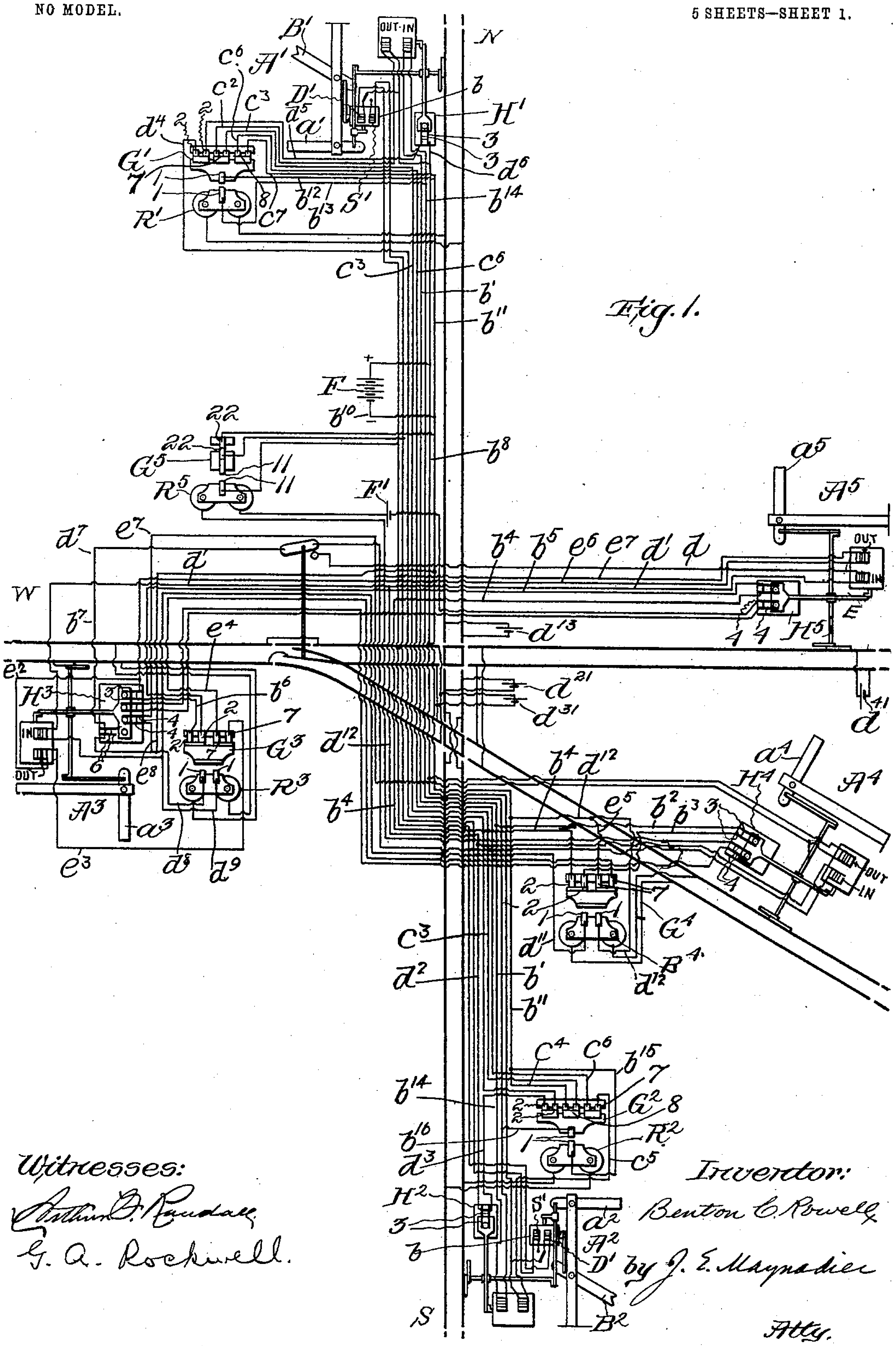
No. 774,498. PATENTED NOV. 8, 1904.

B. C. ROWELL.

AUTOMATIC INTERLOCKING SIGNAL SYSTEM FOR RAILWAYS.

APPLICATION FILED MAY 19, 1900.

NO MODEL. 5 SHEETS—SHEET 1.



