(No Model.)

5 Sheets—Sheet 1.

C. A. HAMMOND.

ELECTRIC SIGNAL FOR RAILWAYS.

No. 523,767. Patented July 31, 1894.

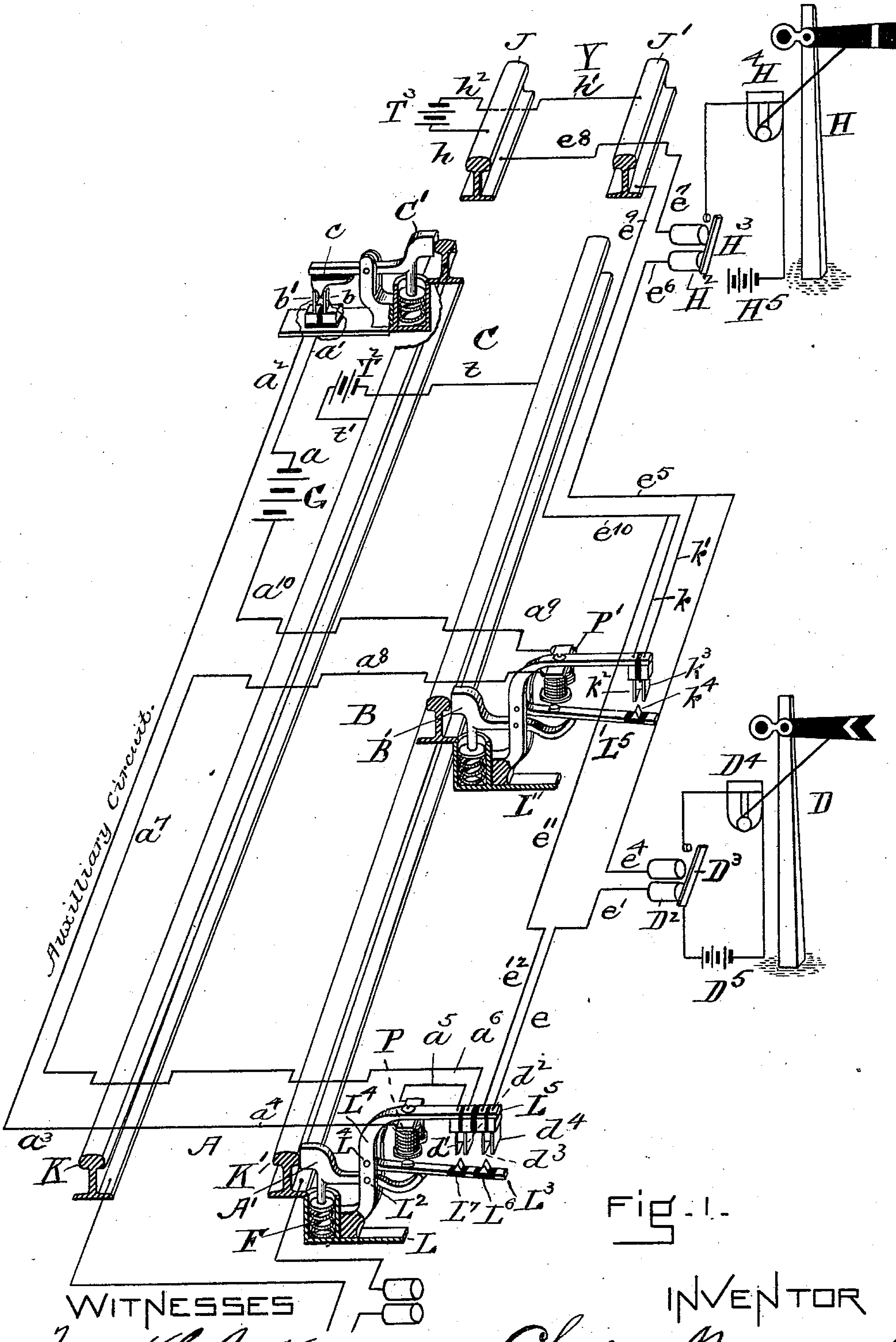

Fig. 1.

