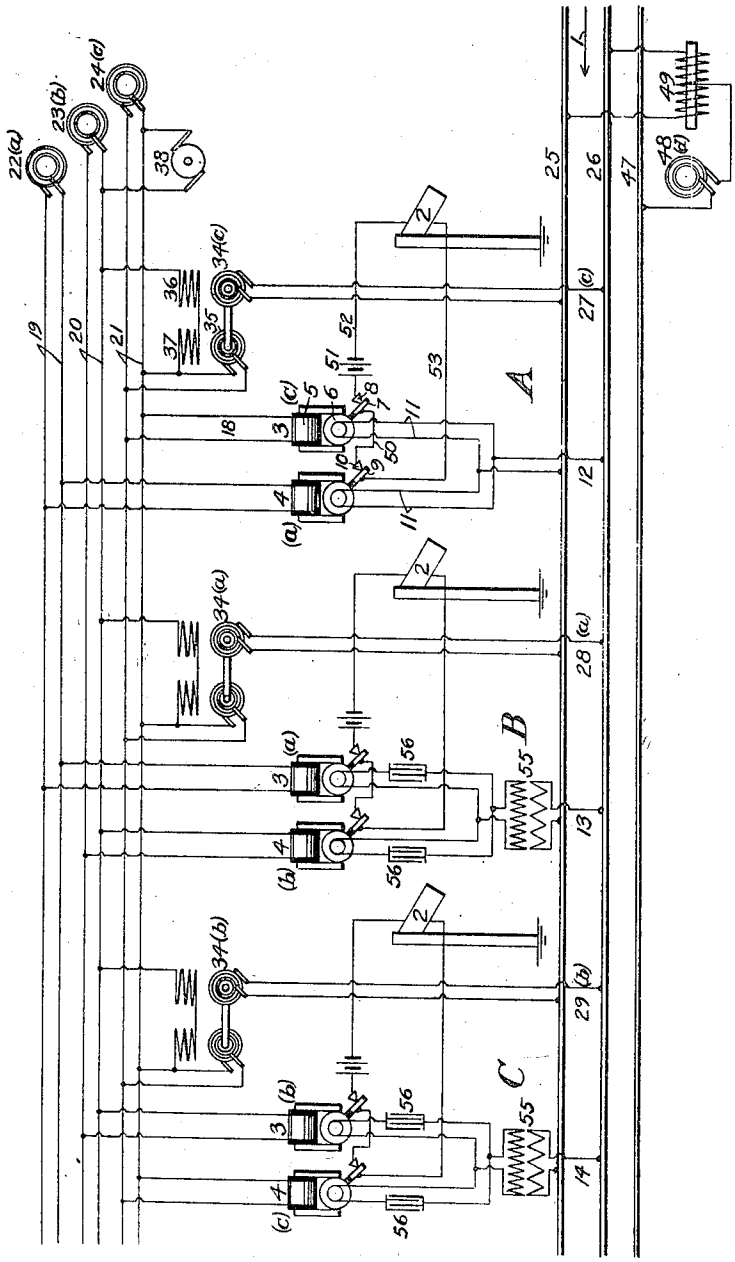
A. V. T. DAY.

RAILWAY SIGNALING SYSTEM.

APPLICATION FILED AUG. 28, 1908.

1,125,488. Patented Jan. 19, 1915.



Witnesses

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RAILWAY SIGNALING SYSTEM.

1,125,488. Specification of Letters Patent. Patented Jan. 19, 1915.

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To all whom it may concern:

Be it known that I, ALBERT V. T. DAY, a citizen of the United States, residing at New Rochelle, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Railway Signaling Systems, of which the following is a specification, reference being had therein to the accompanying drawings, forming part thereof.

My invention relates to electric traffic-controlling systems and apparatus for railways, and the object of the invention, generally stated, is to produce a traffic-controlling system which shall be simple and reliable in construction and operation.

While my invention is applicable, in general, to systems of various kinds, for the operation of various traffic-controlling devices, such as automatic train-stopping devices, switches, derailing switches, and the like, it is particularly applicable to automatic systems for controlling visual signals, such as semaphores, and I have illustrated and particularly described my invention as applied to such a signal system.

It has heretofore been proposed to use traffic-controlling systems in which the track rails are employed as conductors in signal-controlling circuits and are fed at different points with alternating or other periodic currents of different frequencies. These currents are used to actuate relays, which control the signals, and each of the several relays is made responsive only to current of one frequency, so as to be actuated only by current flowing from a given feeding point or points in the rails. This arrangement is designed to operate in such a manner that each relay is controlled by the presence or absence of a train in or near the portion of the track connecting the relay with the point from which the appropriate current flows, the train, when present, acting to short-circuit either the relay or the source of current so as to deënergize the relay in so far as the current of the particular frequency necessary for actuating the relay is concerned.

