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C. E. BENNETT.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED JULY 11, 1905.

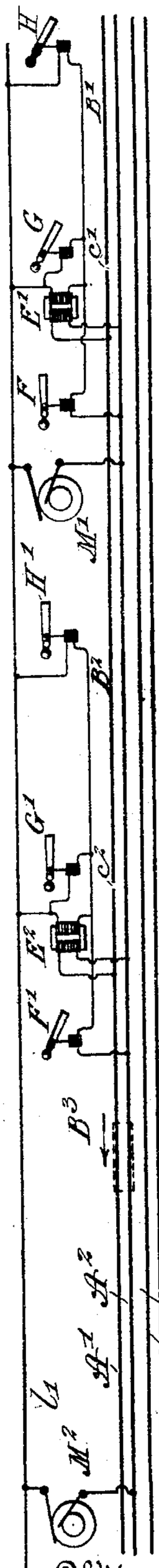

Fig. 1.

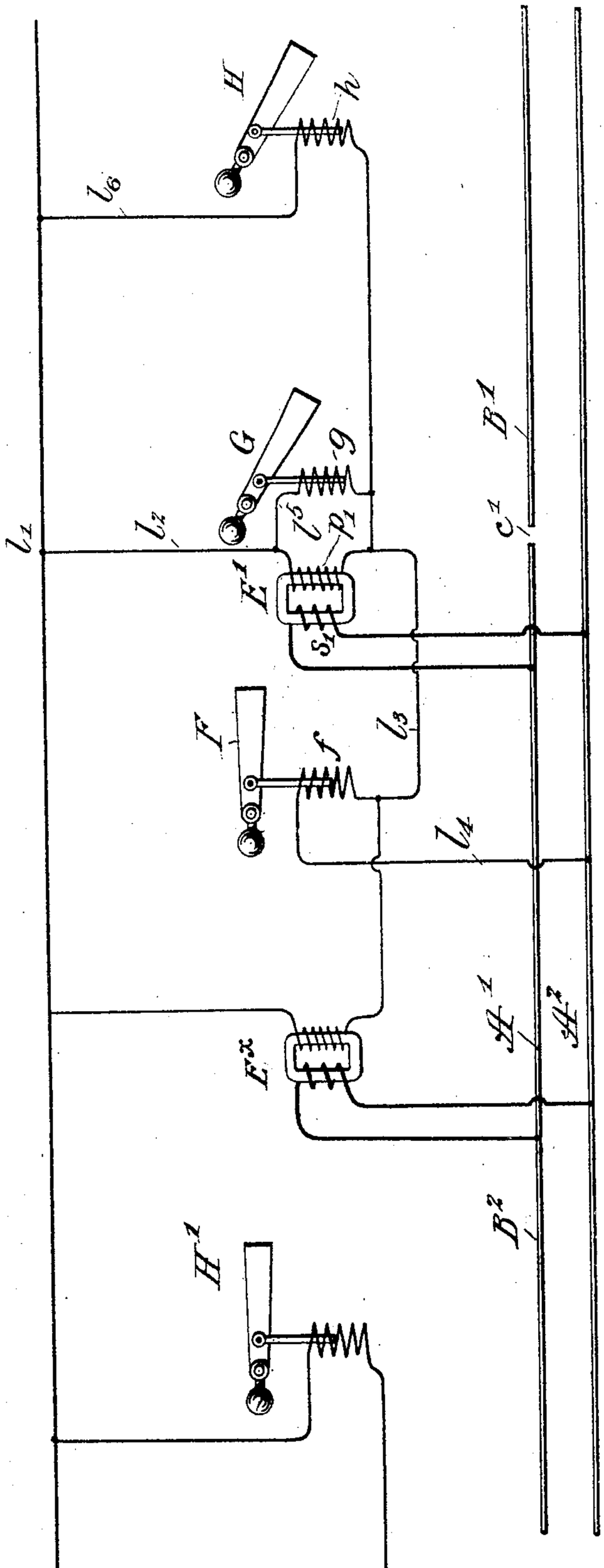

Fig. 2.