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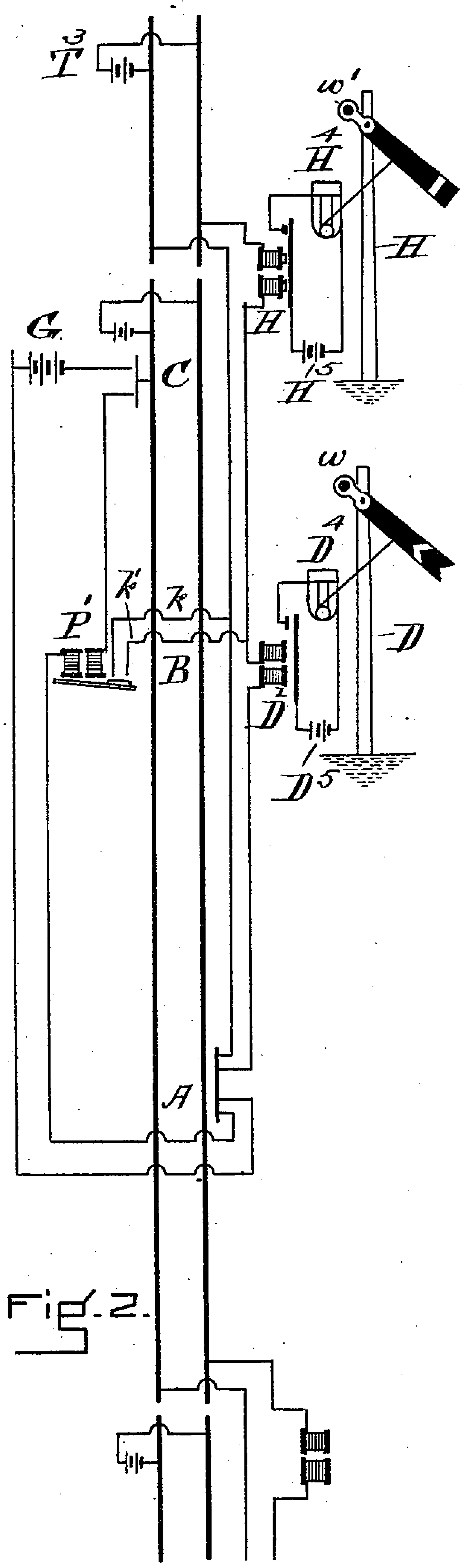

Fig. 2.

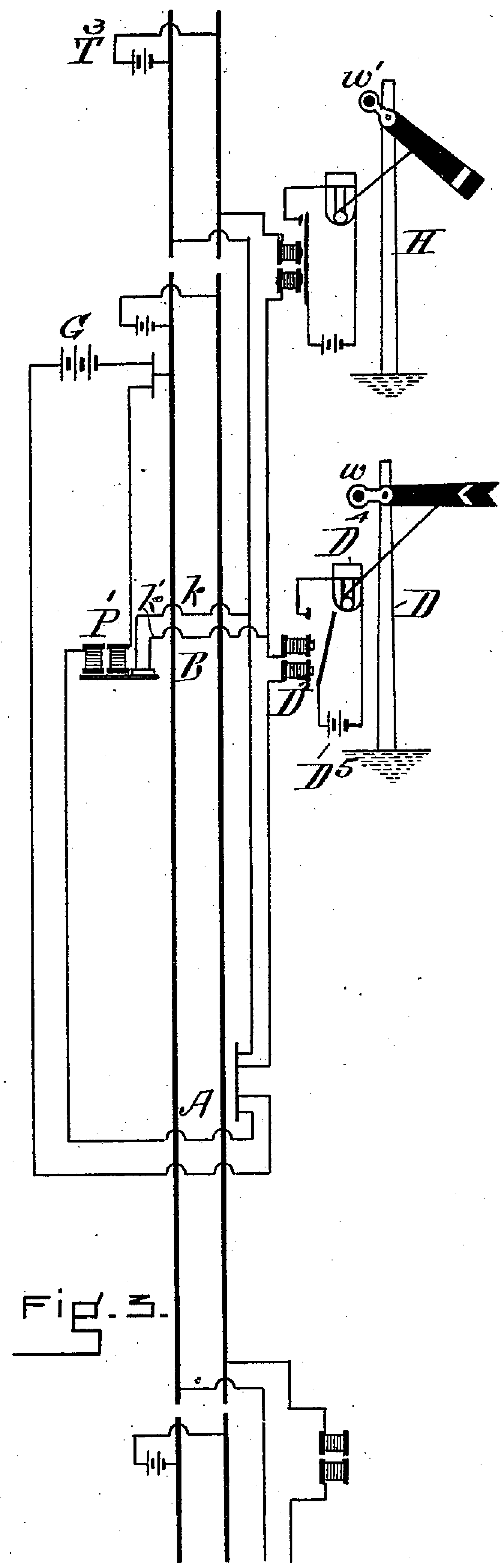

Fig. 3.