In the system above referred to, it has been proposed to supply the current of a given frequency at the several different feeding points through a transmission line from a common generator, and to derive the current at these points through suitable transformers. This arrangement is defective for the reason that where current is derived at different points on the track from a common conductor, this conductor may act, under certain circumstances, as a conductor for stray currents from other sources, with the result that current of a given frequency may be conducted and fed to points in the rails where it is intended to be absent, so that a signal-controlling relay may be improperly actuated by current from an unintended source at a time when its normal source is cut off and the relay should be deënergized. This defect relates particularly to the several relay-actuating currents, and is such that with the above described arrangements each transformer, in addition to feeding the current of proper frequency, may also feed to the rails more or less of each of the other currents of different frequencies used in the system, so that current appropriate to any relay may be found at any point in the rails.

My invention is applicable to a system having the general character of that just described, and one object of the invention is to obviate, in such a system, the objectionable feature above referred to. To this end I provide an independent source of current for each of the several feeding points in the rails. The several sources of current may be generators, and they may be and preferably are, driven by power derived from a common source in such a manner as to synchronize their operation and simplify the construction of the system, but electrically these generators are wholly independent of each other and of the transmission line, so that the arrangement affords no path for the transmission of stray currents.

In the system hereinbefore referred to each relay is rendered selectively responsive to current of the appropriate frequency by providing it with a magnetic field energized by current of the same frequency, derived from the same source as the current in the rails intended to actuate the relay. In order that a relay so individualized may operate in an entirely reliable manner it is necessary to guard absolutely against the energization of its field by stray currents of a frequency other than that intended. This cannot be done in the arrangement above referred to, and under certain circumstances a relay may therefore become more or less responsive to currents from sources other

than the source from which alone it is intended that the relay should be controlled.

An object of my invention is to avoid this cause of defective operation, and to this end I energize the fields of the relays from sources wholly independent of the sources from which are derived the currents fed to the rails.

In the system hereinbefore referred to, when alternating or other periodic current is used for traction purposes, the track rails serving as a return conductor therefor, the traction current is necessarily of a different frequency from that of any of the relay-actuating currents, in order to avoid direct interference of the traction current with the signal-controlling system. Indirectly, however, even a traction current of substantially different frequency may interfere with the proper operation of the relays. In case there arises, from any cause such as a broken rail or bond, a substantial difference of potential in the track rails due to the traction current, traction current will flow into the transmission lines and into the fields of the relays, thereby rendering the relays responsive to traction current, and a portion of the traction current, flowing through the armature coils of the relays from the rails, may actuate the relays at improper times.

An object of my invention is to avoid this defective operation, and this result is accomplished by energizing the fields of the relays from sources wholly disconnected from the track rails, so that no possible path is afforded for traction current from the rails to the fields of the relays.

Other objects and features of my invention will be set forth in connection with the description of the embodiment of my invention illustrated in the accompanying drawings.

I will now describe the illustrated embodiment of my invention, and will thereafter point out my invention in claims.

The drawing illustrates diagrammatically a portion of an electric signal-controlling system.

The track rails 25 and 26 constitute the westbound track of a double-track railroad, the trains moving from right to left, as indicated by the arrows 1. The track is divided into blocks by signals 2, although the track rails are bonded or otherwise rendered continuously conductive throughout the system. The signals are located each at the entrance end of a block, while the signal-controlling relays are located approximately at the middle of each block.

In the following description a signal with its controlling relays and the means for energizing the track rails at the entrance end of the block, are considered as constituting a "signal station" and in the drawings the several signal stations are designated successively by the captial letters A, B, etc. Portions of the apparatus which are in all respects similar at the several stations are designated by the same reference numbers, but in the following description the letters A, B, etc., are sometimes added to the reference numbers, when it is necessary to indicate at which station any one of such similar parts is located.

Each signal 2 is controlled by two track relays 3 and 4. The relay 3 is of the polarized periodic current type. It has a field magnet 5 and a pivoted armature 6 provided with a coil and carrying a contact finger 7, which coöperates with a fixed contact 8. The relay 4 is in all respects similar in construction, and has a contact finger 9 and a fixed contact 10. The construction of these relays is such that when the field magnet and the coil carried by the armature are energized by periodic currents of the same frequency and of proper phase relation the contact finger is held in engagement with the fixed contact, thereby closing the circuit controlled by the relay while under any other circumstances the contact finger falls and opens the circuit.

