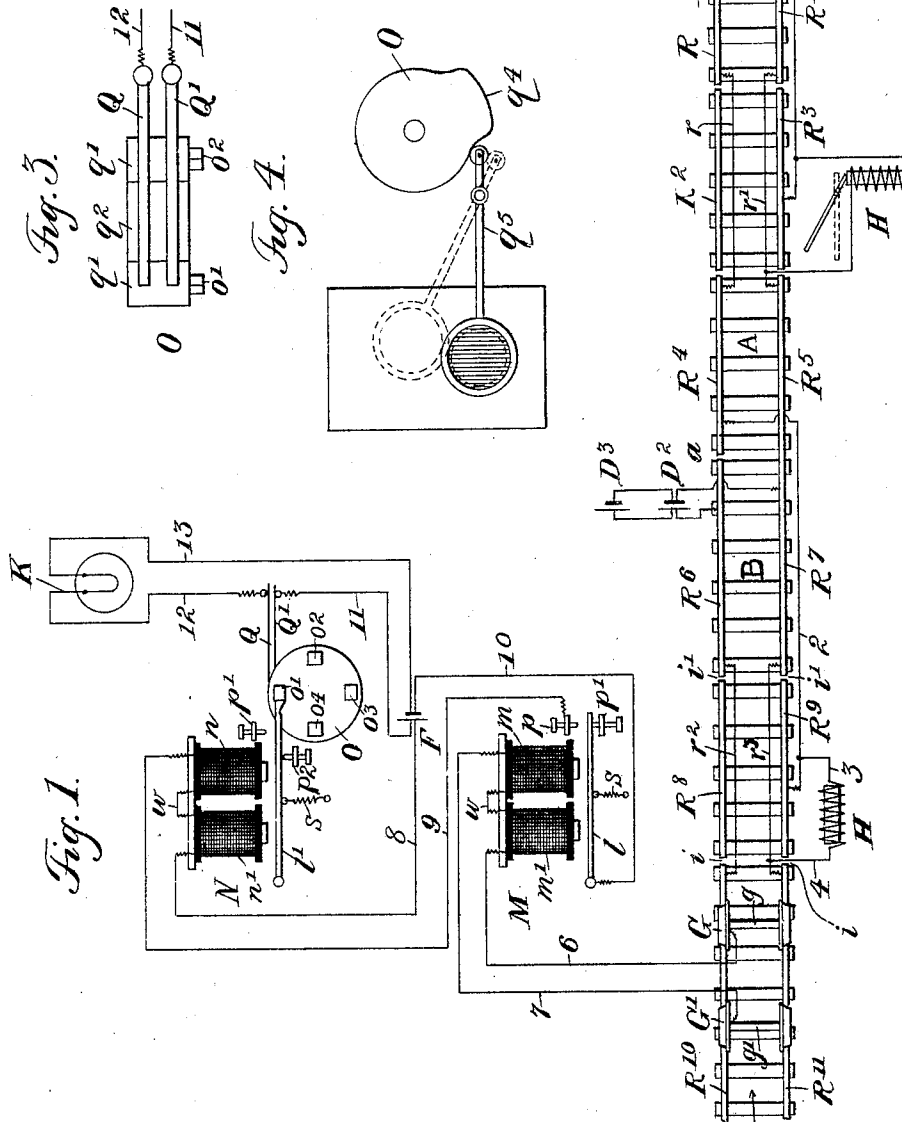
PATENTED AUG. 21, 1906.

H. W. SPANG.

ELECTRIC CIRCUIT AND APPARATUS FOR RAILWAY SIGNALING.

APPLICATION FILED AUG. 21, 1902.

2 SHEETS—SHEET 1.



WITNESSES:

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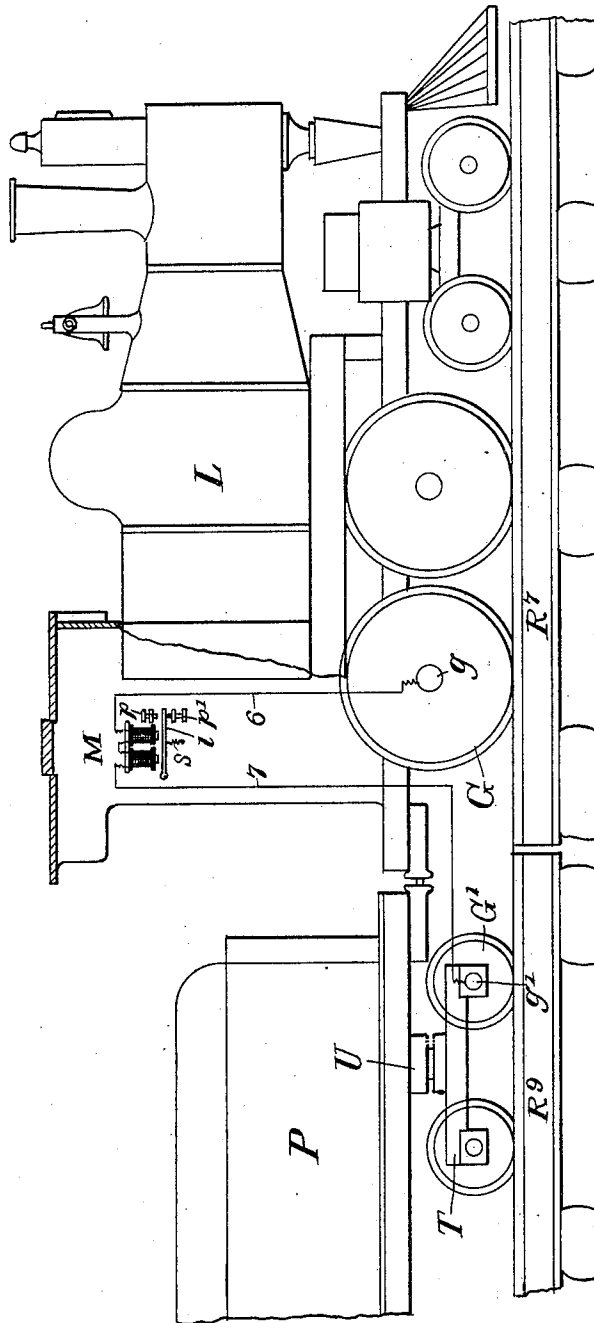
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Fig. 2.



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UNITED STATES PATENT OFFICE.

HENRY W. SPANG, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO CHARLES H. KETCHAM, OF YONKERS, NEW YORK.

ELECTRIC CIRCUIT AND APPARATUS FOR RAILWAY SIGNALING.

No. 828,980.

Specification of Letters Patent.

Patented Aug. 21, 1906.

Application filed August 21, 1902. Serial No. 120,447.

To all whom it may concern:

Be it known that I, HENRY W. SPANG, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric Circuits and Apparatus for Railway Signaling, of which the following is a specification.

My invention relates to electric circuits and apparatus designed more particularly for use in railway signaling; and its object is to provide improved circuits and devices whereby an electromagnet upon some portion of the rolling equipment may be controlled or operated for the purpose of giving a signal or for any other desired purpose. Said electromagnet, as well understood in the art, may be a relay-electromagnet which controls a local circuit or may operate directly upon the visual or audible signal or directly upon any other device whose action is to be controlled.

It has before been proposed in railway signaling to place an electromagnet upon a locomotive, together with a suitable battery, and to connect the terminals of the partial circuit containing said battery and electromagnet, one with a wheel or wheels of the rolling equipment and the other with other wheels of the equipment insulated from the first in the moving equipment itself, but electrically connected with one another by the rails on which they move, excepting when they bear, respectively, upon different rails or sections of rails insulated from one another and themselves connected with another part of the circuit controlled by a relay-electromagnet on the permanent way, which in turn has its coils joined to any suitable control or guard circuit. In such a system the condition of said guard or control circuit controls the position of the relay-armature, and the latter by closing or breaking the connection between the aforesaid rails or sections of rails insulated from one another governs the action of the magnet upon the rolling equipment when the car or train of cars reaches said rails. Such a system is objectionable for two reasons: First, the relay-lever is liable to stick to the circuit-closing stop, especially during thunderstorms, thereby giving a false signal on the locomotive; second, the magnet upon the rolling equipment is constantly energized, excepting when it reaches the point where

the insulated sections of rail controlled by the relay-lever are located, this being due to the fact that the rails of the track are usually bonded in some way or other and form a closed connection between the terminals of the partial circuit on the train in those cases where said circuit terminates in wheels moving over the same line of rails. If the attempt be made to control the action over sections of rail lying, respectively, in opposite sides of the track, then the magnet is constantly energized through the circuit normally completed through the axles. This is very objectionable, because the magnet is apt to become so strongly charged that it will be prevented by its residual magnetism from responding to any break in its circuit.

