No. 795,600. PATENTED JULY 25, 1905.

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## SIGNAL SYSTEM.

APPLICATION FILED APR. 18, 1905.

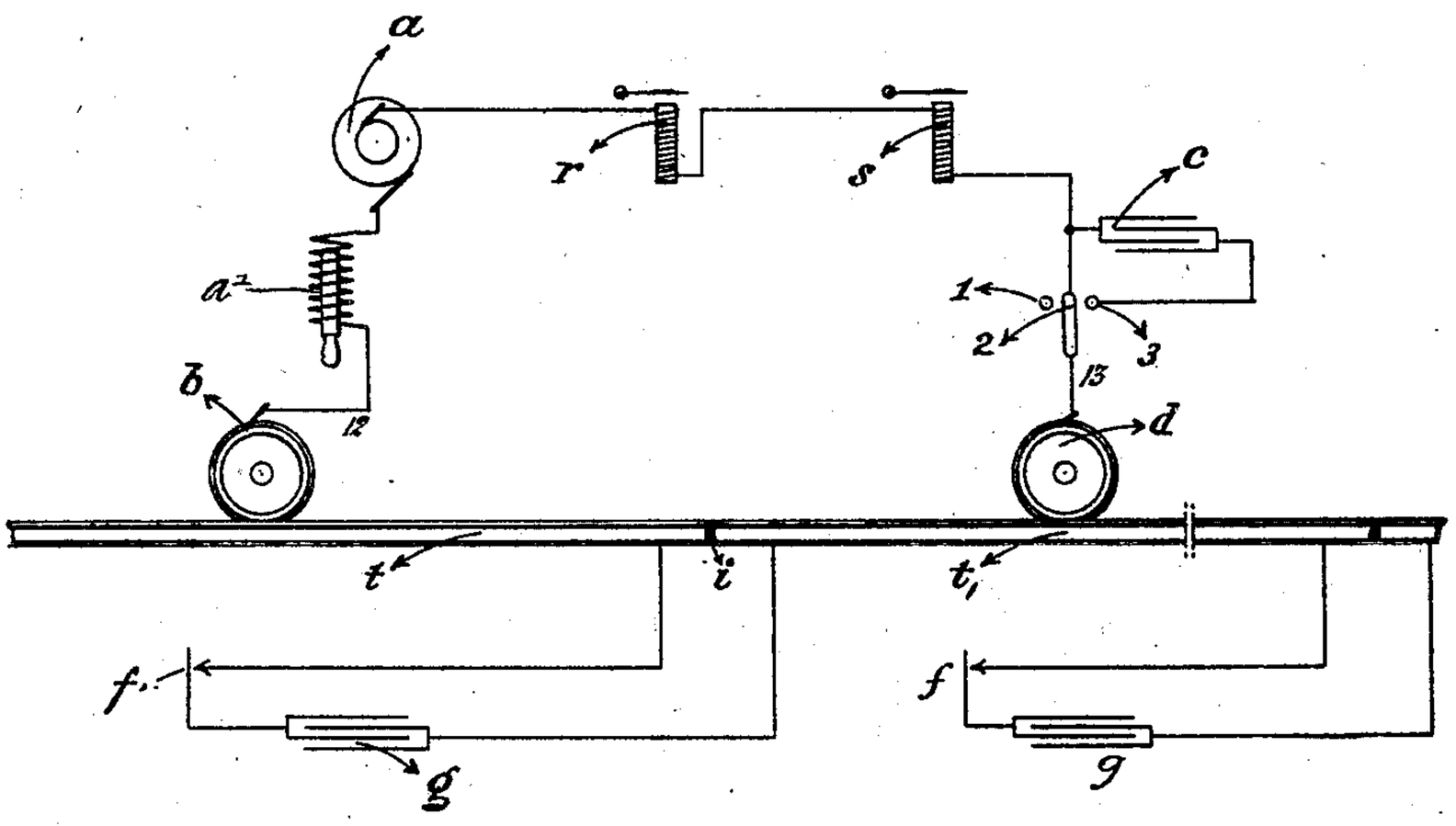


Fig. 1.

