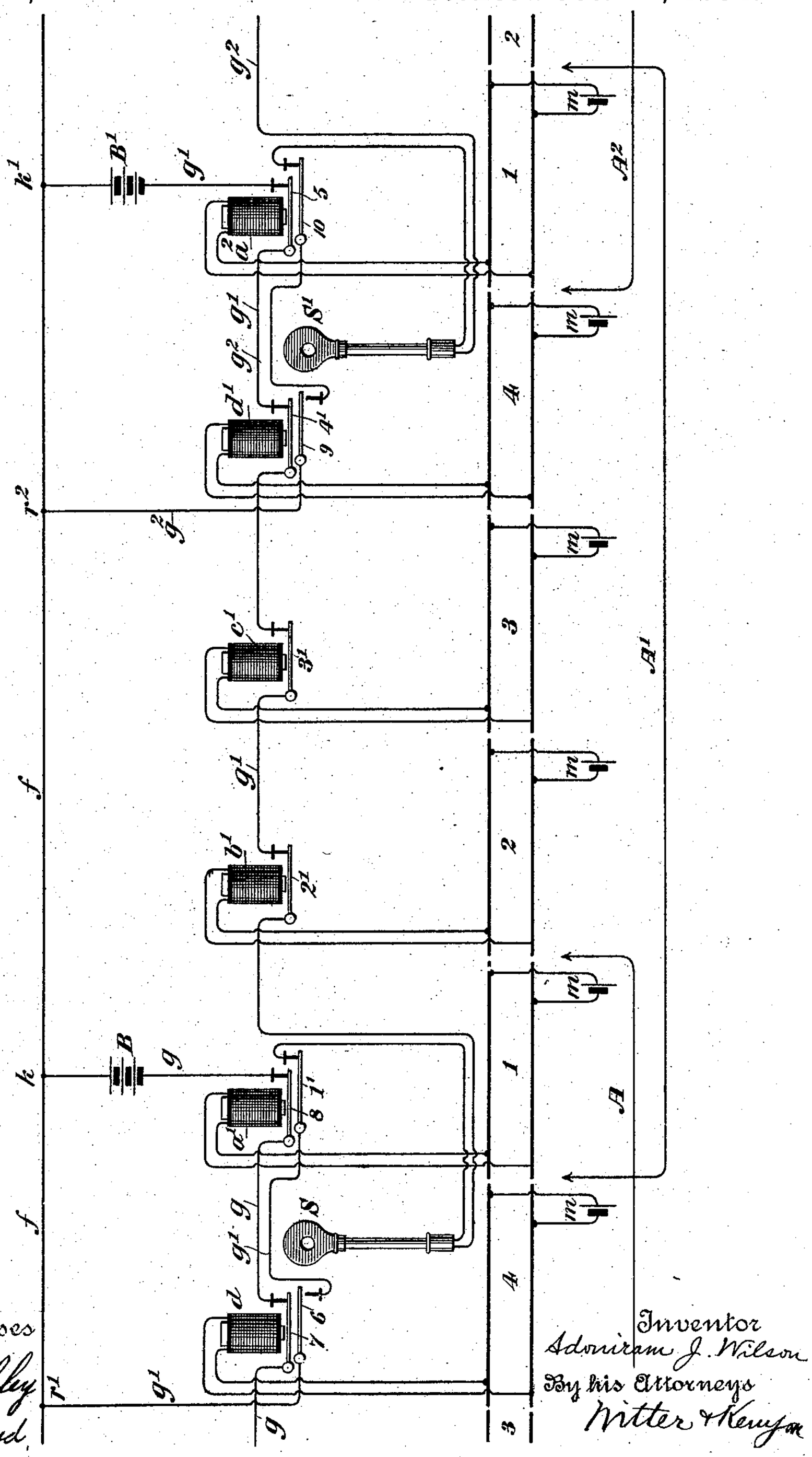
(No Model.)

A. J. WILSON.

ELECTRIC RAILWAY SIGNAL.

No. 528,246. Patented Oct. 30, 1894.



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ELECTRIC RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 528,246, dated October 30, 1894.

Application filed December 16, 1892. Renewed March 28, 1894. Serial No. 505,497. (No model.)