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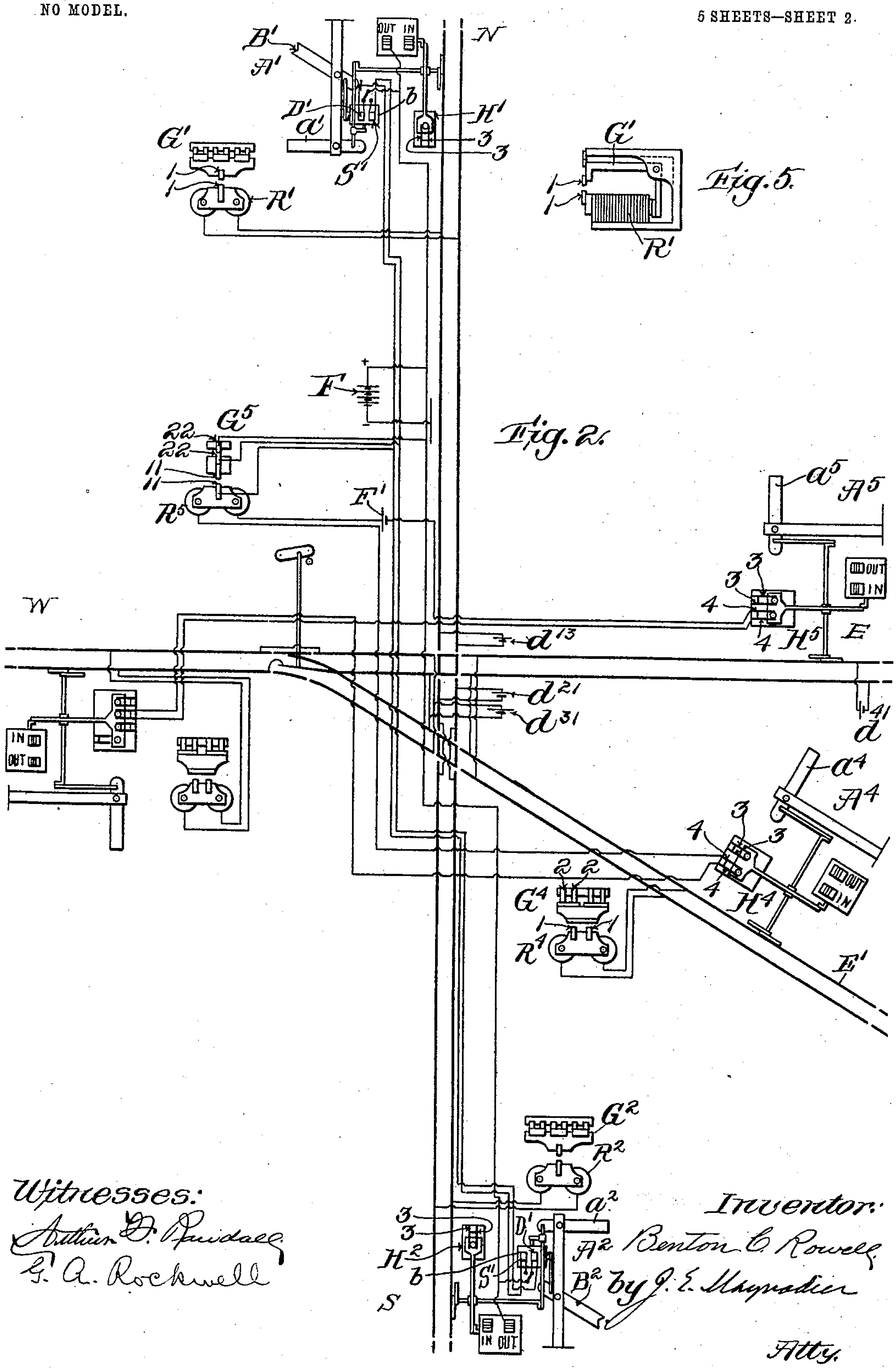

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NO MODEL. 5 SHEETS—SHEET 3.

Fig. 3.