One of the objects of my present invention is to avoid these objections to the use of a magnet on the rolling equipment controlled over a circuit herein termed a "partial circuit" and terminating in wheels on the rolling equipment; and to this end my invention consists, substantially, in removing the battery or generator from the car or locomotive and placing it in the portion of the circuit upon the permanent way which terminates directly in the sections of insulated rail or rails, insulated from one another and adjacent rails, and by engagement with which the wheels of the rolling equipment complete the connection from the battery through the partial circuit upon the locomotive or train, and thereby completing a guard-circuit.

By the term "guard-circuit" as herein used I mean to include a section of railway-track forming one of the blocks of a block system or any circuit controlled directly by a railway-switch, drawbridge, or signalman and having the battery or generator either on normally open or normally closed circuit and complete or incomplete at some other points than the terminals formed of the aforesaid insulated rails or rail-sections. My invention is, however, especially useful in those systems wherein the guard-circuit embraces the rails of a section of track and the action of the magnet on the car or locomotive depends upon the condition of such section or the presence thereon of a car or locomotive, and my invention in this respect affords a simplified and reliable means whereby a railway may be laid off according to the block system and a signal be given

upon the locomotive of a train to indicate "safety" or "danger" to the engineer.

Another part of my invention relates to means whereby the momentary action of the armature of an electromagnet momentarily energized by the passage of a train over any track-circuit closer may produce a prolonged closure of a circuit containing a signal device of any desired character—such, for instance, as an electromagnet and the usual associated visual arm or indicator or an incandescent lamp. This part of my invention consists, substantially, in the combination, with the circuit on which the prolonged closure or interruption of continuity is to be produced and the electromagnet momentarily energized, of an intermediate circuit closer and breaker driven by any suitable power and having insulating and conducting surfaces of any desired extent suitable for the purposes and means connected with said electromagnet whereby the same may release or bring said driving power into action and then again after a suitable interval bring the same to rest ready for another operation of said electromagnet.

The invention consists, further, in the novel combination, with the portion of guard-circuit on the permanent way, including battery terminating in insulated rails or short sections of track over which the connection is completed with the partial circuit on the locomotive or other part of the rolling equipment, of an artificial resistance connected in such manner to the said portion of the guard-circuit on the permanent way as to keep the same in normally closed circuit through said resistance, and thereby preserve the gravity or other closed-circuit type of battery in working order, all combined as hereinafter described and operating in such manner that said resistance will be shunted when the wheels of the moving equipment complete the circuit for the magnet on the locomotive or car.

The invention consists, further, in utilizing said resistance as a means for giving a signal or indication upon the permanent way to the engineer of the train in addition to that given by the action of the magnet on the car or locomotive, which may be done by employing the coils of an electromagnet as the artificial resistance and then operating an indicator by the said magnet or by a magnet or other device in a relay-circuit controlled thereby. In carrying out this part of my invention the indicator controlled or operated by said resistance would preferably be so located as to be in view of the engineer before he reaches the point where the magnet on the train is operated, so that the condition of said indicator when it comes into view will indicate the condition of the guard-circuit, and thereby give an additional indica-

tion before the indication given by the magnet on the rolling equipment.

In the accompanying drawings, Figure 1 is a diagram illustrating one form of my invention as applied to one track of a double-track system in which the trains always move in one direction, as indicated by the arrow, the second or return track not being illustrated herein. Fig. 2 is a side elevation of a locomotive and tender, illustrating the portion of electric circuit thereon. Fig. 3 illustrates a portion of signal-circuit closer. Fig. 4 shows a modification in a detail of the devices for giving a prolonged signal on the locomotive.

A is a section of track which may be a mile long, more or less, and having one line of its rails separated from metallic contact with the adjacent line of rails of the adjacent sections B and C, as shown at ends *a* and *a'*. Rails *R R' R² R³ R⁴ R⁵* constitute section of track A, and rails *R⁶ R⁷ R⁸ R⁹ R¹⁰ R¹¹* constitute section of track B. Rails *R² R³* of section A and rails *R⁸ R⁹* of section B are insulated from the adjacent rails of their respective sections. Each line of rails *R R' R⁴ R⁵* of section A and rails *R⁶ R⁷ R¹⁰ R¹¹* of section B should have metallic continuity throughout its length by means of suitable metallic bonds or connectors at the rail-joints thereof. Rails *R, R', R⁴, and R⁵* of section A are connected together by connectors *r r'*, and rails *R⁶ R⁷ R¹⁰ R¹¹* of section B are connected together by connectors *r² r³*. Rails *R⁵ and R⁷* of sections A and B are metallically connected together, and rails *R'* of section A are metallically connected with adjacent rails of section C, thereby making with connectors *r' r³* a continuous line of rails of the railway, the opposite line of rails thereof with connectors *r r²* being divided by the insulations at ends *a a'* of each block into sectional lines of rails.