To all whom it may concern:

Be it known that I, ADONIRAM J. WILSON, a citizen of the United States, and a resident of Port Chester, Westchester county, State of New York, have invented a certain new and useful Improvement in Electric Railway-Signals, of which the following, taken in connection with the accompanying drawing, forming part hereof, is a specification.

My present invention relates to automatic electric railway signals for block systems and has for its object to improve and render more certain the operation thereof, thus reducing the liability of false signals, and also to provide for an increase in the present length of the blocks beyond which it is now not practicable to operate the signals. It consists of the devices and their arrangement hereinafter set forth. In systems of this class it has been usual to divide the track into a series of blocks, locating a signal near the beginning of each block and to control these signals by means of signal circuits operated by circuits which include the rails of the track. These blocks have generally been not more than one mile in length and the rails which form part of the circuit of each block have been laid directly upon the cross ties and without the intervention of any insulation. As the train advanced upon the block it operated the signal by bridging the rails and thus shunting the battery from the magnet included in circuit with the rails, thus breaking the signal circuit. It is of course apparent that anything that might break the rail circuits or connect the rails of a section would necessarily operate the signal. Ordinarily the track battery of each section finds the normally closed metallic circuit through the rails of so much less resistance than that offered by the cross-ties that mechanically bridge the rails, or than that offered by the gravel, stone, ashes or other similar material of which the road bed is generally made, that there is little possibility of the battery being short circuited through the cross-ties or roadbed to such a degree that the signal would be thrown to danger; but if the block is materially increased in length its resistance is likewise increased while the resistance of the material composing the roadbed remains the same. It is therefore obvious that there must be a limit to the length of the track section which can safely be employed, for, when its resistance approximates that of the material of the roadbed lying between the rails the battery is likely to be short circuited and produce false signals. For this reason it is not usual to employ a track circuit in systems of this character longer than one mile. There are cases, however, where it has been found advantageous to employ blocks two or three miles in length, or even longer, but the increased resistance of the track circuits and the consequent liability of short circuits between the rails, and therefore false signals, has rendered their employment impracticable. Again, it has been found that the resistance afforded by roadbeds varies considerably in accordance with the particular material used and with the care with which the roadbed may be constructed. For example, it has been ascertained that a cinder roadbed offers less resistance than one made of earth, and also that, where perfect drainage is not provided for, pools of water standing on the track and either bridging the rails or soaking the cross-ties may provide a short path for the circuit. Moreover it may be desirable in some cases to increase the strength of the track battery to such an extent that a considerable portion of its current may find a short path across the rails while scarcely enough finds circuit through the signal circuit to render the operation of the signal certain. These various objectionable features and limitations of construction are largely obviated by my present invention, the embodiment of which permits blocks of considerable length to be employed, and permits this to be accomplished notwithstanding poor insulation of the roadbed, and permits blocks of ordinary length to be employed where the condition of the roadbed would prevent efficient operation with the signaling devices and circuits heretofore employed.

My invention also includes an exceedingly simple and efficient arrangement of circuits and arrangement and construction of other apparatus.

This system has features in common with

my system described in an application filed November 21, 1892, Serial No. 452,631, and it is distinguished principally by the normal de-energization of the signal circuit which retains the signals normally at danger. Before a train enters a block it energizes this circuit and throws the signal to safety. If, however, there is a train in the block about to be entered, this train will de-energize the signal circuit at a second point. The engineer on the first train finding therefore that his train does not put the signal at safety, knows that a train is somewhere in the block which he is about to enter, and waits until the signal clears before he enters the block.

By employing a normally de-energized signal circuit a great saving is made in battery consumption, because the battery or batteries of the signal circuit is normally inactive and is only in a state of excitation just before a train enters a clear section, and by employing a signal normally at danger with a normally open signal circuit, any failure of the parts to act when a train approaches a signal, will leave the signal at danger and thus insure safety.

I may employ various means for maintaining the signal circuit in a de-energized condition, and in the same way I may employ various means for de-energizing the signal circuit at various points along the track section. I have, however, shown and shall describe my system as employing the ordinary means of de-energizing the circuits, viz., a make-and-break contact, but do not wish to be limited to the use of this particular means.

