(No Model.) 2 Sheets—Sheet 1.

# C. W. GRANT.

## RAILWAY SIGNAL.

No. 589,170. Patented Aug. 31, 1897.

Fig. 1.

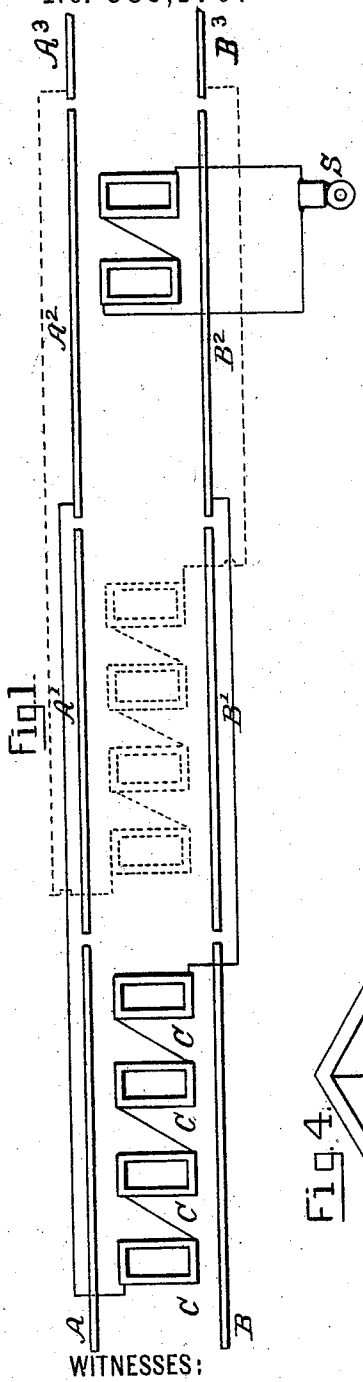



Fig. 4.

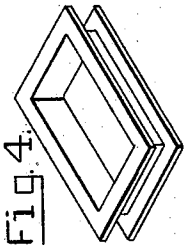
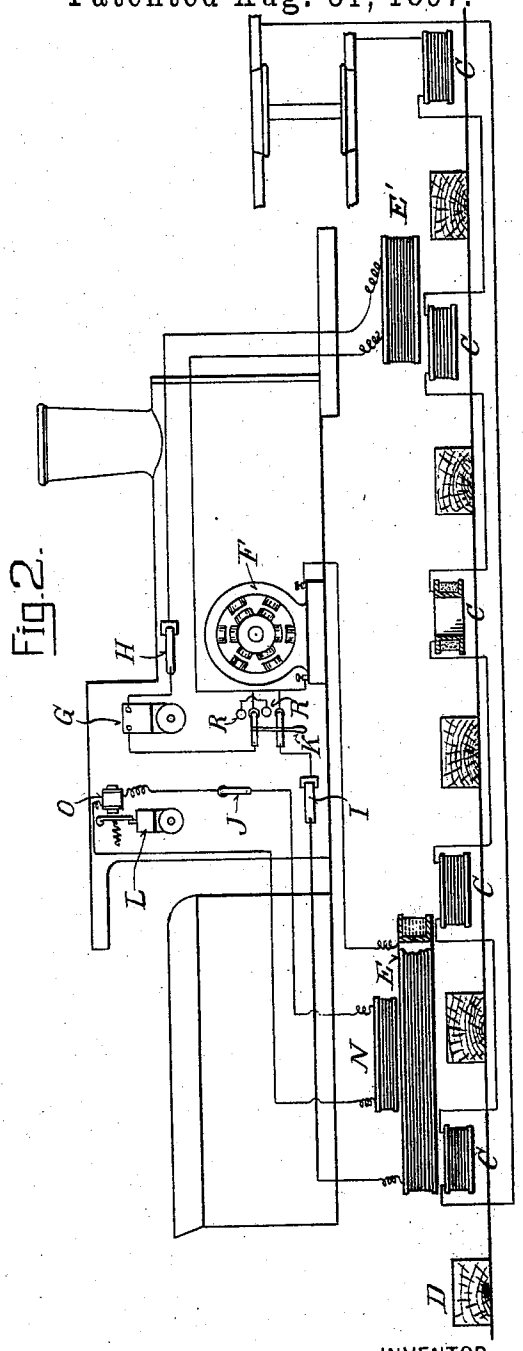


Fig. 2.