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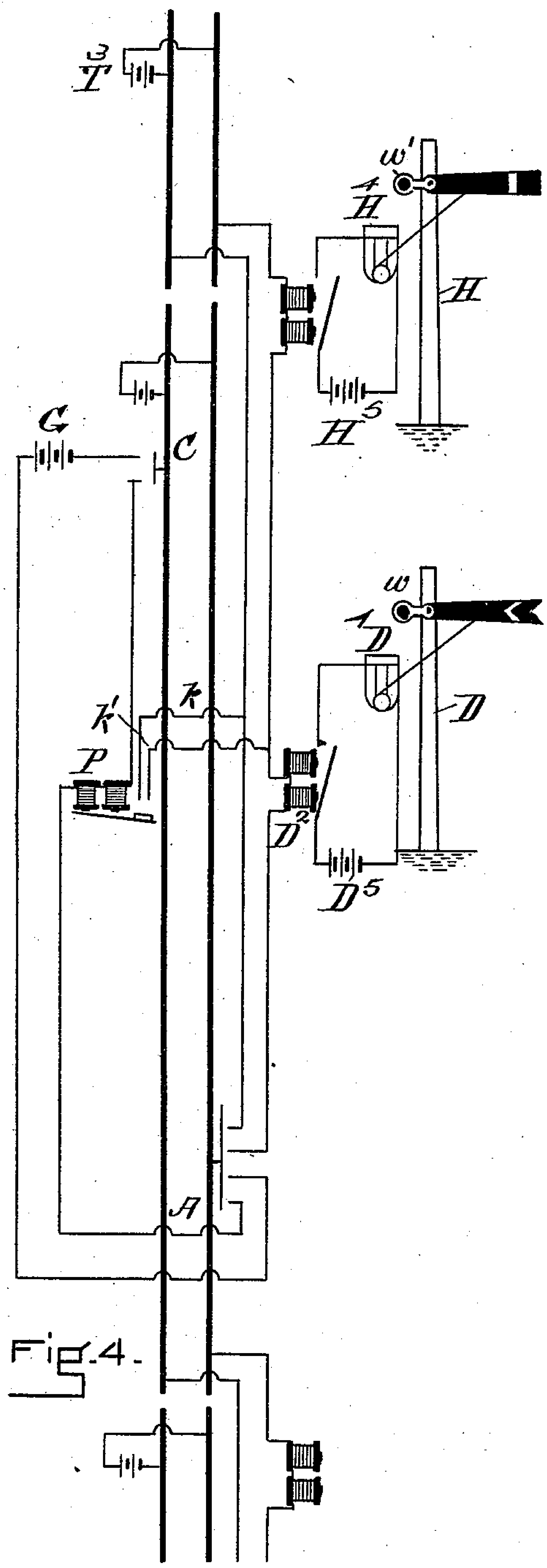

Fig. 4.

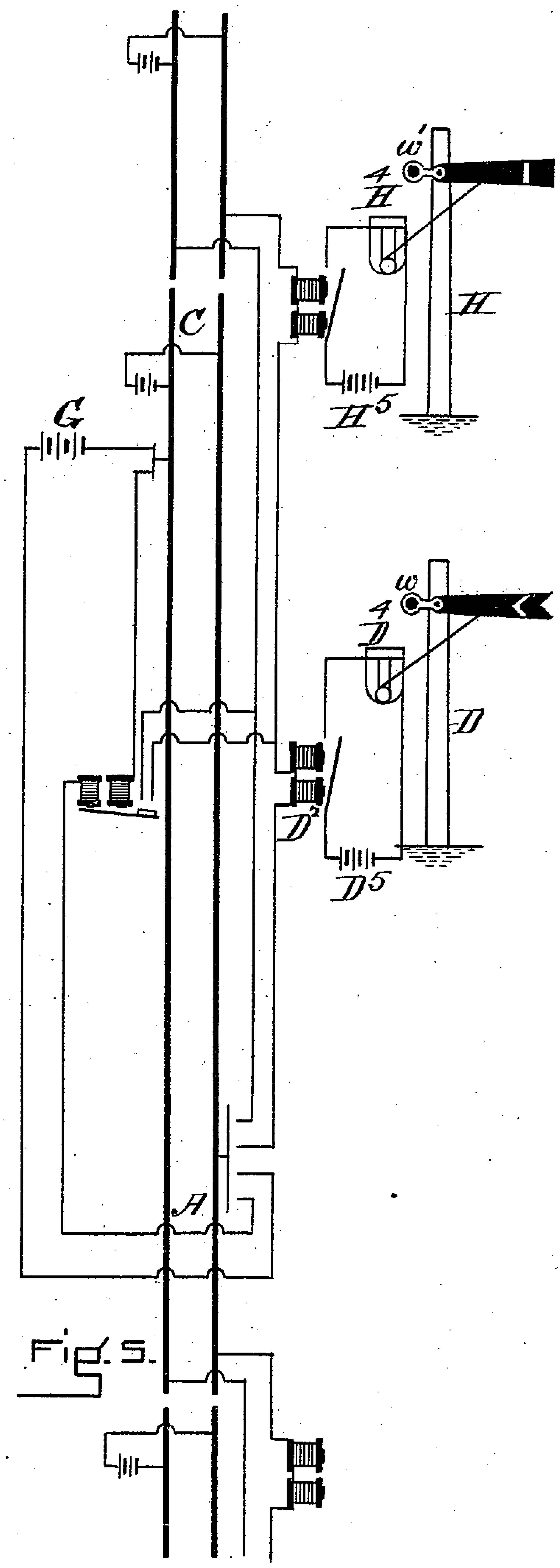

Fig. 5.

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No. 523,767. Patented July 31, 1894.