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BLOCK-SIGNAL SYSTEM.

No. 803,540. Specification of Letters Patent. Patented Nov. 7, 1905.

Application filed July 11, 1905. Serial No. 269,224.

To all whom it may concern:

Be it known that I, CHARLES E. BENNETT, a citizen of the United States, residing in the city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Block-Signal Systems, of which the following is a full, clear, and exact description.

My invention relates to block-signal systems for railways.

In my prior application, Serial No. 264,675, I have set forth a block-signal system for railways of general applicability, in which transformers are employed in such a way as to avoid the use of relays, contactors, circuit-breakers, and all similar devices.

In the present application I will set forth a system by which the general principles of my generic invention as embodied in the above-entitled application are applied to a double-track system in which home or danger signals are displayed to indicate a train in the block immediately ahead, while caution-signals are provided to indicate the condition of the block to a train before it arrives at the entrance to the block.

A further object of the present invention is to provide means by which an additional signal, which I shall term a "telltale-signal," is displayed within each of the block-sections to indicate the operation of the signals after a train has passed, thereby notifying an engineer that the system is in operative condition and the preceding signals were properly actuated to have shown "safety" in the block which he is entering.

A still further object of the invention is to devise means whereby the failure of any power source will not cripple the system and to further provide means whereby the breakage or short-circuiting of the conductors at any point can only set the signals to "danger," and under no circumstances or combination of circumstances can display signals which would lead an engineer to enter an already-occupied block.

The invention further contemplates a system of such simplicity and freedom from complicated devices as to render the probability of a breakdown exceedingly remote and to permit of easy repair in case a breakdown should occur.

With these and other objects in view my invention consists in the construction, combination, location, and arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally particularly pointed out in the appended claims.

Figure 1 is a diagrammatic view showing a double-track railway having signals embodying the principles of my invention applied thereto. Fig. 2 shows a portion of the same enlarged.

The principle which I employ has already been set forth in my prior application above referred to and need not be reiterated in detail here. It depends on the peculiarity of all transformers, whether single or poly phase, to take a greater amount of current when under "load" than when under "no-load" conditions, due to the change in the inductive resistance of the primary coil when the secondary is put under different load conditions.

Referring now to the drawings and to the various views and reference-signs appearing thereon, wherein like parts are designated by the same reference-sign wherever they occur, A indicates an ordinary double track of any railroad installation, either steam or electric, or any ordinary trolley-line, and comprises rails A', A^2, A^3, and A^4. Inasmuch as the connections for the respective tracks are substantially similar, I will consider only one of them—namely, the upper track in Fig. 1, which includes the rails A' and A^2. I have shown a plurality of blocks or sections B', B^2, and B^3. Between adjacent blocks I have provided the rail A' with insulating-joints c' and c^2, the rail A^2 remaining continuous throughout its length and constituting a return or ground conductor for the system. While I have shown the rails formed in this manner, I do not desire to be limited or restricted thereto, since it is evident that both rails may be made with insulating-joints, or entirely separate conductors may be used, if desired.

E' and E^2 indicate transformers which should be of the "step-down" variety and are preferably wound with a voltage ratio of ten to one, although any convenient ratio may of course be used.

In practice I prefer to employ a pair of transformers instead of a single transformer E' E^2 in each block, and I have designated the second or supplemental transformers as $E^\times$ in Fig. 2. It will be understood that these transformers $E^\times$ are merely supplemental and are used in shunt with the transformers E' and E^2 and have their secondary terminals connected to another point of the

block-section from those of the main transformers E′ and E², the purpose being to insure that the potential drop due to the leakage of current through the rail-ties will not result in too low a voltage at any point of the block-section.