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(No Model.)

2 Sheets—Sheet 2.

# C. W. GRANT.

## RAILWAY SIGNAL.

No. 589,170. Patented Aug. 31, 1897.

Fig. 5.

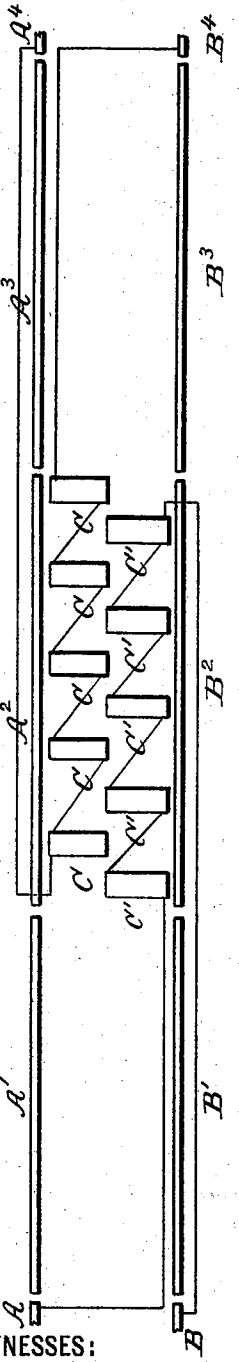



Fig. 3.

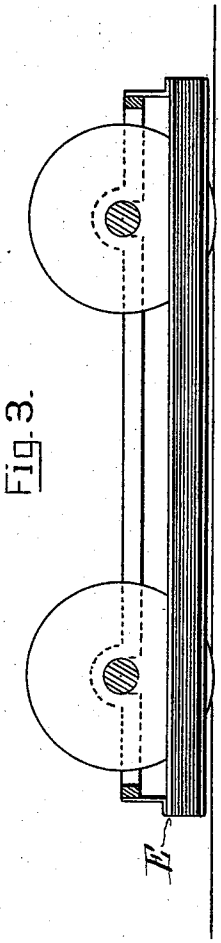
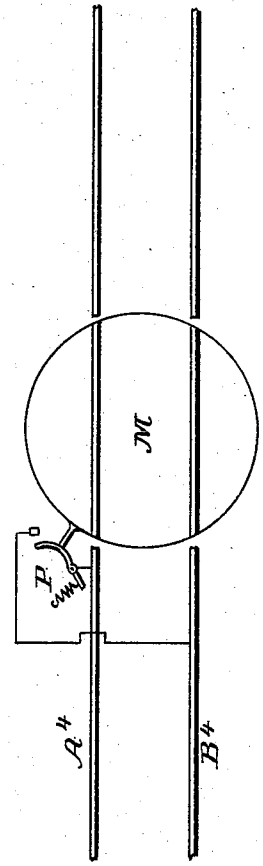



Fig. 6.




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# UNITED STATES PATENT OFFICE.

CHARLES W. GRANT, OF CONCORD, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN ELECTRIC TRAIN AND SWITCH SIGNAL COMPANY, OF BOSTON, MASSACHUSETTS.

## RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 589,170, dated August 31, 1897.

Application filed November 19, 1896. Serial No. 612,733. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES W. GRANT, a citizen of the United States, residing at Concord, county of Middlesex, and State of Massachusetts, have invented certain new and useful Improvements in Railway-Signals, of which the following is a specification, reference being made to the accompanying drawings, wherein—

Figure 1 is a diagram representing the plan of a road-bed prepared for use in connection with my system. Fig. 2 illustrates diagrammatically a section of the said road-bed and a locomotive equipped with the apparatus required to operate with the corresponding apparatus on the roadway. Fig. 3 represents a truck having an induction-coil suspended therefrom. Fig. 4 represents the core upon which the induction-coils are wound, and Fig. 5 illustrates the invention as applied to a single-track road. Fig. 6 illustrates the part as applied to a drawbridge or turnout-switch.

My invention is based upon the principle of electromagnetic induction between certain stationary coils along the road-bed and certain other coils carried by the locomotive of a train.