In the accompanying drawing, which represents diagrammatically one embodiment of my invention, the circuits are shown in their normal condition, *i. e.*, when there is no train on the track to operate the signals.

One complete block of the railway is shown in the drawing extending from the signal S to a point beyond the signal S′ so as to make an overlap of a block upon the succeeding block. Portions of the preceding and succeeding blocks are also shown. Thus the section of track guarded by the signal S includes the entire block intervening between the signals S and S′ (divided into sub-sections 1, 2, 3, 4) and a sub-section (1) of the next block. A′ designates this guarded block, A the portion shown of the preceding guarded block, and A² the portion shown of the succeeding guarded block. Each signaling block may be divided into any convenient number of sub-sections, and the overlap may include any desired number of sub-sections. The track sub-sections in each block shown are designated 1, 2, 3 and 4 and 1. Each sub-section of the track is provided at its inner or exit end with a battery *m* and at its outer or entering end with a bridge circuit including a magnet, said magnets being lettered respectively *d*, *a′*, *b′*, *c′*, *d′* *a²*. The signal is located at the outer end of each guarded block. Extending along the track is the line wire *f*, to which are connected the wires *g*, *g′*, *g²*, of guarded blocks A, A′, A², respectively. The wire *g′* connects with *f* at the points *r′* and *k′*, and extends through the normally open circuit breaker 6 (controlled by electro-magnet *d*) and through the normally closed circuit breakers 1′, 2′, 3′, 4′ and 5 (controlled respectively by electro-magnets *a′*, *b′*, *c′*, *d′* and *a²*) and extends to the signal S. At the signal S this circuit acts directly or through intervening mechanism and circuits to put the signal at clear when a current flows through the circuit *f*, *g′*. The circuit *f*, *g′* includes at some convenient point a source of energy here shown as a battery B′, which supplies current to the circuit. To the wire *f* is connected at *r²* a circuit wire *g²*, belonging to the block A². The wire *g²* extends through a second circuit breaker 9 (normally open) controlled by the electro-magnet *d′*, and through a second circuit breaker 10 (normally closed) controlled by the electro-magnet *a²*, then to the signal S′ and thence through the several circuit breakers of the sub-sections and through the battery of the guarded block A² and back to wire *f* in exactly the same way as the wire *g′*. At the point *k*, is connected a circuit wire *g*, belonging to the block A, which passes through the battery B, the two normally closed circuit breakers 8 and 7, the circuit breaker 8 being controlled by the electro-magnet *a′*, and the circuit breaker 7 being controlled by the electro-magnet *d*. Thence the circuit wire passes through the magnets and signal mechanism of the block A. The circuit *f g* being operated to hold its signal to danger after the signal circuit *f g′* is operated to put its signal to danger so that the train is protected by the danger indication of the signal S before a protection of the preceding signal is withdrawn, it is thus seen that these circuits overlap. In the same way it will be seen that the circuits *f g′* and *f g²* overlap.

The operation is as follows:—The signals being normally at danger, as a train enters sub-section 4 of the block preceding the signal S and of the guarded block A it shunts battery *m* from the magnet *d* and breaks the circuit *f g*, at 7 and closes the circuit *f g′* at 6. The break at 7 continues while any part of the train is on the sub-section 4, and retains the signal of block A at danger (or in other words prevents it from going to clear in front of an approaching train) as will hereinafter appear. The completion of circuit *f g′* at 6 operates the signal S of block A′ and throws it to safety, the circuit passing from point *r′*, through circuit breaker 6, circuit breaker 1′, signal S, circuit breakers 2′, 3′, 4′, 5, battery B′ and through wire *f*, back to point *r′*. As the train passes onto sub-section 1 of the guarded block A′, it again breaks the circuit *f g*, this time at 8, and also breaks the circuit *f g′* at 1′, returning signal S to danger. When the train has passed entirely off sub-section 1, the circuit *f g* will be closed at 8 and restored to its normal condition. As the train advances

upon the succeeding sub-sections of block A′ it operates the magnets b', c', d', and a^2, successively, and breaks the circuit $f\ g'$ at these points. As the train enters sub-section 4 it not only breaks the circuit $f\ g'$, but also closes the circuit $f\ g^2$ at 9, which, through its battery, not shown, throws the signal S′ to safety.