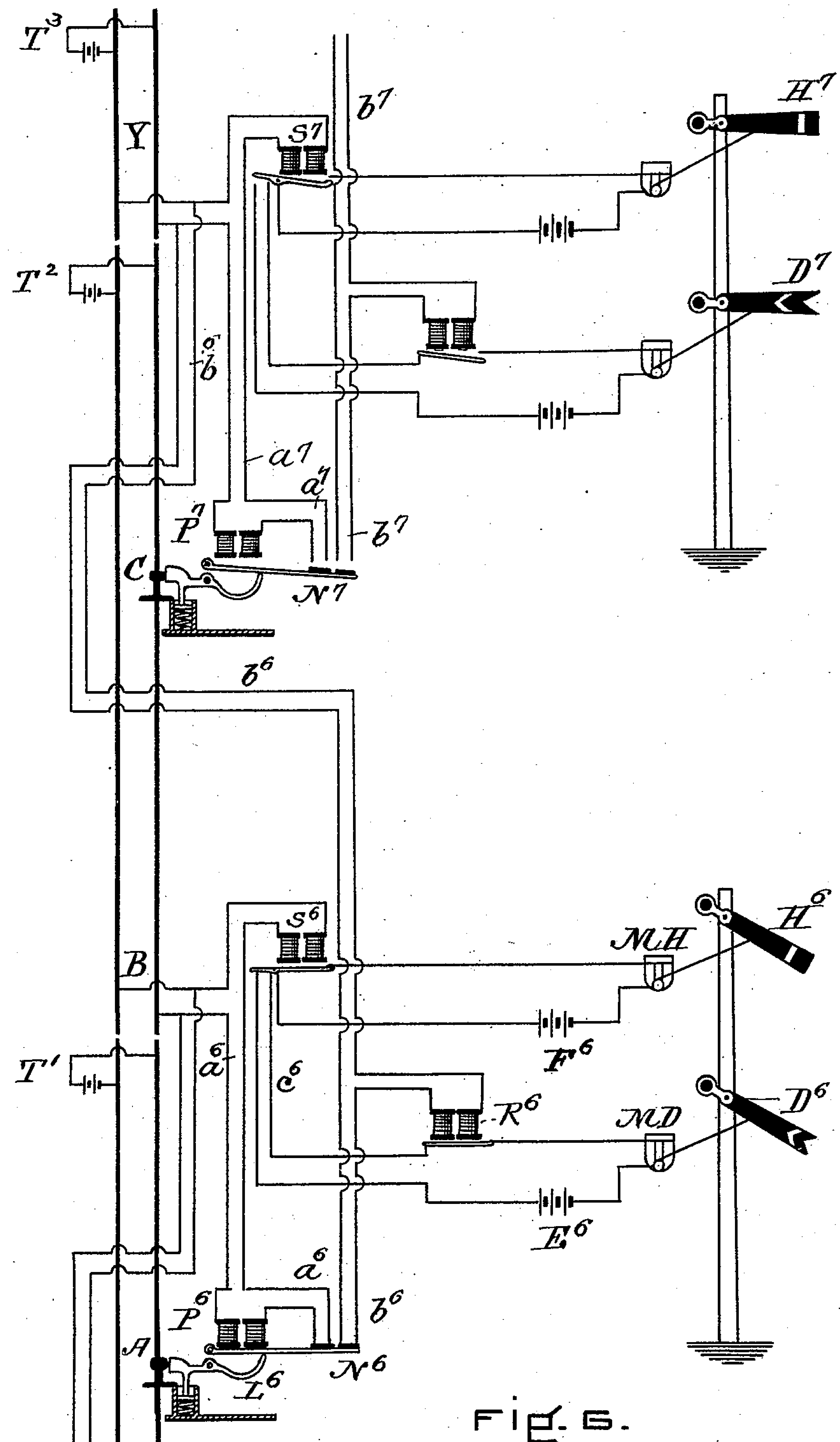

FIG. 5.

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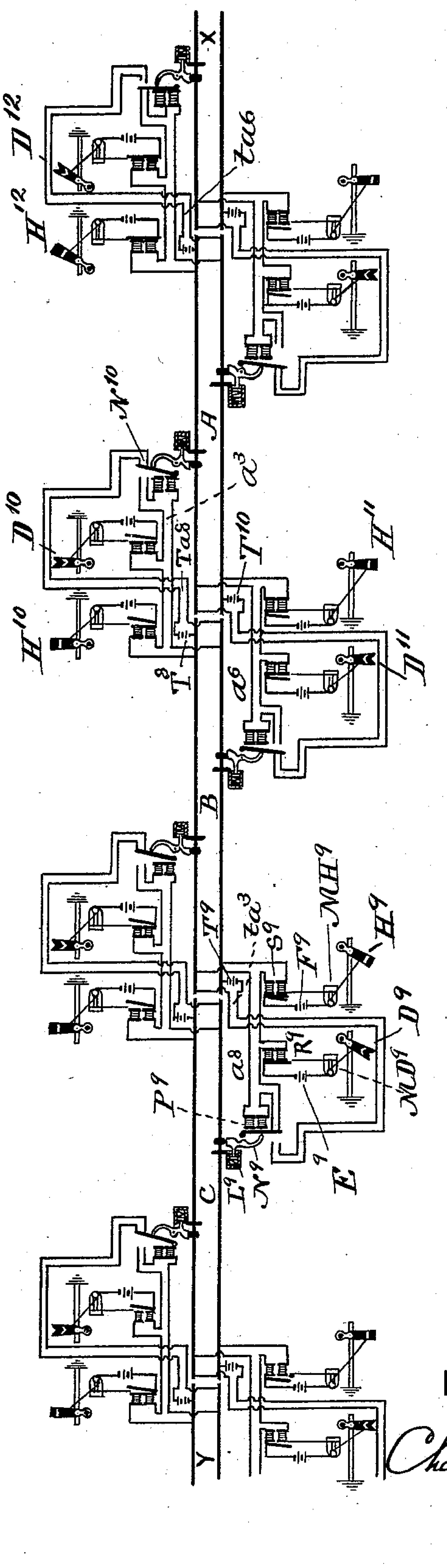

FIG-7-

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES A. HAMMOND, OF BOSTON, MASSACHUSETTS.