It is to be understood that the use of two transformers within each block-section having their primaries in multiple and their secondaries connected at opposite ends of the section is merely a convenient practical expedient, the features of the main invention operating in the same way with a single transformer in each section as with the two transformers shown.

Referring now more particularly to Fig. 2, the various circuits and connections which I have found convenient to employ in a practical embodiment of my invention will be particularly set forth.

l' indicates a line-wire in which is impressed by any suitable means a constant alternating voltage of any amount—as, for example, two hundred volts.

I have shown a convenient arrangement for impressing the desired voltage in the line-wire, comprising a series of motor-generators or alternators of any sort M′ and M², which are connected in multiple across the line-wires at points between the respective transformers. These operate synchronously in the usual manner of alternating-current generators, and it is clear that any one or more than one of them may be temporarily put out of action without impairing the efficiency of the service. It is also apparent that a break at any portion whatever of the line-wire l' cannot disable the system, since each of the transformers still lies in a circuit with certain of the motor-generators.

I will now consider a convenient arrangement of connections for any one of the block-sections—for example, the section B², which displays signals overlapping the section B′. From l' a circuit is made through primary p' of the transformer E′, wire l^3, and solenoid f of a signal F, from whence the current passes through l^4 into the return-wire or rail A². At the same time a current passes through coil g of signal G, which is in a shunt-circuit around the primary p' of the transformer.

l^6 indicates an additional shunt-circuit around both the primary p' and coil g, and I have included in this circuit a coil h of a signal H.

While I have shown coils for operating the signals F, G, and H, I do not desire to be limited or restricted thereto, since it is obvious that lamps or any other form of signal means could be used in lieu thereof and still fall within the spirit and scope of my invention.

s' indicates the secondary of the transformer formed of a small number of turns of thick wire to give the necessary step-down ratio, and I connect the terminals of this winding to the respective rails A′ and A² of the block-section B².

Under normal conditions when no train is passing any of the block-sections circuits are not completed by the axles of the train through any of the transformer secondary windings, and accordingly each transformer acts like a simple "choke-coil" and imposes a high inductive resistance in the primary thereof. Accordingly current will pass largely through the branch circuits l^5 and l^6, so as to energize the coils g and h to a considerable extent. The effect of energizing these coils is to lower both of the signals G and H to "safety." The current after passing through coils g and h is led through wire l^3 and coil f, but under normal conditions is not sufficient to energize the coil f enough to lower the signal F to "safety." When now a train passes onto a section B², the secondary s' is practically short-circuited, and the inductive effect of this coil serves to diminish the impedance of the primary p', and a comparatively heavy current immediately commences to pass through this winding. Owing to the decreased potential drop across the primary p', the coils g and h no longer receive sufficient current to energize them enough to lower the signals G and H to "safety," and these signals accordingly automatically rise to "danger" by gravity. At the same time the signal F, which is somewhat in advance of the beginning of the block, receives an increased current and is drawn to the safety position. The train thereby receives a clear signal from F and sets the danger-signal G at the entrance to the block, also displaying the caution-signal H at a point a suitable distance back therein or, if desired, at the entrance of the preceding section.

The particular purpose of the signal F, which I have termed the "telltale-signal," is to indicate to the engineer that the apparatus is in working order and the signals G and H were properly displayed behind him to "safety" when he entered the block. It might happen in practice that one of the terminals of the secondary of one of the transformers might become disconnected from its rails, so that safety-signals would be given at the entrance to a block notwithstanding the fact that a train was already located thereon; but by my telltale device such a following train would be stopped by the telltale-signal F, which would not drop to "safety" when the second train entered the block. In like manner the failure of the telltale-signal F to operate indicates to the engineer that the signals G and H have not been properly operated behind him.