From this description of the operation it is obvious that just before entering the guarded block A′ and passing its signal S a train will complete the normal break in the circuit of said block A′ at 6 and that, if the circuit is not broken at 1′, 2′, 3′, 4′ or 5 by the presence of a train on this block, the signal will be moved to safety; and that if a train is already in block A′ the signal S can not be thrown to safety although the circuit may be closed at 6. It is also obvious that as soon as the train enters the sub-section 1 and as long as it is in the block it breaks the circuit fg' and prevents signal S from being thrown to safety by a succeeding train. Thus a train always has a block including its overlaps clear to itself, and danger of collision is avoided.

By introducing into each signal circuit as thus set forth a number of circuit breakers, each controlled by a comparatively short track circuit it is obvious that the length of a block may be indefinitely increased, whatever may be the character of the roadbed, without endangering in any degree the certainty of operation of the system. It is also obvious that inasmuch as the track circuits may be shortened to any degree, whatever may be the length of the block, the batteries m will always find ready circuit through their magnets and maintain the signal circuit intact. In fine, whatever may be the condition of a road bed and its liability to shunt a track battery or whatever may be the strength of a track battery or the length of a signal block desired, my system may be adjusted to meet fully the requirements of each case.

I do not confine myself to any particular character of signal or signal operating mechanism, as they of course may be varied at will. Various other changes may be made without departing from my broad invention. For instance, the track circuits for each subsection need not necessarily include the rails of the track, but the train may operate these track circuits by means of track instruments. Moreover, although I have shown permanently unbroken track circuits adapted to be shunted but never broken, I do not wish to be limited to a circuit of this form. Again the means for operating the signal circuit through the track circuits may be widely varied. The wire f need not be a general circuit wire extending continuously along the track, but may be coterminus with its section and the overlapping feature need not necessarily be employed.

I have shown the overlap of each section covering one sub-section but it may cover more than one or be omitted altogether if desired. Various other changes may also be readily suggested.

The term "track-section" in the claims is of broader significance than the term "block" and, when taken by itself, may include more or less sub-sections than a block is defined to include.

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

1. In an electric signalling system for railways, the combination of a block of a track divided into two or more sub-sections, a track circuit for each sub-section, a normally de-energized signal circuit, means preceding said block for energizing the signal circuit by sending a current therethrough to operate the signal, and means included in said signal circuit for de-energizing it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

2. In an electric signaling system for railways, the combination of a block of a track divided into two or more sub-sections, a permanently unbroken track circuit for each sub-section, a normally de-energized signal circuit and a signal normally at danger, means preceding said block for energizing the signal circuit by sending a current therethrough to operate the signal, and means included in said signal circuit for de-energizing it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

3. In an electric signaling system for railways, the combination of a block of a track divided into two or more sub-sections, a track circuit including the rails of the track for each sub-section, a normally de-energized signal circuit, means preceding said block for energizing the signal circuit by sending a current therethrough to operate the signal, and means included in said signal circuit for de-energizing it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

4. In an electric signaling system for railways, the combination of a block of a track divided into two or more sub-sections, a permanently unbroken track circuit including the rails of the track for each sub-section, a normally de-energized signal circuit, a signal normally at danger, means preceding said block for energizing the signal circuit by sending a current therethrough to operate the signal, and means included in said signal circuit for de-energizing it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

5. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, a track circuit for each sub-section, a normally deenergized signal circuit for each block adapted to operate a signal near the entrance thereof, each block and each signal circuit overlapping, respectively, the suc-

ceeding block and signal circuit, means included in each signal circuit for sending a current therethrough to energize it upon a change in the electric condition of a track circuit of the preceding block, and means included in each signal circuit for deenergizing it upon a change in the electric condition of each of the succeeding track circuits of its block, substantially as and for the purpose set forth.

6. In an electric signaling system for railways, the combination of a block of a track divided into two or more sub-sections, a track circuit for each sub-section, a normally open signal circuit, means preceding said block for closing the signal circuit to operate the signal, and means included in the signal circuit for breaking it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

7. In an electric signaling system for railways, the combination of a block of a track divided into two or more sub-sections, a track circuit including the rails of the track for each sub-section, a normally open signal circuit, means preceding said block for closing the signal circuit to operate the signal, and means included in the signal circuit for breaking it upon a change in the electric condition of each of the track circuits of the block, substantially as set forth.

8. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, a track circuit for each sub-section, a normally open signal circuit for each block adapted to operate a signal near the entrance thereof, each block and each signal circuit overlapping, respectively, the succeeding block and signal circuit, means included in each signal circuit for closing it upon a change in the electric condition of a track circuit of the preceding block, and means included in each signal circuit for breaking it upon a change in the electric condition of each of the track circuits of its block, substantially as and for the purpose set forth.

9. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, one or more sub-sections at the inner end of each block constituting one or more sub-sections at the outer end of the succeeding block, a normally closed track circuit for each sub-section, a normally open signal circuit for each block adapted to operate a signal near the entrance thereof and overlapping the signal circuit of the succeeding block, means for closing the signal circuit upon a change in the electric condition of a track circuit of a preceding block and means for breaking the signal circuit upon a change in the electric condition of each of the succeeding track circuits of its block, substantially as and for the purpose set forth.

10. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, a normally closed track circuit including the rails of the track for each sub-section, a normally open signal circuit for each block, means for closing the signal circuit upon a change in the electric condition of a track circuit of a preceding block to operate the signal, and means for breaking the signal circuit upon a change in the electric condition of each of the succeeding track circuits of its block, substantially as and for the purpose set forth.

11. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, the last one or more sub-sections of each block constituting the first one or more sub-sections of the succeeding block, a normally closed track circuit for each sub-section including the rails of the track and a magnet, a signal circuit for each block including circuit-controllers, each controlled by the magnet of a track circuit, the signal circuit being normally open at the circuit-controller of the first magnet but normally closed at the circuit controllers of the other magnets, the magnets of the last one or more track circuits of each block respectively controlling also the first one or more armatures of the signal circuit of the succeeding block, substantially as and for the purpose set forth.

12. In an electric signaling system for railways, the combination of a block divided into sub-sections, a permanently unbroken track circuit for each sub-section, a signal, a separate track circuit preceding said block, a normally open signaling circuit extending approximately from the outer to the inner end of the block and connected to said signal, said signaling circuit containing a series of normally closed circuit breakers each operated by a change in condition of one of the track circuits, and a normally open circuit breaker operated by a change in the condition of the track circuit preceding said block, substantially as set forth.

13. In an electric signaling system for railways, the combination of a block divided into sub-sections, a normally closed track circuit including the rails of the track for each sub-section, a signal, a separate track circuit including the rails of the track preceding said block, a normally open signaling circuit extending approximately from the outer to the inner end of said block and connected to said signal, said signaling circuit containing a series of normally closed circuit breakers, each operated by a change in the condition of one of the track circuits of the block, and a normally open circuit breaker operated by a change in condition of the rail circuit preceding said block, substantially as set forth.

14. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into subsections, a track circuit for each sub-section including the rails of the track and an electro-

magnet, the inner sub-section of one block corresponding with the outer sub-section of the adjoining block, a signal for each block, a signal circuit for each block connected to said signal and including normally closed circuit breakers, each controlled by an electro-magnet of one of the track circuits of the block, the electro-magnet of the overlap controlling two of said circuit breakers, one in each signaling circuit, and also including a normally open circuit breaker controlled by the electro-magnet of the sub-section of a preceding block, substantially as set forth.

15. In an electric signaling system for railways, the combination of a track divided into a series of blocks, each divided into sub-sections, a normally closed track circuit for each sub-section including an electro-magnet, a portion of the inner end of each block constituting a portion of the outer end of the succeeding block, a signal circuit for each block, one side of which comprises a portion of a wire extending continuously along the track and the other side of which comprises a loop, joining at one of its ends the first mentioned side of the circuit near the inner end of the block, and at its other end joining the said first mentioned side at a point within the exit end of the preceding block, the loop side of said signal circuit including normally closed circuit breakers, each of which is controlled by the electro-magnet of a track circuit of the block and another circuit breaker normally open and controlled by the magnet of a track circuit of the preceding block, the magnets which control the two circuit breakers at the inner end of a block also controlling the first two circuit breakers at the outer end of the succeeding section, substantially as set forth.

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Witnesses:
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