ELECTRIC SIGNAL FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 523,767, dated July 31, 1894.

Application filed April 12, 1894. Serial No. 507,301. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. HAMMOND, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Electric Signals for Railways, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention has relation to an automatic electric block system for railways in which the track is divided into insulated sections, with appropriate signals and signal operating mechanism and circuits for the several sections or blocks. For each track section I provide what I term a track circuit, which includes and is completed through the rails of that section and is extended beyond that section by means of wires to a point within the limits of a preceding section at which point is located a train operated circuit closer or controller which controls normally open contacts in said track circuit, the closing of these contacts producing a current from the track battery located at the farther end of the block section covered by that track circuit through the entire length thereof, with the result of energizing one or more signal relays for controlling normally open signal circuits, the magnets of which relays are excited by the track circuit when the latter is closed.

When the train operated circuit closer is actuated by the passing train, and the signals respond, then the engineer knows that the block in advance to which the signals pertain is clear. The moment the train reaches that block it will by furnishing a path of lower resistance for the current of the track circuit of which the rails of that block form part, cut out the signal relays and thus return the signals which it has just passed to normal, and in fact restore all parts of the working devices of that circuit to normal condition. Should however there be another train or any part of a train on the section or block in advance, then when the train on the preceding section actuates the train operated circuit closer, the signals will fail to respond because the magnets of the signal relays are short circuited by the train on the block in advance (that block as before said forming part of the track circuit which includes such relays), and consequently the engineer will at once be informed that the block in advance is not clear.

For a single track railroad I provide for each section or block two distinct track circuits of the kind above referred to, these track circuits being extended in opposite directions from one and the same insulated track section, which each of them includes, to points within the limits of the adjoining sections, in combination with a track battery at each end of said section, one for each track circuit, and circuit closing and opening devices so organized and arranged that the closing of either one of the track circuits shall keep open the other circuit, so that only one battery at a time can send a current over the same section, and only one set of signals can be operated at a time, thus rendering it impossible for conflicting signals to be given for the same section or block. These are the more prominent features of my invention. They with other features will be more particularly explained in connection with the accompanying drawings to which I shall now refer in order to describe the manner in which my improvements are or may be carried into effect.

In the drawings—Figure 1 is a perspective view partly mechanical and partly diagrammatical, showing the application of my invention to a system involving the employment of home and distant signals for each insulated block or track section. Figs. 2, 3, 4, and 5 are diagrams illustrative of the working of this system. Fig. 6 is a diagrammatic representation of a modification in which the home and distant signals for each section are on the same post. Fig. 7 is a diagram illustrating the application of my invention to a single track railway system.

In Fig. 1, K, K′ are the two rails of an insulated block or track section A, B, C; and Y is a succeeding block having rails J J′. The track circuit of section Y has its battery T^3 at the further end of the section. The circuit includes the rails of the section, and thence by wires is extended to a point A within the limits of the preceding section at which point it has normally open contacts d^3, d^4, which are to be closed by the train operated circuit controller located at A and to be presently described. This track circuit may be traced as follows: Battery T^3, wire h, rail J, wire e^8, e^7, e^6, e^5, e^4, e', e, contacts d^3, d^4, wire e^{12}, e^{11}, e^{10}, e^9, rail J′, wire h', h^2, back to battery. This circuit is normally open and is closed through contacts d^3, d^4, controlled by the train operated circuit closer. It includes the magnets H^2, D^2, of two signal relays, which through their armature levers H^3, D^3, control normally open contacts in separate signal or working circuits, the one H^5, for operating the home signal H, the other D^5 for operating the distant signal D. In each case the signal is operated by an electric motor H^4 or D^4, energized by the closure of the working circuit in which it is included.