The various signals continue to be displayed as above described until the train leaves the block, when the system returns to its original condition with signals G and H at "safety" and the signal F at "danger." In the

meantime the succeeding signals F′, G′, and H′ are displayed by circuit conditions in the following block. It is evident that an engineer in passing the signal H receives a caution-signal indicating the condition of a block before he arrives thereat and further receives a danger-signal at G at the entrance to the block in case a train is still at any point thereon. A breakage or short-circuiting of any of the parts or connections of the primary circuits can only deënergize the various signal-magnets, so that one or more of the signals F, G, or H rises to the danger position to stop the train. It is also evident that a break in the secondary circuit, which would prevent the displaying of danger-signals at G and H, will at the same time prevent a safety-signal at F, so that an engineer is notified of the conditions.

While I have shown the signals as disposed along the track at certain intervals, it is obvious that any other arrangement may be made—as, for example, to have the caution-signal at the entrance to one block and the danger-signal at the entrance to the succeeding section, or, if desired, the signals F or H may of course be omitted altogether.

What I claim is—

1. In a block-signal system, a transformer having a primary circuit including a caution and a danger signal, and a secondary circuit adapted to be closed by a passing train.

2. In a block-signal system, a danger-signal and a caution-signal, a transformer, and means operated by a change in the current strength in the primary of said transformer for displaying said signal, and means operated by a passing train for closing the secondary of said transformer.

3. In a block-signal system, a circuit including the primary of a transformer in which is impressed a constant alternating voltage, a signal-circuit in shunt with said primary, a second signal-circuit in series with said primary, and means actuated by a passing train for varying the load on said transformer.

4. In a block-signal system, a transformer having a constant alternating voltage impressed in its primary winding and having its secondary circuit adapted to be closed by a passing train, and signals which are related to said primary circuit to simultaneously give safety and danger indications in different blocks.

5. In a block-signal system, a transformer, a shunt-circuit for the primary winding of said transformer including a pair of signals, a signal in series with said primary, and means for applying a load to said transformer.

6. In a block-signal system, a pair of transformers having a constant alternating voltage impressed in their primary windings, signals adapted to be actuated by current changes in said primary windings, and a track-section having different points of its length connected to the secondaries of the respective transformers.

7. In a block-signal system, a series of motor-generators arranged to impress a constant alternating voltage in a single line-wire or circuit, a series of transformers having primary windings in multiple across the mains of said circuit and between the motor-generators, and signals operated by current variations in said primary windings.

8. In a block-signal system, a step-down transformer having a shunt-circuit across its primary adapted to operate a caution signal, a second signal in series with said primary and first-named signal, and means actuated by a passing train for imposing a load on said transformer.

9. In a block-signal system, a step-down transformer having its primary in shunt with a home and a caution signal and its secondary connected to the respective rails of a block-section.

10. In a block-signal system, a transformer having its primary arranged to operate a signal by current variations therein, and arranged to display an additional signal in the opposite way to said first-named signal, and means on each of said signals for automatically setting them to danger when the current is open or short-circuited at any point.

11. In a block-signal system, a transformer having a primary adapted to operate home and caution signals, and to simultaneously actuate a telltale-signal in a manner opposite to that of the first-named signals by current variations therein, and means for varying the load on said transformer.

12. In a block-signal system, a step-down transformer having a shunt-circuit across its primary winding, a home and a caution signal in shunt with one another and with said primary winding adapted to be actuated by current variations therein, and means for imposing a load on said transformer.

13. In a block-signal system, a step-down transformer, a signal in shunt with the primary of said transformer, a telltale-signal in series with the primary of said transformer, and a block-section having its rails connected to the secondary of said transformer.

14. In a block-signal system, a series of alternators arranged to impress a constant alternating voltage in a single line-wire or circuit, a series of transformers having primary windings in multiple across the mains of said circuit and between the alternators, and signals operated by current variations in said primary windings.

In witness whereof I subscribe my signature in the presence of two witnesses.

CHARLES E. BENNETT.

Witnesses:
FRANK S. OBER,
ALFRED W. PROCTOR.