G is a pair of wheels and axle upon a locomotive, tender, or car insulated from another pair of wheels, as at G', upon the same or another part of the rolling equipment. One set of wheels may be on the locomotive and the other on the tender or a truck of an adjacent car, or said wheels may be respectively on different trucks of the same car or of different cars, the only requirement being that in the rolling equipment itself wheels G and G' shall be insulated from one another.

Each of insulated rails *R⁸ R⁹* of section B and *R² R³* of section A can be a single rail or two or more bonded rails, according to the distance employed between wheels G and G', and having their insulations *i i'* or separations preferably opposite one another, as shown in Fig. 1. The insulated rail or section of rail *R⁹* forms one terminal of the portion of guard-circuit consisting of the block or section of track A ahead, and the adjacent

sections $R^7 R^{11}$ in section B constitute the opposite terminal of said portion of guard-circuit. The said insulated rail and sections of rail when bridged by wheels $G G'$ constitute a track-circuit closer for closing connection between a magnet M on the locomotive and the battery or batteries connected to the track-section, thereby forming the guard-circuit. Insulated rail R^3 in section A forms one terminal of the portion of guard-circuit consisting of the rails of track-section C, and rails $R^3 R'$ in section A constitute the other terminal of said portion of guard-circuit. Such insulated rails are preferably selected at a suitable point ahead of the near end a of section of track A or C, so that when either of wheels G or G' , moving in the direction of arrow, contact with rails $R^8 R^9$ of section B or with rails $R^2 R^3$ of section A and section A or C is clear a safety-signal will be given upon the locomotive at a safe distance ahead of the near end a of such preceding section.

$D D'$ are gravity batteries or cells connected in multiple. In some cases they can be connected in series, and in other cases a single cell can be employed for a section of track.

H is a resistance inserted, as shown, between one side of the track section or circuit and the return or opposite sides and serving to keep the batteries on constant closed circuit, and thereby in proper working order. It also when of sufficient resistance will serve as an impedance or choke coil and cause stray or induced current in the rails to discharge into the adjacent ties, ballast, and earth.

Resistance H , as indicated at the right side of Fig. 1, may be a relay or electromagnet controlling a visual signal or a current-indicator after the manner well known in the art.

M is a relay-magnet of suitable type consisting of helices $m m'$, connected by wire w , armature-lever l moving in one direction and making contact with stop p when said helices are energized and in the opposite direction by gravity or spring s , or both, and making contact with stop p' when said helices are deenergized. Magnet M is upon a locomotive L , Fig. 2, and is connected by wire 6 to a suitable metallic part thereof which is in metallic or good electrical connection with axle or axles g of wheels G thereof and by wire 7 to a suitable metallic part of a truck T or T' of the tender P , through which the connection is completed with the axle or axles g' of the wheels G' , the truck being insulated from the metal portion of tender P by wooden beam U or U' , and hence also from the locomotive. If the beams of the tender P are of metal or the locomotive and tender are combined, it is evident that wire 7 must be connected with a suitable part of

the truck of an adjacent baggage, express, or other car, or wires 6 and 7 can be connected, respectively, to suitable metallic parts of the front and rear trucks of such car adjacent to tender or locomotive, or, respectively, to a truck of two different cars of a train, such wires being attached to or supported by the air-brake hose or bell-cord of forming part thereof or connected with relay M upon locomotive and trucks in any other convenient and substantial manner.

N is the control-magnet for a circuit-closer adapted to close a signal-circuit for a suitable length of time and giving a signal to the engineer upon locomotive after magnet-helices $n n'$ have been momentarily energized by battery F .