The track operated circuit closer at the point A consists of the lever L^3, pivoted at its inner end to the bracket L^4, L^5, which is supported on a base piece L, and carries the various working parts of the circuit controlling apparatus, including the contacts d^3, d^4. Upon the lever L^3 is a contact L^6, which when the lever is lifted by a passing train enters between the contacts d^3, d^4, and thus closes the track circuit of the section Y in advance. The circuit closing lever L^3 is thus actuated by the vibratory track lever A′, pivoted between its ends at L^2 to the bracket, with its curved outer end extending beneath and supporting the circuit closing lever, and having its inner end in proximity to the track rail and held above the level of the rail in position to be struck and depressed by the wheels of a passing train by means of a dash pot and spring F upon which bears a plunger extended downward from this end of the track lever. Thus when a train in passing the point A strikes the circuit closer or controller the latter thereby will be operated to close the contacts d^3, d^4, of the track circuit of the section Y next in advance, thereby energizing the distant and home signal relays, and consequently closing the circuits controlled by them with the result of bringing both home and distant signals to safety, as indicated in Fig. 2. This result however is conditioned absolutely upon the section Y being clear. If for any reason that section is out of condition, for example, because either of broken rails, or of a train being still on that section, then notwithstanding the closing of the contacts at d^3, d^4, the signal relays will not be energized. In the first instance supposed, the broken rail will still render the track circuit incomplete, and in the second instance supposed, the train still on section Y will, by the path of lower resistance offered by its wheels and axles, short circuit the relays, and keep them inert and inactive, which condition of affairs will continue until that train has wholly cleared section Y.

It is desirable to provide means for holding the circuit closing lever in its closed position for some time after the train has passed, and to this end I mount on the bracket L^4, L^5, an electro-magnet P, whose armature is placed upon the circuit closing lever L^3. This magnet has no essential lifting effect upon the lever; it is simply a holding magnet which when energized retains the circuit closing lever in lifted or raised position, and whose energizing circuit is in fact closed only by the lifting of that lever. The energizing circuit of the holding magnet is the one which is designated "auxiliary circuit" in Fig. 1; it is a normally open circuit completed through contacts d', d^2, controlled by the circuit closing lever L^3, which for this purpose carries the contact piece L^7, and may be traced as follows—battery G, wire a, a', a^2, a^3, a^4, a^5, contacts d', d^2 (closed by lifting of movable contact L^7, but otherwise open), wire a^6, a^7, a^8, a^9, a^{10}, back to other pole of battery G. Thus the holding magnet will keep the lifted circuit closing lever L^3 of the train operated circuit closed at A after the train has passed it.

In order to release the lever L^3 and allow it to drop back, I provide means whereby the energizing circuit for the holding magnet is broken at or about the time the train is passing from section A B C onto the section Y in advance. These means consisting of a pivoted track lever C′ located at the point C which controls and holds normally closed contacts b, b' in the "auxiliary circuit" by means of a movable contact piece c carried by it. The train in passing the point C strikes and depresses the rail end of the track lever C′ thus lifting its contact end c and momentarily opening the energizing circuit at b, b', thus de-energizing the holding magnet at A and allowing the circuit closing lever L^3 to drop, with the effect of opening the track circuit at d^3, d^4, and consequently putting the signal relays H^2, D^2, out of operation, and returning the signals to their normal position of danger. But even without the track instrument at C the signal would still go to danger the moment the train passed from A B C onto Y, because the relays thereby would be short circuited and their signals would of course be free to return to danger position.

The distant signal (which is first met by the advancing train) is, in the plan represented in Figs. 1 to 5, not infrequently separated by a considerable interval from the home signal, so that the train may have to travel some distance after it passes the distant signal before it reaches the home signal. In recent and more improved methods of block signaling, it is deemed highly desirable that after the train passes the distant signal, that signal shall go to danger without waiting for the home signal, thus guarding the rear of the train from any undue approach of a following train. This I provide for in my system as follows: A shunt or short circuit k, k' is led out from the track circuit at a point between the distant and home signal relays, which shunt is completed through normally open contacts k^2, k^3, controlled by a train operated circuit closer at B within the limits of section A B C, similar in all respects to the train operated circuit closer at A save that it has only one contact piece k^4 on its circuit closing armature lever. The holding magnet P′ of this instrument is included in the "auxiliary circuit," and acts to retain its circuit closing armature lever in the position into which it is lifted by the passing train. Thus when the train, after passing the distant signal meets and strikes the train operated circuit closer at B, the latter will be operated to close and hold closed the shunt k, k', thus cutting out the distant signal lever D^2 and consequently allowing the distant signal to go to danger, while the home signal continues at safety, as indicated in Fig. 3. The train in its further progress over section A B C will at the point C operate the track instrument there located to open the auxiliary circuit contacts located at that point. Thus de-energizing both holding magnets and opening the contacts controlled by them, as indicated in Fig. 4. After the train passes the point C the contacts at that point are reclosed, the condition of the several circuits then being as shown in Fig. 5, which is the normal condition, all of the circuits being open.

The separate "auxiliary circuit" for energizing the holding magnets of the train operated circuit closers or controllers is a nicety rather than a necessity. It, together with the track instrument at C, can be dispensed with, and the holding magnet of the train operated circuit controller at A can be placed directly in the track circuit of Y as is represented in Figs. 6 and 7 to be presently described. In this event the holding magnet of the train operated circuit closer at B for controlling the contacts of the shunt k, k' (when a shunt is used) would of course be included analogously in the shunt which it in part controls.