More particularly I place along the road-bed a series of coils provided with iron cores and arranged in series in a circuit terminating at the two opposite and insulated rails of a section of track more or less remote whereon an interfering or obstructing train may be standing or running. These coils are arranged to receive current, in the event of their circuit being closed by the presence of the interfering train aforesaid, from a constantly-energized coil carried by the locomotive in a position where it may act inductively thereon. In the event of the said track-coils being energized they in turn act inductively upon a second coil carried by the locomotive and connected with a bell or other signaling device responsive to an alternating current. In practice the track-coils will be grouped together in a series, including those adjacent to one section of track, and the terminals of their circuit will be connected, respectively, to the two opposite and insulated rails of another section of track more or less distant. In operation the constantly-energized primary coil carried by the locomotive and receiving an alternating current from a generator located thereon will tend to induce secondary currents in the track-coils; but such tendency will only become effective in the event of the circuit of said track-coils being closed by the presence of an interfering train on the distant section, and in such event the secondary currents in the track-coils will induce tertiary currents in the signal-receiving coil carried by the locomotive. In this manner any locomotive will be automatically notified through its own coils and its own generator of the presence of another locomotive, train, or car within a specified distance ahead of it.

My invention also consists in certain details of construction hereinafter set forth, and particularly in certain testing arrangements by which the condition of the train apparatus may be constantly indicated and any failure or disarragement be immediately disclosed.

The advantage of my system lies principally in the fact that there is no apparatus along the track containing any moving parts, and the system, so far as the track is concerned, depends only upon fixed coils and conductors, which when once properly installed are not liable to injury by weather or temperature or to disarrangement in operation. There are also no stationary batteries or generators along the track, and such current as is employed is derived from a low-frequency alternating-current dynamo of a simple type placed on the locomotive, while the remaining part of the apparatus carried by the train is free from complications and is under the constant supervision of the engineer. It is also of a character not at all liable to disarrangements of any kind.

Referring to the drawings, A A′ $A^2$ represent three insulated sections of railway-rail, and B B′ $B^2$ represent corresponding sections of the opposite rail. Between the two rails of each section on a uniform level I place a series of coils C C C, which are preferably

wound on rectangular iron frames of the form shown in Fig. 4, and I connect together in series all of the coils in any one section. The two terminals of the coils thus grouped together are extended along the track and connected, respectively, to the rails of another section, more or less distant, preferably the second section ahead. Thus in Fig. 1 the coils C C, &c., (shown in full lines as placed between the rails A and B,) are connected in series and their terminals connected to the rails $A^2$ and $B^2$ of the next section but one in advance. Similarly the coils between sections A′ and B′ will be connected to the rails of section $A^3$ $B^3$. If it is desired to work in both directions on a single track, there will be required two sets of coils C C, &c., the coils of one set alternating with those of the other set, and the terminals of one set connecting with rail-sections in advance and those of the other set with rail-sections in the rear. Thus, referring to Fig. 5, there are shown between the rail-sections $A^2$ $B^2$ two series of coils C C, &c., and C′ C′ C′, &c., the former series connecting with the rail-sections $A^4$ and $B^4$ and the latter sections with the rail-sections A and B. With the arrangement described it is obvious that in Fig. 1, for instance, a train on rail-sections $A^2$ $B^2$ will close the circuit of coils C C, &c., between rail-sections A and B, while in Fig. 5 one set of coils will have their circuit closed by a train on $A^4$ $B^4$ and the other by a train on a set A B. Moreover, I may arrange that any unusual circumstance—such as the opening of a drawbridge or the throwing of a turnout-switch—in any section will operate to close a circuit between the two rails and thereby complete the circuit of the track-coils connected with said rail. Thus in Fig. 6, M represents a drawbridge in rail-sections $A^4$ $B^4$, and it is so arranged that when moved from its normal position (shown in the drawings) it will release a spring-switch P and close the circuit between rails $A^4$ and $B^4$, in which event an approaching train will receive a signal in the same manner as it would if the rails $A^4$ and $B^4$ were connected by a train standing or running thereon.