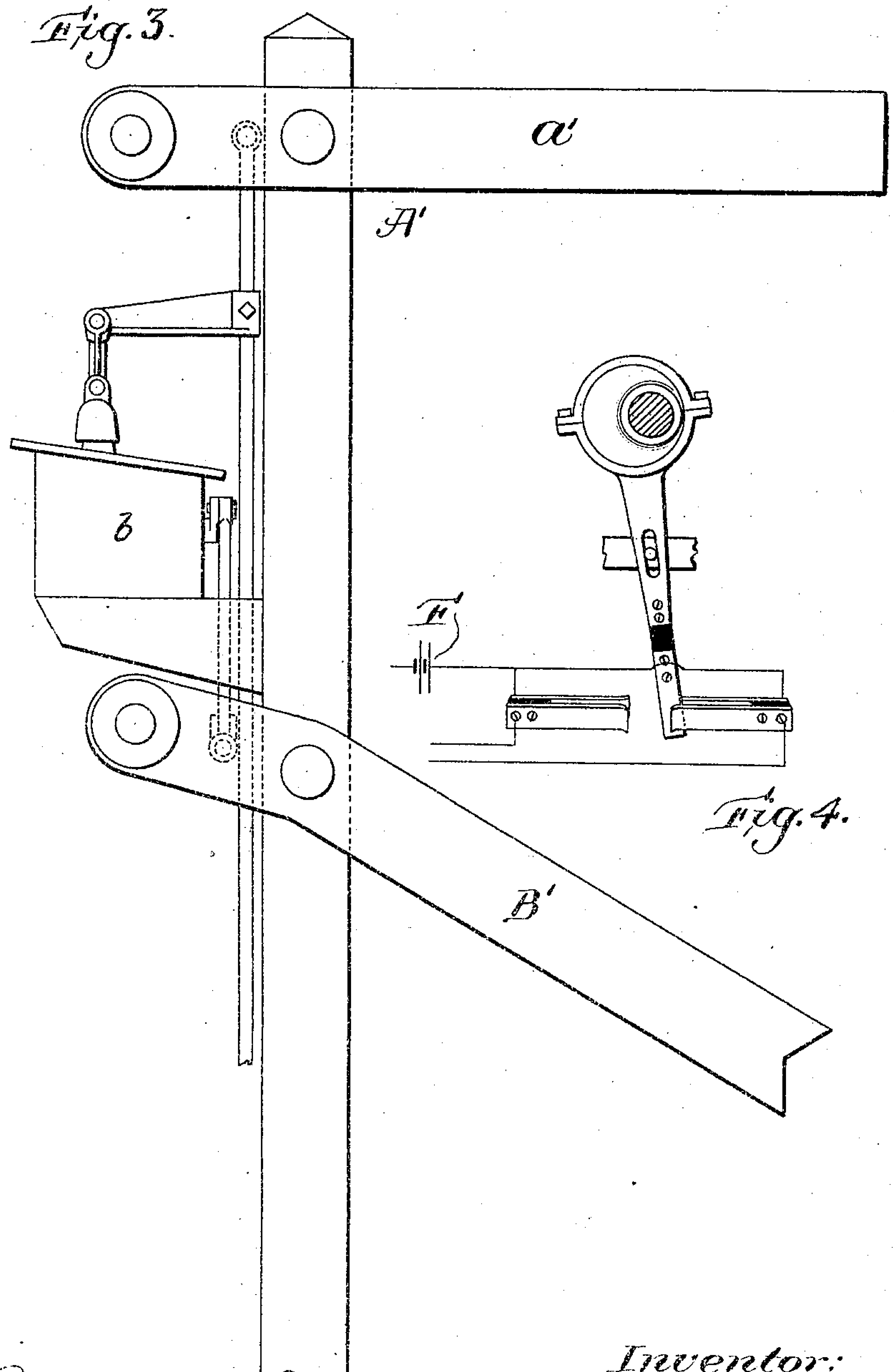

Fig. 4.

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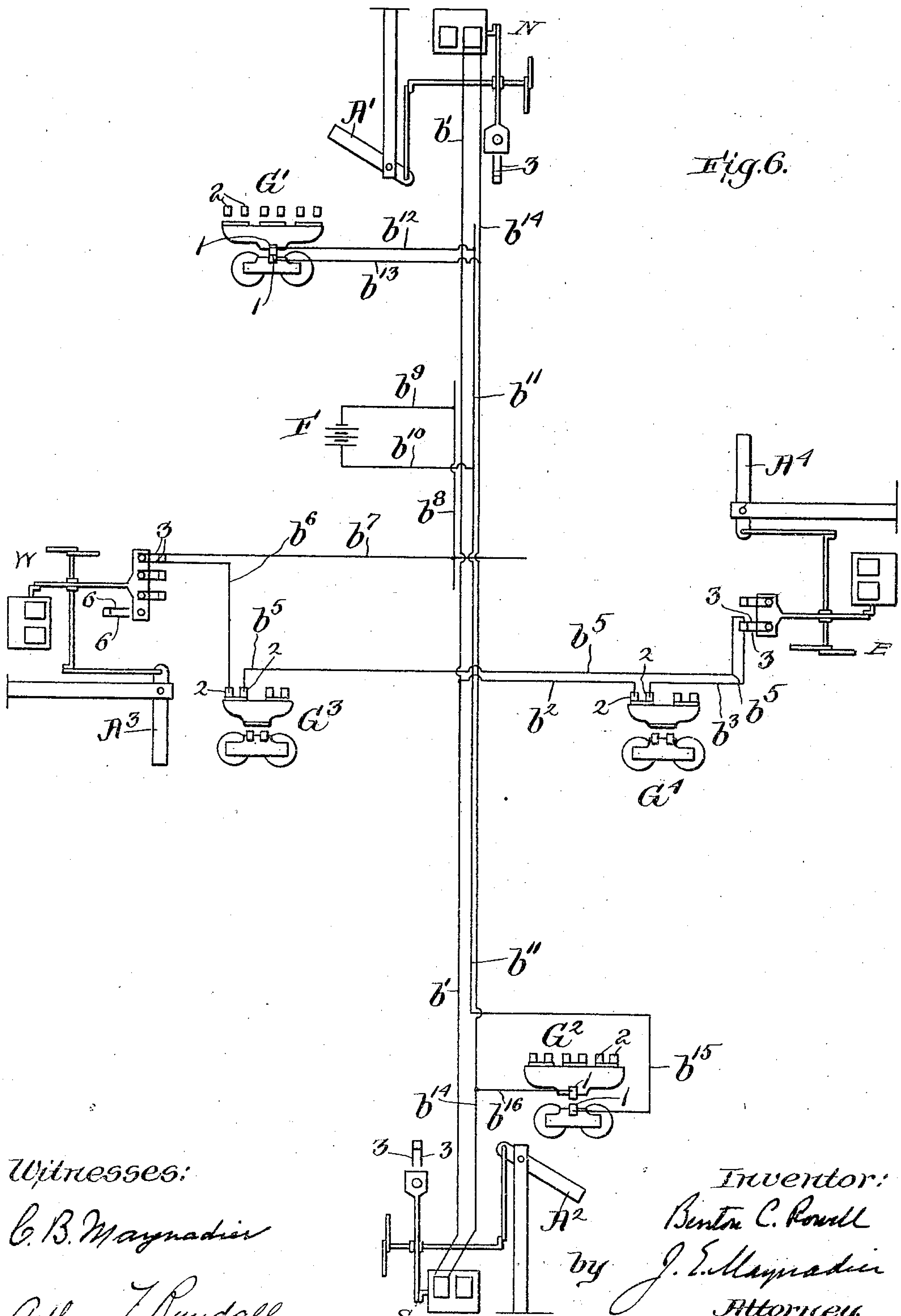

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NO MODEL. 5 SHEETS—SHEET 5.