O is a circuit making and breaking wheel driven by any suitable means and provided with stop-pins or detents $o' o^2 o^3 o^4$, one of which normally engages the end of armature-lever l' when helices $n n'$ are deenergized and said lever rests against stop p^2 . When the helices are energized and lift the lever against stop p' , the pin o' is released, and the wheel then revolves gradually in the direction of the arrow, and contact-springs $Q Q'$, which normally touch insulation q' upon the periphery of said wheel, as shown in Fig. 3, touch the metal portion q^2 of the wheel and close the circuit of battery F through incandescent lamp K or other device until pin o^2 engages end of armature-lever l' , which in the meantime has returned to stop p^2 . This gives a prolonged closure of circuit to device K in response to the momentary action of armature-lever l' . Batteries $D D'$ are normally closed over wire 1, rails R , wire r , rails R^4 , wires 2 and 3, resistance H , wires 4, r^3 , rails $R^7 R^8$, wire r' , rails R' and wire 5.

When wheels G make contact with rails $R^8 R^9$ and wheels G' make contact with rails $R^{10} R^{11}$ or when said wheels make contact, respectively, with rails $R^6 R^7$ and with rails $R^8 R^9$, the current from the batteries $D^2 D^3$ will be shunted by the wheels and axles upon the rails $R^{10} R^{11}$ or $R^6 R^7$, and therefore cannot energize magnet M . When wheels G contact with rails $R^8 R^9$ and wheels G' contact with rails $R^{10} R^{11}$ and section of track A is clear, the current of the batteries $D D'$ will flow over wire 1, rails R , wire r , rails R^4 , wire 2, rail R^9 , wheels G , wire 6, magnet M , wire 7, wheels G' , rails R^{11} , wire r^3 , rails R^7 and R^8 , wire r' , rails R' and wire 5, and magnet M will be momentarily energized and its lever will make contact with stop p and momentarily close circuit of battery F through helices of magnet N , thus momentarily actuating the lever l' and allowing wheel O to revolve and produce a prolonged closure of circuit through the lamp K or other indicator to give the safety-signal. As $R^2 R^3$ of section A are but single rails or short sections, it will ordinarily be impossible for all the wheels of a lo-

comotive and tender in that block to occupy them, and hence batteries D D' will then be shunted and cannot energize magnet M and cause a safety-signal to be given on another locomotive passing over rails R⁸ R⁹. Should a signal be given upon the locomotive before reaching the track-circuit closer R⁹, the engineer will know that the lever of relay-magnet M has stuck to contact *p* or that circuit-closer N or other part of the apparatus is out of order. Hence under this system the engineer cannot be misled by a defective relay-magnet or defective signal mechanism.

It will be noticed that when the magnet M is energized the resistance H is in shunt or derived circuit with said magnet across the two sides of the guard-circuit charged by the battery; but with proper proportioning of the resistance of H and coils of M sufficient current will flow in the latter to energize the same and lift the armature *l*.

When resistance H comprises the coils of an electromagnet, said magnet may operate a visual indicator, as indicated at the right of the figure, or said electromagnet may control the local circuit of a visual signal or current-indicator, as well understood in the art. The signal thus given or controlled by resistance H is preferably placed so as to come into view of the engineer before the signal K on the locomotive is operated. The signal given by indicator H will in such cases obviously show whether the track-circuit is intact or whether it is occupied or not by a locomotive or car, and a double safeguard is thus provided against the entrance of the train into the block ahead.

It will be observed that normally, or when the wheels G G' are running upon sections of rail not insulated from one another, as R¹⁰ R¹¹ R⁶ R⁷, the magnet M will be shunted by said wheels and such sections of rail, and that, consequently, will not then be affected by stray or induced currents of electricity in the rails.

In some cases magnet M can be dispensed with and wires 6 and 7 connected directly with helices *n n'*. It is obvious that my improved circuit and apparatus are applicable to the case of a guard-circuit normally open and controlled by a switch, drawbridge, or signalman. Wire 2 can also be connected with rail R⁸. I do not confine myself to the employment of a continuous line of rails in connection with an insulated rail R⁹ and wheels G G' for completing a guard-circuit, as rails R⁵ R' of section A can be insulated at ends *a* and *a'* and rails R⁵ connected by a wire to an insulated rail or rails adjacent to rail R⁹.

It is also obvious that my invention is not confined to the particular arrangement of insulated rails or sections of rails constituting the track-circuit closer herein shown and described, nor is it limited to the particular means described for securing a prolonged ac-

tion of the signal upon the locomotive in response to a momentary action of an electromagnet energized directly or indirectly upon the rolling equipment through closure of circuit on the track-circuit closer.