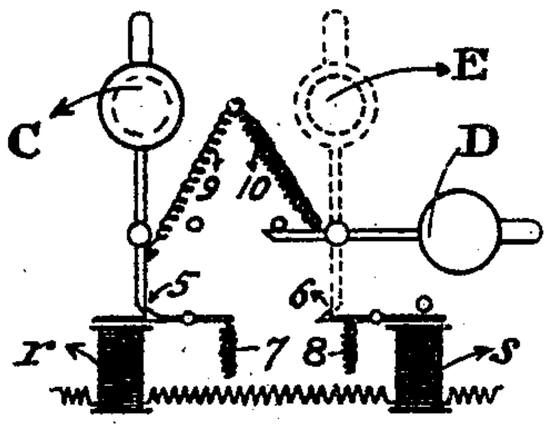


Fig. 2.

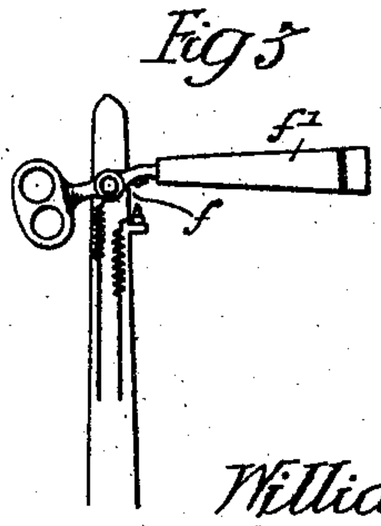


Fig 3

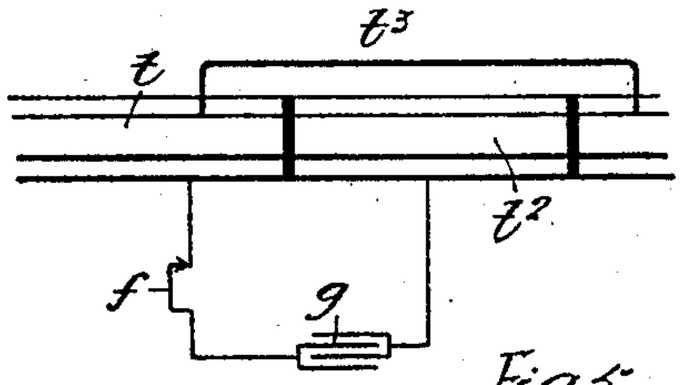


Fig. 4.

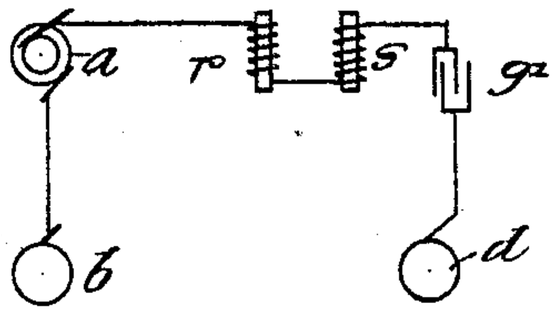


Fig. 5.

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# UNITED STATES PATENT OFFICE.

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## SIGNAL SYSTEM.

No. 795,600. Specification of Letters Patent. Patented July 25, 1905.

Application filed April 18, 1905. Serial No. 256,187.

*To all whom it may concern:*

Be it known that we, WILLIAM S. FRANKLIN, a citizen of the United States, and WILLIAM R. WHITEHORNE, a subject of the King of Great Britain, both residing in Bethlehem, Pennsylvania, have invented certain Improvements in Signal Systems, of which the following is a specification.

Our invention consists in a combination of apparatus comprising a system designed to indicate in the operator's cab of a train the condition or position of successive signals along the line of the track.

One object of the invention is to provide a system, including apparatus partly on the train and partly at the ends of each section of track, so arranged in combination with any of the automatic or other signals at present in use on railroads that a device in the operator's cab of each train will be actuated whenever the train passes from one block to another or passes over definite portions of the track, and thereby caused to indicate whether said signal is in the danger or in the clear position or is inoperative.

Another object of our invention is to provide a system having the above-noted characteristics which shall, while being relatively simple as regards its parts and their arrangement, require but little attention to maintain it in operative condition, while at the same time being practically certain and positive as regards its operation.

It is further desired to provide a signal system, as above noted, of such a nature that it may be applied to roads already equipped with any of the ordinary block-signal systems without requiring material change of or interfering with such systems.