Referring to Fig. 2, I have shown the track-coils C C, &c., as laid in the roadway flush with the upper surface of the ties D D, the center one of the five coils being shown in section in order to illustrate the construction of the coil, which, as I have already stated, is wound about a rectangular frame grooved on its periphery to receive the wire. A coil E of similar construction is carried on one part of the locomotive—for instance, underneath the tender—being suspended directly from the axles or any fixed point, as shown in Fig. 3, in order that it may be held at an invariable distance away from, but in close proximity to, the track-coils C C. The track-coils may be as numerous as desired, although their number will naturally be limited by the length of the coil carried on the tender and the frequency with which it is desired to receive indications from the section ahead. This coil E is connected directly with an alternating-current generator F on the locomotive, which will be constantly running and sending at all times an alternating current through the coil. A similar but smaller coil E′ will be carried at a remote point of the locomotive—for instance, directly under the pilot or forward track—so as to be free from the inductive influence of the primary coil E. This coil E′ will be suspended, just like E, at a fixed distance from the track-coil C C, &c., and its line-circuit will include a bell G or other device responsive audibly to an alternating current. The circuit of coil E′ will be controlled by an ordinary switch H and the circuit of coil E by a similar switch I.

The operation of the apparatus thus described will be obvious. The generator F will keep the coil E constantly energized by an alternating current, which in turn will induce secondary currents in the track-coil C C, &c., provided there is an interfering train in the neighborhood on the section of track to the rails of which the coils C C are connected. When such an induced current passes in the coils C C, they will act inductively to produce a tertiary current in the coil E′ that will serve to operate the bell G.

Referring again to Fig. 2, it will be observed that just above coil E and in close proximity thereto is a similar but smaller coil N, having a magnet O included in its circuit, which circuit is controlled by a switch J. The purpose of this coil is to serve as a continual test on generator F and primary coil E. So long as the normal current is passing through the said generator and coil a secondary current will pass through coil N and magnet O and maintain in its attracted position the armature of the said magnet, which in turn controls a mechanical bell L. If for any reason there is an interruption of the usual current in the primary circuit, it will be followed by a cessation of current in the secondary circuit, and the magnet O will hence release its armature, allowing the bell L to ring. I have also provided a switch K, by means of which I can at any time throw the coils E and E′, the bell G, and generator F into a common circuit in series. I thus provide means for testing the integrity of coil E′ and the operativeness of bell G at any time.

In the position of switch K shown in the drawings the two circuits are independent of each other; but if the switch be moved upward, so as to throw the switch-arm into contact with the connected points R R, respectively, there will obviously be a series circuit provided through the several parts of the apparatus above described.

It is possible also to place one or more track-coils in a local circuit along the line for the purpose of signaling at crossings and at other points where it is desired to give warning of an approaching train. In Fig. 1 I have shown

two sets of coils in section $A^2$ $B^2$, which are connected with a local circuit including a bell S.

I am aware that it has been heretofore proposed to communicate with a moving train by means of a line-wire extending along the track and acting inductively upon a coil on a train. I have, however, ascertained by experience that such a system is impracticable, at least for audible-signaling purposes, and that it is essential to employ a series of coils capable of acting with considerable inductive strength upon each other.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination in a railway signaling system of a series of coils located along a section of railway and having their terminals connected to the track-rails of a neighboring section, a generator on the train for energizing the said coils by induction and a receiving-coil carried by the same train in proximity to the said series of track-coils and connected with signal-receiving apparatus on the train, substantially as and for the purpose set forth.

2. The combination in a railway signaling system of a series of coils provided with iron cores located along a section of railway and having their terminals connected to the track-rails of a neighboring section, a generator on the train for energizing the said coils by induction and a receiving-coil having an iron core carried by the same train in proximity to the said series of track-coils and connected with signal-receiving apparatus on the train.

3. The combination in a railway signaling system of a series of track-coils having their terminals connected to the opposite insulated rails of a neighboring section of the track, an alternating-current generator carried by the train, a coil on the train in the circuit of said generator carried at a point adjacent to the track-coils, so as to induce current therein, and a receiving-coil also on the train carried in a similar position and provided with signal-receiving devices, substantially as and for the purpose set forth.