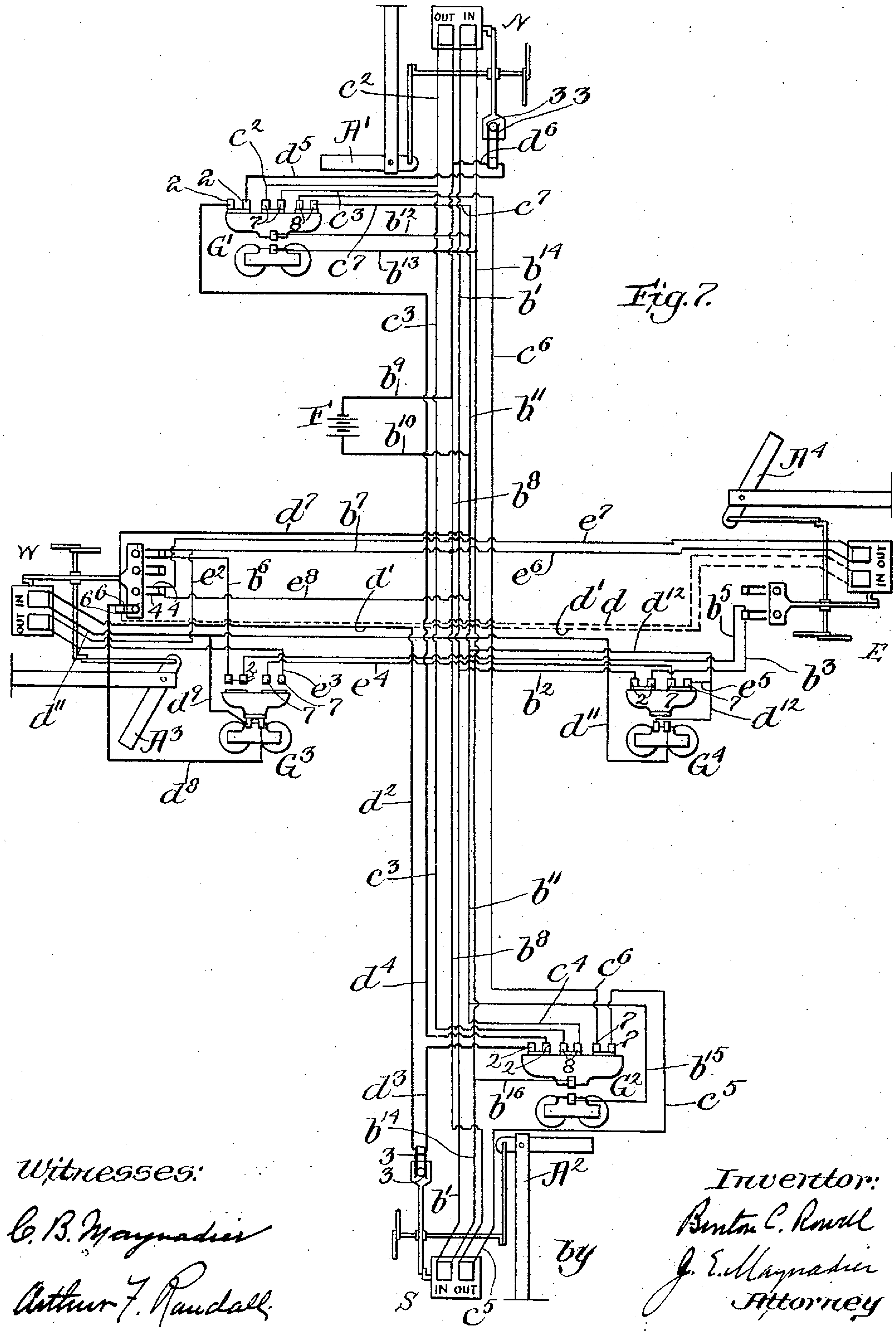

Fig. 7.

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No. 774,498. Patented November 8, 1904.

UNITED STATES PATENT OFFICE.

BENTON C. ROWELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE ROWELL POTTER SAFETY STOP COMPANY, OF PORTLAND, MAINE, A CORPORATION OF MAINE.

AUTOMATIC INTERLOCKING SIGNAL SYSTEM FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 774,498, dated November 8, 1904.

Application filed May 19, 1900. Serial No. 17,241. (No model.)

To all whom it may concern:

Be it known that I, BENTON C. ROWELL, of Chicago, in the county of Cook and State of Illinois, have invented an Improved Automatic Interlocking Signal System for Railways, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a diagram showing one example of my invention. Fig. 2 is a like diagram, but with some of the circuits omitted for clearness. Fig. 3 is an elevation of a signal-post with a main and a secondary signal and a power-storing apparatus which is supplied with power from the main signal and uses that power to operate the secondary signal. Fig. 4 is a detail of a switch forming part of a power-machine and is described below. Fig. 5 is a detail of magnet R′ and circuit-shifter G′ of Fig. 1. Fig. 6 is a diagram like Fig. 1, but without the branch track and secondary signals and showing the safety-circuits only. Fig. 7 is a diagram like Fig. 6, but showing both the danger and safety circuits.