These objects we attain as hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view illustrating one set or equipment of the apparatus and connections employed in our system. Fig. 2 is an enlarged view, to some extent diagrammatic, illustrating a possible form of indicating device for use in the operator's cab of a locomotive or train. Fig. 3 illustrates somewhat in detail a possible construction of switch used with a well-known form of semaphore-signal. Fig. 4 is a diagrammatic view showing a portion of a track arranged to cause operation of the indicating device on a train from a signal placed at some point other than at the end of a block-section, and Fig. 5 is a diagrammatic view illustrating a slightly-modified combination of apparatus for carrying out our invention.

In the above drawings, $t$ and $t'$ are respectively the rails at the ends of two adjacent block-sections of a railroad, these being insulated from one another, as indicated at $i$ and as required in all of the block systems at present in use. It will be understood that as usual there is at each end of each block one or more visual signals—such, for example, as is illustrated in Fig. 3—which when there are no trains in the block extends in a line forming an acute angle with the vertical and which is automatically or otherwise moved to a horizontal or danger position when the contrary is the case. If desired, however, this signal may be of the type normally standing at "danger" and automatically set at "clear" on the approach of a train if there is no other train in the block ahead. In such case the switch controlled by this signal and described hereinafter would be modified accordingly.

Our system is designed to indicate to the engineer of a train the position of the signal-arm $f'$, and as part of the apparatus for carrying out this object we provide a switch $f$, so supported that it will be closed whenever the arm $f'$ is in its inclined or safe position and open when said arm is in its horizontal or danger position. One terminal of this switch we connect to the rail-section $t$ and the other terminal to one terminal of a condenser $g$, whose second terminal is connected to the rail-section $t'$. While we have shown in the drawings but a single equipment of this portion of our system, it will be understood that each semaphore along the line has a similar outfit.

Upon each locomotive or operator's car we provide a small alternating-current generator $a$, driven in any desired manner, and connect one terminal of this to one of the wheels, as $b$, of the locomotive electrically insulated from the other wheels, or said terminals may be connected to the frame of a tender or another car connected to the locomotive by insulating-couplings. The second terminal of the generator we ground on the frame of the locomotive through two magnet-windings $r$ and $s$ and a switch 2, all connected in series. This switch is provided with three points, on the first of which, 1, it opens the generator connection to the frame of the locomotive. When on another point, 3, it places an auxiliary con-

denser $c$ in circuit with said generator and the two magnets $r$ and $s$, and on the intermediate point said magnets and the generator are connected in series between the insulated wheel $d$ and the frame of the locomotive or, what is the same thing, one of its other wheels, $b$. If desired, we may place in series with the generator an adjustable inductance $a'$ for a purpose hereinafter noted.

As shown in Fig. 2, the magnet $r$ is provided with an armature having a trigger 5, whereby an indicating-banner C is maintained in a vertical position against the action of a spring 9. There is connected to the said armature a relatively strong spring 7, opposing movement of said armature under the action of the magnet $r$ to such an extent that such motion cannot occur unless a relatively large but predetermined current flows through said magnet. The trigger on the armature is so placed that the banner is maintained in its vertical position as long as the armature is not moved toward the magnet.

The magnet $s$ is provided with an armature having a trigger 6 so placed that as long as said magnet is energized and holds the armature in its attracted position against the action of a spring 8 a banner D is maintained in a vertical position against the action of its spring 10. As soon, however, as the magnet $s$ is deënergized said spring 8 causes the trigger to release the banner, so that it moves to its horizontal position, as shown in Fig. 2.

Under operating conditions if a locomotive equipped with the apparatus above described be moving upon a track within a single block-section with its generator in operation and its switch 2 in the intermediate position it will be seen that the alternating current generated will flow through the two magnets $r$ and $s$, through switch 2 and wheel $d$ to the track, thence through wheel $b$ and the adjustable inductance $a'$ back to the generator. Under these conditions the current flowing is equal to