I prefer generally to have the wheel O produce a prolonged action of an electric battery or generator, although it would obviously be within my invention to permit said wheel to produce a prolonged mechanical action—as, for instance, by means of a cam thereon used in place of the conducting metal *q*². This is indicated in Fig. 4, wherein the cam referred to is marked *q*⁴, while *q*⁵ indicates the arm of a signal-disk thrown into view to indicate "safety" by the action of the cam upon the short end of the lever *q*⁵.

Resistances H can be dispensed with, especially by properly employing an electric generator with a number of track or guard circuits.

I apply the term "guard" to a primary or main circuit which embraces a relay or electromagnet energized by the current of a generator included in a rail or any other circuit of a block-section and under the control of a train or when included in a primary circuit having a circuit-controller operated by a railway-switch, drawbridge, or signalman, such relay or magnet controlling a secondary or signal circuit or directly controlling a signal or other device upon the rolling equipment.

I am aware of United States Patents No. 672,626, April 25, 1901, and No. 709,040, September 26, 1902, in which is employed upon a locomotive an armature-lever controlling signal-circuits actuated by two opposite magnets which respectively terminate in two and three sets of insulated wheels of the rolling equipment, the said magnets upon locomotive being energized by a generator located upon the permanent way when the said insulated wheels bridge insulated sections of rail. The said magnets and battery constitute a local circuit confined solely to a point ahead of the near end of the block-section to be guarded, and such local circuit is controlled by guard-circuits wholly along the permanent way. I do not claim such a combination.

I claim, broadly, a guard-circuit, partially along the permanent way and partially upon the rolling equipment, which is completed when two sets of insulated wheels of the rolling equipment bridge insulated rails of the permanent way preferably located at a suitable distance ahead of the portion of said circuit embracing block-section, railway-switch, &c., to be guarded.

I claim as my invention—

1. In a railway signal system, a guard-circuit for controlling a signal upon a locomotive, comprising a portion thereof upon the rolling equipment containing a controlling relay or electromagnet and terminating in wheels of said equipment, insulated from one

another, and a portion thereof upon the permanent way containing a battery connected at one end of a track-section with its two lines of rails and terminating in insulated rails or sections of rail of a preceding section which when bridged by said wheels complete said guard-circuit.

2. In a railway signal system, a guard-circuit for controlling a signal upon a locomotive, comprising a portion thereof upon the rolling equipment containing a controlling relay or electromagnet and having one terminal connected with a wheel or wheels of the rolling equipment, and the other terminal with another wheel or wheels of the rolling equipment insulated from the first in the moving equipment itself, and a portion thereof upon the permanent way containing a battery connected at one end of a track-section with a sectional line of rails and terminating in insulated rails or sections of rail of a preceding section, and also with a continuous line of rails of the railway, so that when said insulated rails and adjacent portion of the continuous line of rails are bridged by said wheels of the rolling equipment said guard-circuit will be completed.

3. In a railway signal system, a guard-circuit for controlling a signal upon a locomotive comprising a portion thereof upon the rolling equipment containing a controlling relay or electromagnet and terminating in wheels of said equipment, insulated from one another, and a portion thereof upon the permanent way containing a section of railway-track constituting a block of a block system, a battery or generator having its opposite poles connected to the opposite rails of said block-section at farther end thereof, insulated rails or sections of rail connected to the said opposite rails at the near end of said block-section to constitute a circuit-closer for completing said guard-circuit when bridged by the said wheels of the rolling equipment.

4. The combination substantially as described, of a railway signal guard-circuit charged normally by a battery on the permanent way and normally closed through a resistance, an electromagnet on the rolling equipment, and a track-circuit closer for placing said electromagnet in circuit with the generator but in multiple with said resistance and connections from said electromagnet to the elements of the track-circuit closer carried by the rolling equipment.

5. In a railway signal apparatus, the combination substantially as described, of an insulated section of track, a generator or battery having its circuit normally closed through the rails of said section and through a suitable resistance, an electromagnet on the rolling equipment included in a partial circuit which terminates in normally insulated wheels of said equipment, and insulated

rails or section of rail adapted to place said electromagnet in multiple with the resistance through said wheels, as and for the purpose described.