My invention relates to the automatic protection of trains at crossings; and it consists in the combination of blocking appliances, means for shifting those blocking appliances, shifting-circuits by which the means for shifting the blocking appliances are caused to operate, and switches in those shifting-circuits, two of which are automatically operated by the train and the third is automatically operated on the shifting of the blocking appliance, all as more fully described below.

A second feature of my invention is the combination of the main blocking appliances of my system with secondary or auxiliary signals in such a way that the main or home signals may indicate "danger," while the auxiliary or secondary signals indicate "safety"—that is, the secondary or auxiliary signals when set to "safety" simply give advance information, in effect, that although the home signals are set to "danger," yet the automatic devices are so set that the home signal will clear or be shifted automatically to "safety" before the train reaches it, and all this will be made clear below.

The devices employed in my system in practice are as follows: Blocking appliances, (indicated by A′ A^2, &c.,) shown conventionally as semaphore-blades *a′* a^2, &c.; mechanisms for actuating them, (shown diagrammatically,) which also actuate the switches H′ H^2, &c., and these mechanisms, called "power-machines," are set in motion by the magnets marked "Out" and "In" in a manner long well known, and fully described in my Patents No. 599,456, dated February 22, 1898, and No. 671,032, dated April 2, 1901; switches G′ G^2, &c., (shown in side elevation in Fig. 5,) operated by magnets R′ R^2, &c.; switches H′ H^2, &c., which move with the blocking appliances A′ A^2, &c., but are directly controlled by the power-machines, which shift those appliances from "danger" to "safety," and vice versa, and in so doing open or close the switches H′ H^2, &c.

The blocking appliances need no detailed description, as they have long been known and are familiar to all skilled in the art under the general name of "signals," either indicative, as instructing the engineer not to pass when the signals are at "danger," but allowing him to pass when they are at "safety," or prohibitive, as preventing the passage of a train when the signals are at "danger," but allowing it to pass when they are at "safety." The mechanism for actuating the blocking appliances are also so well known that they need no detailed description, but those preferred as elements of my combination comprise two magnets, (marked "Out" and "In" in the drawings,) a current through the coils of the "in" magnet shifting its blocking appliance to "safety," while a current through the "out" magnet shifts it back to "danger."

The switches H′ H^2, &c., are simply switch-points 3 3, connected, respectively, to two moving parts of the blocking appliance in order that the shifting of the blocking appliance to "danger" will connect the switch-points, while its shifting to "safety" will disconnect them. The switches G′ G², &c., are also well-known arrangements of switch-points 1 1 and 2 2 and 11 11 and 22 22, controlled by magnets R′ R², &c., a current through these magnets separating the points 1 1 or 11 11 and bringing the points 2 2 or 22 22 together.

Considering first the section of track N, a train entering at N electrically connects the rails of that section of track and short-circuits track-battery d^{13}, one pole of which connects with one rail of section N, the other with the other rail, as usual. Magnet R′ is thus caused to drop its armature and connect the normally open points 1 1 of its switch G′, thereby completing "safety-circuit" from the main battery F through the "in" magnet of the main power-machine of signal A′, as clearly shown in Fig. 1. It will also be clear that this circuit is through the "in" magnet of the main power-machine of signal A². The completion of the safety-circuit through the "in" magnet of the main power-machine of signal A′ clears signal A′, so that the train can pass onto section N, and the completion of safety-circuit through the "in" magnet of the main power-machine of signal A² also clears signal A², so that the train which has passed over section N may pass off of section S. It will also be seen from Fig. 6 that the safety-circuit is from battery F through points 1 1 of G′, through the coils of the "in" magnet of A′, and also from battery F through the coils of the "in" magnet of A²; but the safety-circuit is also through the points 2 2 and 3 3 of switches G³ and H³ G⁴ H⁴, and therefore it is impossible to completely close that circuit unless switch-points 1 1 of G′ and 2 2 and 3 3 of G³ and H³ are both closed; but switch-points 3 3 of H³ are under the control of blocking appliance of A³, being closed only when A³ is at "danger" and open only when A³ is at "safety." The points 1 1 of G′ are closed as soon as a train with the right of way enters section N; but all the points 3 3 are then closed, because all the blocking appliances are then at "danger" and energizing the "in" magnets of A′ and A² results in shifting A′ and also A² to "safety," and that opens points 3 3 of H′ and of H², breaking the circuit of W at 3 3 of A′ and A². The train, which has entered N in its progress toward S, keeps track-battery d^{13} short-circuited until its rear end leaves N; but when its forward end enters S track-battery d^{21} is short-circuited and magnet R² drops its armature, thereby connecting 1 1 of G², but without effect until the rear of the train leaves N, allowing 1 1 of G′ to open and 2 2 of G′ to close, but also without effect, as the circuit will then be through 1 1 of G². As the rear of train from N leaves N battery d^{13} is no longer short-circuited, and therefore R′ is reënergized, lifts its armature, disconnecting 1 1 and reconnecting 2 2 of G′; but this is simply a first step toward resetting A′ and A² to "danger" as the train leaves S, when battery d^{21} being no longer short-circuited reënergizes magnet R², which lifts its armature G², disconnecting 1 1 and reconnecting 2 2 of G², thereby breaking the "in" circuit and restoring the "out" circuit, as shown completed in Fig. 1, through the "out" magnets of A′ and A² and shifting A′ and A² back to "danger," as will be clear.