$$I = \frac{E}{\sqrt{R^2 + \omega^2 L^2}}$$

it being noted that this current is determined by the constants of the generator and the amount of resistance and inductance in circuit. This flow of current energizes the magnet $s$ sufficiently to retain its armature in position to hold the banner D vertical, though such flow does not energize the magnet $r$ sufficiently to overcome the effect of the spring 7 on its armature, and, as a consequence, the banner C also remains in its vertical position. As the locomotive passes from one block to the next there is an interval of time during which the wheels $b$ and $d$ occupy the relative positions shown in Fig. 1—that is to say, the wheel $d$ is upon the rail $t'$ of one block while the wheel $b$ engages the rail $t$ of the next adjacent block. If now the semaphore-arm $f'$ be in the horizontal position shown in Fig. 3, the switch $f$ is open, and, as a consequence, the circuit of the generator $a$ will be broken. The magnet $s$ is therefore deënergized, and the spring 8 moves its armature, so as to release the banner D, which is immediately pulled to its horizontal position, thus indicating that the signal-arm stands at "danger." Even though the magnet $r$ is also deënergized its banner C is not affected, since there is no movement of its armature. On the other hand, if the semaphore-arm $f'$ be in its inclined position the switch $f$ is closed, so that when the locomotive occupies the position shown in Fig. 1 a relatively large current is permitted to flow. This excessive flow takes place for the reason that the capacity of the condenser $g$ neutralizes the inductance of the windings $s$, $r$, and $a'$, the amount of the current being given by the formula $I = \frac{E}{R}$, so that it will be seen that said current is limited only by the ohmic resistance in circuit, where normally it is also cut down by the inductance of the windings above noted. This large current, preferably about ten times that flowing on short circuit, so energizes the magnet $r$ as to completely overpower the action of the spring 7 upon its armature and causes this latter to release the banner C, which consequently moves to its horizontal position, thereby indicating that the block ahead is "clear." Since the armature of the magnet $s$ is already in a position corresponding to the energized condition of the magnet, its banner D will remain in the vertical position. Should the locomotive pass from one block to another without either of its indicating-banners C or D being released, it would show that the main signal system was out of order, as from a short circuit between the rails of adjacent blocks, and would indicate the necessity of the engineer proceeding cautiously.

The inductance $a'$ is made adjustable, so that the total inductance in the generator-circuit may be made of the right amount to be substantially neutralized by the capacity action of the condenser $g$, as will be understood by those skilled in the art.

In order that the engineer may be able at any time to test the operativeness of the indicating apparatus comprised by the magnets $r$ and $s$ and their attached parts, we provide the auxiliary condenser $c$ and the switch 2. By moving the blade of this switch to the point 3 the safe condition of the main signal system is reproduced and the banner C should be released, while, on the other hand, the danger condition may be reproduced by moving the switch-blade to the point 1, thereby open-circuiting the generator and causing release of the banner D if the system is properly operative.

If it be desired to have the indicating ap-

paratus show the position of a signal at some point of a block other than at its ends, we may provide a section of track, as $t^2$, insulated from the remainder, as shown in Fig. 4, the two adjacent portions of the main rail, however, being bonded together by means of the conductor $t^3$. In this case the switch $f$ is, as before, operated by the automatic or manual signal and has one terminal connected to the rail $t$ and its second terminal connected, through the condenser $g$, to the section $t^2$. This arrangement may in many instances be used in place of that shown in Fig. 1, since it would be applicable to any of the existing signal systems without requiring any modification thereof, where, on the other hand, it is possible that the first-described arrangement might necessitate some slight change in existing systems before it could be applied to them.

While we preferably connect the two wires 12 and 13 of the circuit upon the locomotive to two wheels insulated from each other and bearing upon a common rail, it will be understood that it is not absolutely necessary to follow this design, since, if desired, one of said wires may be connected to a brush or auxiliary contact insulated from the frame of the locomotive and bearing upon the rail or it may be connected to the metallic frame of a tender or car connected to said locomotive or its equivalent by insulating-coupling mechanism.

It is to be noted that a great advantage of our system, as above described, is due to the use of the condensers $g$, since these in no way interfere with present electrically-operated systems using the rails $t$ and $t'$ as conductors by reason of the fact that they do not permit of the flow of direct current through them. It will further be noted that it is a practical impossibility for the safe indication to be accidentally given on the locomotive except under the predetermined safe conditions, since it is only when the condenser is placed in circuit with the indicating devices that it is possible for the greatly-increased current to flow.