4. The combination in a railway signaling system of three adjacent sections of track, the rails of each section being insulated from those of the other sections, a series of track-coils arranged along the first of the said sections, two insulated line-wires connected to the terminals of said coils respectively and extending along the second or intermediate one of the said sections and connected respectively to the insulated track-rails of the third or last one of the said sections, an alternating-current generator, an inducing-coil in the circuit of said generator forming a primary coil for inducing an alternating current in said track-coils, a receiving-coil carried by the train in proximity to the said track-coils so as to receive a tertiary induced current in the event of the circuit of said track-coils being closed, and signaling devices on the train included in the circuit of said receiving-coil, substantially as and for the purpose set forth.

5. The combination in a railway signaling system of three adjacent sections of track, the rails of each section being insulated from those of the other sections, a plurality of track-coils connected in series in a common circuit and arranged in a single line adjacent to the first of the three sections aforesaid, two insulated conductors, one connected at the beginning of the said first section to the terminal of the first one of the said track-coils and the other connected at the end of the same section to the terminal of the last of the said track-coils, the two conductors extending from their said connection-points along and beyond the second or intermediate one of the said three track-sections and connected respectively to the two insulated rails of the third or last one of the aforesaid three track-sections, an alternating-current generator, an inducing-coil in the circuit of said generator, forming a primary coil for inducing an alternating current in said track-coils, a receiving-coil carried by the train in proximity to the said track-coils, so as to receive a tertiary induced current in the event of the circuit of said track-coils being closed, and signaling devices on the train included in the circuit of said receiving-coil, substantially as and for the purpose set forth.

6. The combination in a railway signal system of a series of track-coils, an inducing-coil carried by the locomotive for generating current in said track-coils, an alternating-current generator energizing the said inducing-coils, a test-coil placed adjacent to the said inducing-coil, and indicating devices in the circuit of the said test-coils, substantially as and for the purpose set forth.

7. The combination of track-coils C C, &c., an inducing-coil E carried by the train in proximity to the said track-coils, indicating-coil N, generator F, normally energizing coil E, magnet O in the circuit of coil N, and a signaling device L controlled by said magnet O, substantially as and for the purpose set forth.

8. The combination with one or more car-axles of a railway-vehicle, of an inducing-coil suspended directly therefrom, a series of track-coils arranged at or near the surface of the road-bed in proximity to the said inducing-coil, a generator on the train for energizing the inducing-coil and a signaling device on the same train inductively operated by the said track-coil, substantially as and for the purpose set forth.

9. The combination with an induced track-circuit formed in part of the track-rail and in part by a conductor subject to inductive action, of a generator on the train for supplying the said circuit with alternating current and a signaling-circuit on the same train energized inductively from the said track-circuit, substantially as and for the purpose set forth.

10. The combination in a railway signaling system of an induction-circuit along the rail-

way formed in part by insulated sections of track-rail, a drawbridge, or turnout, in said section, a switch controlled by the said drawbridge, or turnout-switch, for closing the circuit between the two rails in the event of the bridge, or turnout, being open, a generator on the train for inducing an alternating current in said track-circuit and signaling devices on the same train operated by the said induced current, substantially as and for the purpose set forth.

11. The combination in a railway signaling system of a railway-track having its rails divided into three or more insulated sections, two induced circuits adjacent to one section and connected respectively with the section in advance and in rear thereof, a generator on the train for inducing alternating currents in said circuits and signaling devices on the same train operated by said induced circuits, substantially as and for the purpose set forth.

12. The combination in a railway signaling system of a line of track-coils adjacent to a section of railway, said track-coils being included in a normally open circuit, an inducing-coil and a receiving-coil carried by the same train and arranged in the same longitudinal line adjacent to the line of track-coils and means for closing the track-coil circuit by the presence of a neighboring train.

13. The combination in a railway signaling system of a series of section track-coils on one section, a circuit for said coils controlled by a train on a neighboring section, local track-coils, a local circuit therefor, a signaling device in said local circuit and an inducing-coil for energizing both the local track-coils and section track-coils, substantially as and for the purpose set forth.

In witness whereof I have hereunto set my hand this 16th day of November, 1896.

CHARLES W. GRANT.

Witnesses:
GEORGE T. CUNNINGHAM,
ERNEST S. WILLIAMS.