Should there be a train approaching at W on the crossing track while a train is on sections N or S, the approaching train will as soon as its front enters W short-circuit track-battery d^{31}, deënergize magnet R³, connect points 1 1, and disconnect points 2 2 of G³, but will not complete the "in" circuit of A³, for the reason that that "in" circuit is broken at points 2 2 of G′ when any part of a train is on N or S and also at points 3 3 of H′ and of H² when A′ and A² are at "safety." Conversely, should any part of a train occupy sections W or E or E′ when a train is approaching N or S the approaching train cannot complete its "in" circuit for A′ or A² and clear either A′ or A², because no "in" circuit can be completed when any opposed "in" circuit is complete, for completing the circuit through any "in" magnet breaks all opposing circuits at the points 2 2 and 3 3—that is, when circuit through "in" magnet of A′ is completed points 1 1 of G′ must be in contact and points 2 2 of G³ and 3 3 of H³ must also be in contact and points 2 2 of G′ are out of contact, while points 3 3 of H′ remain in contact for a few moments only after a circuit through the "in" magnet of A′ is completed.

The safety-circuits of A′ and A² are shown separately in Fig. 6. In that figure the "in" magnet of A′ is connected by wires b' b^{14} to "in" magnet of A². Wire b' is connected by wire b^2 to one of the points 2 2 of G⁴, the other point being connected by wire b^3 to one of the points 3 3 of A⁴. The other point 3 of A⁴ is connected by wire b^5 to one of the points 2 2 of G³, the other point being connected by wire b^6 to one of the points 3 3 of A³. The other point 3 of A³ is connected by b^7 with wire b^8, from which wire b^9 leads to one pole of battery F. The other pole of battery F is connected by wire b^{10} with wire b^{11}. At G′ one of the points 1 1 is connected by wire b^{12} with b^{11} and the other point 1 of G′ is connected by b^{13} with wire b^{14}, so that a train entering N will automatically close 1 1 of G′, and thereby close the safety-circuits of the "in" magnets of A′ and A², providing that circuit is not open at 2 2 or 3 3 of A³ or of A⁴. Wire b^{11} is also connected by wire b^{15} with one of the points 1 1 of G², and wire b^{14} is also connected by wire b^{16} with the other point 1 of G². It will therefore be clear that a train entering at S may close points 1 1 at G² and complete the safety-circuits through the "in" magnets of A′ and A².

The safety-circuits of A^3 and A^4 are shown closed in Fig. 7 and are as follows: When an entering train closes points 1 1 of G^3 and connects wire d^8 with wire d^9, wire d^8 is connected through wires d^7, b^{11}, and b^{10} with battery F. The other pole of battery F is connected through wires b^9 b^8, and d^6 with one of the points 3 3 of A'. The other point 3 of A' is connected by wire d^5 with one of the points 2 2 of G' and the other point 2 of G' by wire d^4 with one of the points 2 2 of G^2, the other point 2 of G^2 by wire d^3 with one of the points 3 3 of A^2, the other point 3 of A^2 by wire d^2 with wire d', connected at its ends with the "in" magnets of A^3 and A^4; but this circuit is at first only from d^2 to the "in" magnet of A^3, thence by wires d^{11} and d^9 back to the other point 1 of G^3. Thus it will be seen that an entering train at W or E first completes only that part of its safety-circuit through the "in" magnet of A^3; but as soon as A^3 is thereby shifted to "safety" points 6 6 of A^3 are bridged and the safety-circuit through "in" magnet of A^3 is extended through "in" magnet of A^4 by wire d and that part of wire d' which connects the "in" magnet of A^4 with wire d^2.

The danger-circuits of A' and A^2 are as follows: starting from battery F by wires b^9 and b^8 to "out" magnet of A', thence by wires c^2, switch-points 7 7 of G', wire c^3, switch 8 8 of G^2, wires c^4 b^{11} b^{10}, back to battery F. This circuit is for the "out" magnet of A' only. The circuit of "out" magnet of A^2 is as follows: battery F, wires b^9 b^8, "out" magnet of A^2 c^5 7 7 of G^2, c^6 8 8 of G', c^7, b^{11}, and b^{10}, back to battery F.

The danger-circuits of A^3 and A^4 are as follows: starting from battery F by wires b^9 and b^8, from b^8 by e^6 to "out" of A^4, thence by e^7, points 4 4 of A^3, e^8, b^{11}, b^{10}, back to battery F; the danger-circuit for A^3 from battery F by b^9, b^8, b^7, and e^2 to "out" magnet of A^3, thence by e^3, points 7 7 of G^3, e^4, points 7 7 of G^4, e^5, d^{12}, b^{11}, and b^{10}, back to battery F.