In the system thus far described the two signal relays, for home and distant signals respectively, are included in one and the same track circuit—or circuit from one and the same track section. I can however include each in a separate and distinct track circuit, the one circuit being from the section next in advance of the section within whose limits the train operated circuit controller is located, and the other being from the section beyond the one first named. In this event the two signals, "home" and "distant," can be and preferably are mounted upon one and the same post. An arrangement of this kind is desirable in that it indicates at once to the engineer of the passing train the condition of the next two blocks in advance of the one on which the train operated circuit controller is located. The system last referred to is represented in Fig. 6. In this figure the train operated circuit closers are similar to that represented at A in Fig. 1. The holding magnets however (typified at P^6, P^7) have no separate energizing circuits of their own but are included in the track circuits which they in part severally control. The home and distant signals for each section are mounted on one and the same post, and of the signal circuits for each section the home signal circuit is controlled by a relay in the track circuit of the section next in advance of that within the limits of which the train operated circuit controller for that circuit is located, while the distant signal circuit is controlled by a relay in the track circuit of the section the second in advance of said circuit controller.

In Fig. 6 A is part of a block section, B is an entire block, and Y is a portion of a third block, succeeding each other in the order named. T′, T^2, T^3 are the batteries for the track section of the respective blocks. The track circuit a^6 from section B is completed through contacts controlled by the train operated circuit closer at A and includes the holding magnet P^6 of that circuit closer as well as the home signal relay S^6 which controls the contacts in the working circuit F^6, including the motor M H which operates the home signal H^6 for section B. The distant signal relay R^6 which controls contacts in the distant working circuit E^6 for the distant signal D^6 of section B, is however included in another and distinct track circuit b^6, leading from the track section Y next beyond B and the second beyond section A—this track circuit b^6 being completed through contacts also controlled by the train operated circuit closer at A. The distant signal working circuit E^6 has in addition to the contacts controlled by the distant signal relay R^6, a second set of contacts controlled by the home signal relay S^6, the arrangement being such that both of these relays must be energized before the distant signal working circuit is completed.

The organization of signals and operating mechanism and circuits for section Y is similar to that for section B, the parts of such organization for Y being designated by the reference letters a^7, b^7, P^7, &c.

In the condition of affairs represented in Fig. 6 the passing train is supposed to have actuated the circuit closer at A to close the home and distant signal circuits a^6, b^6, with the result of energizing the home and distant relays S^6, R^6, causing them to close the signal circuits controlled by them, thus bringing both the home and the distant signals H^6, D^6 of block B to safety, and indicating to the engineer that both block B and block Y are clear. If however block Y should be occupied then the distant signal relay R^6 would be cut out and the signal D^6 would remain at danger although its companion home signal H^6 will still go to safety. But if the first block ahead, B, be occupied it will not do for the engineer to get any clear or safety signal, even though the block Y beyond B be clear; and this is prevented by providing in the working circuit of the distant signal the second set of contacts controlled by the armature lever of the home signal S^6—these contacts being normally open and being closed by the tail of that lever when the latter is attracted by its magnet. Consequently so long as the home signal relay is inactive, the working circuit of the distant signal for the same block cannot be closed. It also would be improper for the distant signal D^6 of section B and the home signal H^7 of section Y, both of which are worked from the track circuit of Y to work simultaneously; for, first, if the train at point A gets the signal D^6 at safety (block Y being unoccupied), and thereby the signal H^7 should also show safety, it might mislead a train waiting on a side-track of block B, the engine-man thinking that the signal was meant for him to proceed to enter upon the main track or block B when the block B had already been cleared for the train at A; and, second, if a train on block B should get (at the point C) the home signal H^7 of block Y at safety, and thereby the distant signal D^6 should also show safety, it would contradict or weaken the meaning of the signal H^6 which (the block B being occupied) remains at danger, and would thus be confusing to the engine-man of the train at point A. This simultaneous action of the signals D^6 and H^7 is therefore prevented by making the extension b^6 of track circuit Y, independent of the extension a^7 of the same circuit, so that when circuit a^7 is open, the extension b^6 may be closed, bringing the signal D^6 to "safety," although signal H^7 remains at danger; but, furthermore, the signal H^7 cannot be brought to safety unless a train at point C has closed the circuit a^7; and when the train at point C is occupying the block B, the track circuit from battery T^2 being short-circuited, the signal H^6 remains at danger, and thus by means of the relay S^6 keeps open the circuit operating the signal D^6, which consequently also remains at danger although signal H^7 may show safety, the block Y being unoccupied; finally, while signal H^7 remains horizontally at danger, and a train is occupying the block B, but has not yet reached the point C, the signal D^7 cannot be inclined to safety, although block Y may be clear, because the occupation of block B, by short-circuiting the circuit a^7, keeps the signal H^7 at danger, and that (by the relay S^6 opening the circuit c^6) keeps the signal D^6 also at danger. By this system of circuits, but one train operated circuit closer is needed for each block, and no auxiliary circuit is required to restore the armature N^6 to its normal position, because its holding magnet is included in the track circuit from B, and consequently the train upon entering the block B at once short-circuits the extension a^6 of the track circuit B, thus demagnetizing the magnet P^6 and allowing its armature N^6 to fall and open the circuits controlling the signals H^6 and D^6.