The armature coils of each pair of track relays 3 and 4 are connected in parallel by wires 11, across the track rails at points designated by the numbers 12, 13, 14, etc. so that both relays are energized by all the currents in the rails. Each relay is responsive, however, only to current of a certain frequency, and the relays of each pair respond to currents of different frequency. The field coil 5 of the relay 3^A is connected by wires 18, with transmission wires 21 fed by an alternating-current generator 24, while the field coil of the relay 4^A is similarly connected with and energized by a generator 22. These generators are designed to produce currents of substantially different frequency, and these two frequencies are for convenience, indicated by the letters *c* and *a* in the drawings, these letters being applied at various points where these frequencies occur or are effective to operate the apparatus.

The object in making the relays 3 and 4 responsive to currents of different frequencies is to make the relay 3 responsive only to current from the eastern half of the block, and the relay 4 responsive only to current from the western half of the block. The eastern half of the block A is fed, at a point 27, by current of *c* frequency, by an alternating current generator 34. This generator is driven by mechanical connection with an electric motor 35, which is of the synchronous alternating-current type. The armature of this motor is fed by the transmission wires 21, and the fields 36 and 37 of the generator and the motor are fed with constant current by connection with

one wire each of the transmission lines 20 and 21, a constant current generator 38 being connected across these wires. The use of these wires as conductor for both alternating and constant currents is merely an expedient of convenience and economy as an independent line might be used for the constant current.

The current of *c* frequency fed at the point 27 to the rails is normally transmitted through the rails to the point 12 and the armatures of the track relays at A; and it actuates the relay 3, causing it to hold its contact finger 7 against its fixed contact 8.

The western half of the block is fed at a point 28 by current of *a* frequency, from a generator 34 similar to the generator, above described, at station A, except that the generator B is constructed to generate current of *a* frequency. The current fed at the point 28 is normally transmitted through the rails to the point 12 and the armatures of the relays 3 and 4^A, and it actuates the relay 4, causing it to hold its contact finger 9 against its fixed contact 10.

The signal 2 and its electrically-controlled actuating mechanism are not particularly illustrated, as they may be of any ordinary or suitable construction. The signal has a bias to danger position, but is maintained in clear position when its actuating mechanism is thrown into operation by the closing of the signal circuit. The signal circuit, beginning at the signal 2^A, passes through a wire 53, to the contact finger 9 of the relay 4^A, thence, through the fixed contact 10 and a wire 50, to the contact finger 7 of the relay 3^A, thence, through the fixed contact 8, to the signal battery 51, and thence, by a wire 52, to the signal again. This circuit is normally held closed by the relays 3 and 4, and the signal is normally held in clear position.

Since the current of *a* frequency fed at the point 28 travels in both directions through the rails the relay 3^B is made responsive to current of this frequency by connecting its field with the transmission wires 19. The relay 4^B is made responsive to current of a third frequency, *b*, by connecting its field with the transmission wires 20, which are fed by a generator 23 similar to the generators 22 and 24. The current to energize the armature of the relay 4^B flows from the point 29 at the western end of the block, where it is supplied by a generator 34^C, similar, except for the frequency of the current generated to the generators 34 at A and B.

At station A the arrangement of the relays is such that the armature coil of each relay receives current not only of the frequency to which it is sensitive, but also currents of other frequencies flowing in the rails, so that it acts to some extent as a short circuit for currents by which other relays are to be actuated. This does not interfere with the operation of the system where the resistance of the armature coils is sufficient to reduce the short-circuiting action to a negligible amount, but this action may be substantially prevented by the arrangement of apparatus illustrated at stations B and C. Here step-up transformers 55 are used between the rails and the relays, and between each relay and the transformer is a condenser 56 tuned in resonance with the field of the corresponding relay, so that each relay armature coil receives only current of the appropriate frequency, the condenser acting to exclude currents of other frequencies.

The frequencies *a*, *b* and *c* are used at the successive feeding points throughout the line, in the same order *i. e.*, *c*, *a*, *b*, *c*, *a*, *b*, etc. The arrangement of the relays and the signal circuits may be precisely the same at all the signal stations and the two track relays at each station are arranged to be responsive to the currents from the feeding points at the eastern and western ends, respectively, of the corresponding block.

All of the track generators 34 of each particular frequency are connected with the two track rails in the same sense, so that there is normally no flow of current therefrom except through the armature coils of the relays.

With the apparatus in normal condition, suppose a car or a train enters the eastern half of the block A, so as to occupy a position between the points 12 and 27 on the track. The wheels and axles of the train connect the two rails electrically, and the current from the point 27 normally flowing to the relays 3 and 4^A is thus short-circuited. The armature of the relay 3^A is thereupon substantially deprived of current of *c* frequency, and the contact finger 7 falls, thereby opening the signal circuit and permitting the signal 2^A to go to danger position behind the train. It is true that unde these circumstances the armature of the relay 3^A is not wholly deprived of current of *c* frequency, since current of this character may be transmitted from the feeding point 30, and from other points farther in advance, but as these points are two and one half blocks or more in advance of the point 12, the current transmitted is reduced to a negligible amount by the impedance of the intervening length of rails, and the relay may be readily adjusted so as not to respond to a current so faint.