As it is necessary in the example of my invention shown in Fig. 1 of the drawings that a switch be used at the fork, an east-bound train entering section W shifts signal A^3 only and does not shift signal A^4 or A^5; but when signal A^3 is shifted from "danger" to "safety" by the entrance of an east-bound train on section W (of course if there be no train on section N or S and if each of the signals A' and A^2 be at "danger") then one of the signals A^4 or A^5 will be shifted to "safety" by signal A^3, and it will depend wholly upon the position of the switch of the fork which of the two A^4 or A^5 is shifted from "danger" to "safety." It will also be clear that shifting the track-switch at the fork will shift the electric switch controlled by the track-switch, and thereby shift A^5 to "safety," the purpose being in this particular instance to allow trains to use sections W, E, and E' for switching, but to amply protect all trains on W, E, or E' from collision with crossing trains on N or S and also to protect all trains on N or S from collision with crossing trains on W, E, or E'. In this example of my invention I have not shown any means for protecting trains from strictly head-on or strictly rear-end collisions, mainly because such protection was not in fact desired in the case shown in the drawings, but also because that is fully described in my pending application, Serial No. 705,435, filed February 13, 1899.

When there is no train on either section N or S, the circuits through the "out" magnets of the main power-machine of home signals A' A^2 are completed, for when there is no train on any part of section N its track-battery is no longer short-circuited, and consequently its magnet R' or R^2 attracts its armature, and thereby disconnects contact-points 1 1 and reconnects all the other contact-points of circuit-shifter G' or G^2.

When magnet R' is energized by the absence of a train from section N and contacts 1 1 disconnected, but all other contacts of G' connected, the circuit through the "out" magnet of home signal A' is completed so far as circuit-shifter G' can complete it; but that circuit is not fully completed until there is no train on section S, when circuit-shifter G^2 is operated and disconnects contacts 1 1 of G^2, reconnecting all other contacts of G^2 and completing not only a circuit through "out" magnet of A', but also a circuit through "out" magnet of A^2.

The object of causing the circuit of the "out" magnet of A' to depend upon the circuit of the "out" magnet of A^2, and vice versa, is simply to hold both signals A' and A^2 at "safety" so long as any train is on either section N or S and both at "danger" only when there is no train on either N or S, for this results in economy in construction in this instance and in all cases in which direct rear and direct front end collisions are not to be guarded against.

When there is no train on section W, its track-battery is not short-circuited, and therefore magnet R^3 is energized, contacts 1 1 of G^3 disconnected, and all other contacts of G^3 reconnected, and this so far completes the circuit through the "out" magnet of signal A^3 that if there be no train on either section E or E' the track-battery common to sections E and E' will not be short-circuited and magnet R^4, also common to sections E and E', will be energized and contacts 1 1 of G^4 disconnected and all other contacts of G^4 reconnected, completing the circuit of "out" magnet of A^3 and shifting A^3 back to "danger;" but when the safety-stop, derail, or other absolute blocking appliance which forms part of home signal A^3 goes to "danger" it not only closes a circuit at 3 3 of circuit-shifter H^3, as before described, but also closes a circuit at 4 4 of H^3 and breaks a circuit at 6 6 of H^3; but making contact at 4 4 completes the circuits through the "out" magnets of signals A^4 and A^5, which go to "danger." The break at 6 6 of circuit-shifter H^3 breaks the circuits through the "in" magnets of A^4 and A^5. When A^4 and A^5 go to "danger," contacts 3 3 and 4 4 of circuit-shifters H^4 and H^5 are of course closed.

In order that the trainmen of a train running rapidly toward section N or toward section S may have advance information as to whether sections W, E, and E′ are clear, I have devised what I call "indicator-signals" B′ B^2, which for convenience are shown mounted on the posts of semaphores *a′* a^2; but the indicator-signals B′ B^2 must be wholly independent in their movements of home signals A′ A^2, for they must be automatically shifted by trains running over sections W, E, and E′ in this example of my invention. Each of these secondary or indicator signals is so connected to a main signal that the movement of the main signal operates a small machine *b* (conventionally represented) for storing power, and that small power-storing machine operates its secondary signal, there being no necessary connection between the main signal and its secondary signal, except that the movement of the former furnishes power by which the latter may be automatically moved as desired. The advantages are that advance information can be given to trainmen as to the condition of a section of track as to which they need information before that information can be given by the home signal, and this is of high importance in automatic interlocking systems, especially when the home signals are such as to compel a stop. The main novelty of this feature of my invention is that a train on W, E, or E′ automatically shifts the secondary signals B′ B^2, either or both, as may be desired, on sections N S, and while this is new with me yet as a practical matter it is far better to actuate the secondary signals B′ B^2 by power stored up from the movements of the home signals A′ A^2 than to provide track power-machines for the secondary signals B′ B^2, for the power ample for the secondary signals is small compared to that practically essential for the home signals, and consequently this feature of my invention is as a practical matter the combination of a home signal, (including signals of any kind,) a secondary signal, a power-storing apparatus, connections between the main signal and the power-storing apparatus by which movements of the main signal store up power in the power-storing apparatus, and other connections between the power-storing apparatus and the secondary signals by which the power-storing apparatus when released shifts the secondary signal, including, of course, proper instruments by means of which the secondary power-storing apparatus is released when the secondary signal is to be shifted. In this example of my invention these secondary signals B′ B^2 are required only for sections N and S, over which trains run at high speed, and I have shown only one magnet R^5 and circuit-shifter G^5 for controlling the circuits of the magnets S′ and D′ of both secondary power-machines. These circuits are shown in Fig. 2, in which R^5 is magnetized from battery F′ when the home signals A^3 A^4 A^5 are each at "danger," for when the safety-stops or derails forming part of the home signals A^3 A^4 A^5 go to "danger" the points 4 4 of each circuit-shifter H^3 H^4 H^5 are connected, and a circuit is thereby completed through magnet R^5, battery F′, and points 4 4 at A^3 A^4 A^5. When R^5 is energized, points 22 22 of circuit-shifter G^5 are connected, and circuits from battery F are thereby completed through safety-magnets S′ of both secondary power-machines and both secondary signals B′ and B^2 are shifted to "safety;" but when either of the signals A^3, A^4, or A^5 is at "safety" the points 4 4 are disconnected and the circuit through magnet R^5 thereby broken and points 22 22 disconnected and 11 11 reconnected; but when 11 11 of G^5 are connected the circuits of which 11 11 are electrodes are through magnets D′ of the secondary power-machines, and the secondary signals B′ B^2 are therefore shifted to "danger," and this also will be clear from Fig. 2, for the saftey-circuits of the secondary power-machine are much the same as the danger-circuits of those machines, the main difference being that points 22 22 of G^5 must be connected to complete the safety-circuits of the secondary signals B′ B^2, while points 11 11 must be connected to complete the danger-circuits of those secondary signals.