Fig. 7 illustrates an application of my system to a single track. The complete track blocks are designated A, B and C, and portions of two other blocks X and Y, are also shown. Each block has a track battery at each end, and a train advancing in either direction can control the track battery of the next block ahead necessary to give signals for said block in favor of a train approaching the same in the opposite direction. For instance, a train on block C, going toward block X has operated the track instrument L^9 closing the armature N^9 and (if block B be unoccupied) also the extension a^8 of the track circuit of block B worked by the track battery T^8 if no train in the opposite direction on block A has opened said track circuit ($t\ a^8$ extension) by the track instrument L^{10}; the track circuit of block B thus being intact from armature N^{10} to armature N^9 through the extensions $t\ a^8$ and a^8 the relays R^9 and S^9 are energized; and so by the local batteries E^9 and F^9, and the motors M D^9 and M H^9 the distant and home signals D^9 H^9 of block B are inclined to the safety position, allowing the train at point C to proceed toward block B. While this is taking place the relay P^9 which has closed the circuit a^8 keeps open the extension a^3 of the track circuit which it would be necessary for the track battery T^9 to operate, in order for a train in the opposite direction on block A, by closing the extension a^3 of the last named circuit of the armature N^{10} to get safety indications of the signals D^{10} and H^{10} governing the right of a train going from block A, toward block Y entering upon block B. To return to the train which is about leaving block C, (going toward block X,) and which in the meantime prevents a train at A (moving in the opposite direction) from getting clear signals for block B, as soon as said train has left block C, and entered upon block B, the wheels of the train also continue to short circuit the track battery T^9 and thus the opposite train at A is still prevented from getting clear signals for block B. Both trains will now find the distant signals D^{10} and D^{11} and the home signals H^{10} and H^{11} against them, and can only proceed with caution and slow speed to the turnout (not shown on the drawings) where the passing is to be made. In a similar manner may be traced the progress of a train at X, getting clear signals D^{12} and H^{12} for a block A which a train going in the opposite direction would be forbidden to use by the signals D^{11} and H^{11}, since the train at X has opened the track-circuit operated by track battery T^{10} of block A through the extensions $t\ a^6$ and a^6.

It will be noticed that as described in connection with the preceding sheets, all circuits are normally open and all signals normally at danger.

Having described my improvements and the best way now known to me of carrying the same into effect, what I claim herein as new and of my own invention is as follows:

1. The combination substantially as hereinbefore set forth of a track section; a track circuit completed through the track rails of said section, and containing normally open contacts; a train operated mechanical circuit closer or controller located within the limits of a preceding track section and acting when struck by the train passing over that section

to close said contacts; a signal relay included in said track circuit; and a working circuit completed through contacts controlled by said relay.

2. The combination, substantially as hereinbefore set forth, of a track section; a track circuit completed through the rails of said section and containing normally open contacts; a train operated mechanical circuit closing lever located within the limits of a preceding track section, and acting when struck by the train passing over that section to close said contacts; a holding magnet for maintaining this circuit closer in the position to which it is brought by the passing train and circuit connections whereby the said magnet is energized at the time the said lever is operated to close the contacts of the track circuit; a signal relay included in the track circuit; and a working circuit completed through contacts controlled by said relay.

3. The combination of a track circuit completed through the rails of an insulated track section, and containing normally open contacts and also including two relays; a distant signal circuit completed through contacts controlled by the one relay, and a home signal circuit completed through contacts controlled by the other relay; a train operated circuit-closer, located within the limits of the preceding track section and controlling the contacts of the track circuit, a normally open shunt or short circuit from the track circuit between the two relays; and a second train operated circuit-closer, also within the limits of said preceding track section, for controlling contacts through which said shunt or short circuit is completed—the combination being and acting substantially as hereinbefore set forth.

4. The combination of insulated track sections A, B, Y, following each other in the order named; two separate and distinct track circuits including the one the rails of section B, the other the rails of section Y, each being completed through normally open contacts and containing a signal relay; and a train operated circuit controller within the limits of section A for closing the contacts of both track circuits—the combination being and acting substantially as hereinbefore set forth.

5. The combination of track sections or blocks B and Y; two track circuits including the one the rails of section B and the other the rails of the succeeding section Y; and a train operated circuit controller for controlling normally open contacts in said track circuits a signal relay included in the track circuit of section B and a signal circuit completed through contacts controlled by said relay; a second signal relay included in the track circuit of section Y; and a second signal circuit completed through two sets of contacts controlled the one by the relay in the track circuit of section B, and the other by the relay in the track circuit of section Y—the combination being and acting substantially as hereinbefore set forth.

6. The block system hereinbefore described for single track railroads, comprising essentially two distinct normally open track circuits extended in opposite directions from one and the same insulated track section, which each of them includes, to points within the limits of the adjoining sections; in combination with a track battery for each track circuit a train operated mechanical circuit closer located in each of said extensions and contacts controlled by the same, substantially as and for the purposes hereinbefore set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 2d day of April, A. D. 1894.

CHARLES A. HAMMOND.

Witnesses:

FRANK G. PARKER,

FRANK G. HATTIE.