If desired, we may include in the circuit carried by the car or locomotive a condenser $g'$, as shown in Fig. 5, for the purpose of preventing the possibility of the indicating devices being actuated by stray direct currents accidentally entering said circuit from the track.

We claim as our invention—

1. A signal system including an indicating device on a car, a generator normally supplying an inoperative current to said device, a main signal, and electrical means responsive only to an alternating current and controlled by said main signal for varying the current-flow through the indicating device under predetermined conditions of said signal, substantially as described.

2. A signal system including an indicating device on a car, a generator normally supplying current to said device to an extent insufficient to operate the same, a main signal, and electrical means including alternating-current apparatus controlled by said signal for augmenting the current-flow through the indicating device under predetermined conditions of said signal, substantially as described.

3. A signal system including an indicating device on a car, a generator normally supplying an inoperative current to said device, a main signal, and a circuit including a condenser controlled by said signal for causing a variation of the current-flow through the indicating device under predetermined conditions of the signal, substantially as described.

4. A signal system including a track having a series of insulated sections, a main signal along the track, a switch controlled by said signal, a condenser connected to the switch and with it connected to two of the track-sections, with a car having an indicating device, and means for connecting said device to the rail-sections, substantially as described.

5. A signal system including a track having a series of insulated sections, a main signal along the track, a switch controlled by said signal, a condenser connected to the switch and with it connected to two of the track-sections, with a car having a circuit including a generator, and an indicating device, the terminals of said circuit being both electrically connected to the track but insulated from each other, substantially as described.

6. A signal system including indicating means on a car having a magnet, an armature therefor, and mechanism controlled by the armature, a generator operating at a voltage normally insufficient to operate said armature, a main signal, a circuit controlled thereby including means open-circuited to direct currents for augmenting the current through said magnet sufficiently to cause it to operate its armature, and means for connecting said circuit to said indicating means when the car is at a predetermined point, substantially as described.

7. A signal system including a car provided with indicating devices having two magnets, a generator normally supplying current to said magnets insufficient to operate the armature of one while holding the armature of the other in its attracted position, with a track for the car and means along said track constructed to be unaffected by direct current for causing the current-flow through said magnets to be augmented sufficiently to operate the armature of said first magnet, substantially as described.

8. A signal system including a car provided with indicating devices having two magnets, a generator normally supplying current to said magnets insufficient to operate the armature of one while holding the armature of the other in its attracted position, with a track

consisting of a series of sections insulated from each other, a main signal for each section, a circuit controlled by each signal and connecting the adjacent ends of each pair of sections, with electrical means including alternating-current apparatus in each of said circuits for causing increase of the current-flow through said magnets sufficient to operate the armature of said first magnet as the car passes a given point, substantially as described.

9. A signal system including a track having a number of sections insulated from each other, a series of independent circuits connecting the adjacent ends of each pair of sections, a switch and a condenser in each circuit, devices for controlling said switches, with a car or cars operative on the track having a circuit including an alternating-current generator and an indicating device, the ends of said car-circuit being electrically connected to the track independently of each other, substantially as described.

10. A signal system including a track having a number of sections insulated from each other, a series of independent circuits connecting the adjacent ends of each pair of sections, a switch and a condenser in each circuit, devices for controlling said switches, with a car or cars operative on the track having a circuit including an alternating-current generator and a magnet provided with indicating mechanism normally unoperated by the current supplied by the generator, the ends of said car-circuit being electrically connected to the track independently of each other, substantially as described.

11. A signal system including an indicating device on a car, an alternating-current generator in circuit therewith, a main signal or signals along the track for said car, a circuit including a condenser controlled by said signal for causing a variation of the current-flow through the indicating device under predetermined conditions of said signal, and an adjustable inductance also in circuit with said generator, substantially as described.

12. A signal system including an indicating device on a car, a generator normally supplying an inoperative current to said device, a main signal, and electrical means controlled thereby responsive only to alternating current for varying the current-flow through the indicating device under predetermined conditions of said signal, with a duplicate equipment of said electrical means carried by the car for testing the operativeness of the generator and indicating device, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM S. FRANKLIN.
WILLIAM R. WHITEHORNE.

Witnesses:
WILLIAM H. FOLTZ,
A. L. COPE.