The switches shown in detail in Fig. 4, one between the "in" and "out" magnets of the main power-machines and the safety and danger magnets of the secondary power-machines, are each shifted by the operation of its power-machine—that is, when a current flows through either magnet, and thereby releases the detent of the power-machine controlled by that magnet, the power-machine rotates until again arrested by its other detent, and thereby shifts its switch from one magnet to the other. This will be clear from Fig. 4, which is a detail showing the switch of the power-machine, the power-machines themselves being well known, and, moreover, they are fully described in my Patent No. 599,456, dated February 22, 1898.

Each home signal must be shifted to "safety" before a train can enter a section, and the shifting-circuit of each home signal must be made complete before the entering train can shift its home signal to "safety;" but each entering train operates its own circuit-shifter and cannot operate opposing circuit-shifters. Thus a train in order to enter section N must connect 1 1 of G′ and disconnect 2 2 of G′; but a train entering at N cannot connect 1 1 of G^3 or G^4, which are circuit-shifters in opposing shifting-circuits, nor can either of those opposing shifting-circuits be completed while points 2 2 of G′ or G^2 are disconnected. So a train entering at W connects points 1 1 of G^3 and disconnects points 2 2 of G^3, and a train entering at E or E′ connects points 1 1 of G^4 and disconnects points 2 2 of G^4. Moreover, the shifting of any home signal to "safety" separates the points 3 3 of the switch H′, H^2, H^3, H^4, or H^5 of that home signal, and thereby makes a second break in all opposing shifting-circuits. Also when either home signal A^3, A^4, or A^5 is shifted to "safety" the circuit-shifter G^5 of the secondary signals B′ B^2 connects points 11 11 and the secondary signals are shifted to "danger," and when A^3, A^4, and A^5 are at "danger" circuit-shifter G^5 connects points 22 22 and the secondary signals are shifted back to "safety." This mode of interlocking the shifting-circuits for shifting the home signals to "safety" so that each shifting-circuit depends not only upon its own circuit-shifter, but also upon two other sets of circuit-shifters, one set under control of opposed trains and another set under control of opposed blocking appliances, insures absolute protection, while interlocking the shifting-circuits of the secondary signals with the shifting-circuits of the opposed home signals makes my system wholly practical, as it enables fast trains to be run at full speed if such trains have the right of way, as the engineer need not slacken speed if the secondary signal be at "safety."

What I claim as my invention is—

1. In an automatic interlocking signal system, signal-shifting circuits each provided with a circuit-shifter or switch for automatically opening opposing signal-shifting circuits and closing its own signal-shifting circuit when a train enters one section; and a second circuit-shifter or switch actuated by the movement of its blocking appliance to cause a second break in opposing signal-shifting circuits.

2. In an automatic interlocking signal system, home signals; shifting-circuits each for automatically shifting its home signal from danger to safety; a circuit-shifter, or switch, for each shifting-circuit actuated by the train for automatically opening opposing shifting-circuits and closing its own shifting-circuit; and a second circuit-shifter or switch for each shifting-circuit controlled by the movement of its home signal for making a second break in opposing shifting-circuits.

3. In an automatic interlocking signal system, home signals; a shifting-circuit for each home signal; a circuit-shifter or switch in each shifting-circuit controlled by its own train; a second circuit-shifter or switch in each shifting-circuit controlled by opposing trains; and a third circuit-shifter or switch in each shifting-circuit controlled by opposing home signals.

4. In an automatic interlocking signal system, home signals; shifting-circuits for the home signals; secondary signals; shifting-circuits for the secondary signals; circuit-shifters or switches in the home-signal-shifting circuits controlled by trains; and a circuit-shifter or switch in the secondary signal-shifting circuits controlled by the circuit-shifters or switches in opposing home-signal-shifting circuits.

5. In combination a main signal; means for automatically shifting the main signal; a secondary signal; means for storing the power of the main signal for automatically shifting the secondary signal; automatic means for controlling the shifting means of the main signal, and automatic means for controlling the shifting means of the secondary signal, all arranged to operate substantially as and for the purposes described.

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