6. The combination with a guard-circuit, of a railway electric signal apparatus, of a battery on normally closed circuit through a suitable resistance, means operated or controlled by such resistance for indicating the condition of the circuit, a track-circuit closer adapted to establish a shunt or branch around said resistance, and a partial circuit on the rolling equipment containing an electromagnet and terminating in wheels adapted to include said electromagnet in the shunt or branch.

7. The combination with a signal upon a locomotive or other part of the rolling equipment, of portion of a guard-circuit upon said equipment containing an electromagnet and terminating in wheels insulated from one another in the rolling equipment, insulated rails or sections of rail of a railway-track over which said wheels pass for the purpose of momentarily completing the guard-circuit and energizing the said electromagnet by the generator contained in the portion of guard-circuit along the permanent way and mechanism controlled by said electromagnet and acting in response to the momentary operation thereof, for producing a prolonged action of the signal but of limited duration predetermined by the action of said mechanism.

8. The combination with a signal-circuit upon a locomotive or other part of the rolling equipment, and an intermediate circuit closer and breaker controlling said circuit, of portion of a guard-circuit upon said equipment containing a relay-magnet and terminating in wheels insulated from one another in the rolling equipment, insulated rails or sections of rail of a railway-track, over which said wheels pass for the purpose of momentarily completing the guard-circuit and energizing the said relay-magnet by the generator contained in the portion of guard-circuit along the permanent way and thereby releasing said intermediate circuit closer and breaker which in passing from one position of rest to its succeeding position of rest, produces a prolonged action or change of condition of said signal-circuit.

9. A locomotive having a partial guard-circuit containing a signal-controlling relay or electromagnet M, and terminating in wheels G, G', insulated from one another in the rolling equipment, which serve when bridging insulated rails R⁹, R¹¹, or R⁷, R⁹, of block-section B to complete a guard-circuit embracing the two lines of rails of adjacent block-section A and batteries D, D', or other generator connected therewith at the farther end of said section.

10. In a railway signal system, a guard-circuit for controlling a signal upon a locomotive

tive comprising a portion thereof upon the rolling equipment containing a signal-controlling relay or electromagnet and terminating in wheels of said equipment insulated from one another, and a portion thereof consisting of batteries D, D', or other generator, rails R, R', R⁴, R⁵, and connecting conductors r, r', of block-section, A, and rails R⁷, R¹¹, and insulated rail or section, R⁹, of block-section, B, which when bridged by said wheels of the rolling equipment complete said guard-circuit.

11. A railway-track, having a continuous line of rails and a sectional line of rails, divided into block-sections, each block-section, B, having two insulated opposite rails, R⁸, R⁹, so adapted that when insulated rail, R⁹, and the continuous line of rails are occupied by insulated wheels G G' of the rolling equipment a guard-circuit will be completed consisting of signal-controlling magnet M upon the rolling equipment, wheels G, G', batteries D, D', of adjacent section A and connecting rails and conductors of sections A and B, as set forth.

12. In a railway signal system, a guard-circuit for controlling a signal upon a locomotive, comprising a portion thereof upon the rolling equipment containing a controlling relay or electromagnet and having one terminal connected with a wheel or wheels of the rolling equipment, and the other terminal with another wheel or wheels of the rolling equipment insulated from the first in the moving equipment itself, and a portion thereof upon the permanent way containing a battery connected with a continuous line of rails and with insulated rails or sections of

rail of a railway-track, which with the adjacent portion of said continuous line of rails when bridged by said wheels of the rolling equipment constitute a circuit-closer for completing said guard-circuit ahead of the guarded portion of circuit on the permanent way.

13. The combination substantially as described of one of two opposite insulated rails or short sections of rails of a railway-track and the adjacent portion or portions of a continuous line of rails and insulated wheels of the rolling equipment coöperating therewith to form the elements of a circuit-closer, as and for the purpose set forth.

14. In a railway signal apparatus, the combination with a partial circuit upon the permanent way consisting of a generator connected respectively with two opposite insulated rails or sections of rails of a railway-track and adjacent portion or portions of one line of rails of said railway-track, of a partial circuit on the rolling equipment consisting of a controlling-relay on locomotive terminating in the wheels of the front and rear trucks of a car, or trucks of different cars of a train as set forth, so adapted that when the said wheels bridge said rails a guard-circuit will be completed substantially as and for the purpose set forth.

Signed at New York city, in the county of New York and State of New York, this 18th day of August, A. D. 1902.

HENRY W. SPANG.

Witnesses:

J. GALLWITZ,
E. L. LAWLER.