When the train reaches the middle of the block it short circuits both relay armatures, thereby doubly opening the signal circuit. When the train is in the western half of the block it intercepts the current of *a* frequency

flowing from the point 28 and thereby causes the relay 4^A to keep the signal circuit open until the train arrives at the end of the block.

The feeding points 27, 28, etc., while located approximately at the entrance ends of each block, are, in each case, situated a short distance to the west of the corresponding signal. As a train advances toward a feeding point it reaches a spot where the distance between the feeding point and the train is so short that the intervening length of rails and the wheels and axles of the train afford a path of low resistance for the current fed at the given point, and in consequence nearly the whole current is short-circuited by the train instead of being transmitted to the relay 3 of the block in advance. The signal therefore goes to danger position when the train reaches this point, and if the feeding point were located at the signal the signal would go to danger position shortly before the train reached it instead of during or after the passing of the train. The westerly displacement of the feeding points is provided to avoid this faulty operation, and the amount of displacement required is determined by the sensitiveness of the relays, the impedance of the rails, and other causes which may be made sufficiently definite for practical purposes.

In order to prevent direct interference of the traction current with the signal system, the traction generator is constructed to give current of a frequency substantially different from the frequencies *a*, *b*, and *c*. This frequency is indicated by the letter *d*.

It will be apparent that as all of the track generators 34 are wholly independent from each other and from the transmission lines by which the fields of the relays are energized, there are no paths afforded for stray currents either from point to point on the track or from a point on the track to the field of a relay. The possibility of improper operation arising from such stray currents in the ways hereinbefore referred to is therefore wholly precluded.

A further advantage of the arrangement of the motors and generators illustrated at A, B, and C lies in the fact that the phase of the current delivered by a generator 34 may be adjusted by turning the armature of the generator upon the shaft by which it is connected with the motor 35. This feature is of value in compensating for the difference in the respective impedances of the paths over which the alternating currents must pass in reaching the same point. Thus, for example, each relay is designed to be actuated by alternating currents of the same frequency and of definite phase relation in its armature coil and its field coil. The current in the field coil is derived from a transmission line, while the current in the armature coil is derived from a generator located at a distance and is transmitted through a track circuit having an impedance which is relatively high and which varies according to the length of the block and other factors. These differences may be completely compensated for, however, and the exact phase relation desired may be obtained, by adjusting the generator armature upon its shaft so as to give the current from the generator sufficient lead to compensate for the impedance of the track circuit.

While I have, for the sake of simplicity in illustration, shown and described a system in which only home signals are employed, the invention is equally applicable to a system arranged in any usual or suitable manner to control both home and distant signals.

The currents of different frequencies used to control the relays selectively need not necessarily be three in number. Two such currents, fed alternately to the rails, will suffice, but three currents are considered, for some reasons, preferable, and in some cases it may be preferable to use four or more.

Various modifications may be made in the embodiment of my invention hereinbefore particularly described and illustrated in the accompanying drawings within the nature of the invention and the scope of the following claims.

I claim:

1. A railway traffic-controlling system comprising track rails, means for feeding periodic currents of different frequencies at different points in the rails, traffic-controlling devices, relays for controlling the traffic-controlling devices, a plurality of the relays being connected with the rails at substantially the same point, and means interposed between a relay and the rails to exclude from the relay currents of other frequencies than that to which the relay should respond.

2. A railway traffic-controlling system comprising track-rails, means for feeding periodic currents of different frequencies at different points in the rails, traffic-controlling devices, relays for controlling the traffic-controlling devices, a plurality of the relays being connected with the rails at substantially the same point, and resonance devices interposed between the relays and the rails to exclude from each relay currents of frequencies other than those to which they should respond.

3. A railway traffic-controlling system comprising track rails, means for feeding periodic currents of different frequencies at different points in the rails, a traffic-controlling device, a relay controlling the traffic-controlling device, connected to the track rails, and selectively responsive to current of a given frequency in the rails, and reso-

nance devices interposed between the relay and the rails to exclude currents of other frequencies from the relay.

4. A railway traffic-controlling system comprising a railway track, separate alternating-current generators arranged to feed the track rails at intervals, motors arranged to propel the generators, a circuit for supplying the motor armatures, a separate circuit for supplying the motor fields, and separate generators for supplying said separate circuits.

In testimony whereof I have affixed my signature in presence of two witnesses.

ALBERT V. T. DAY.

Witnesses:

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WM. ASHLEY KELLY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."