No. 774,618. PATENTED NOV. 8, 1904.

C. W. S. TURNER.

ELECTRICALLY OPERATED BLOCK SIGNALING APPARATUS.

APPLICATION FILED DEC. 22, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

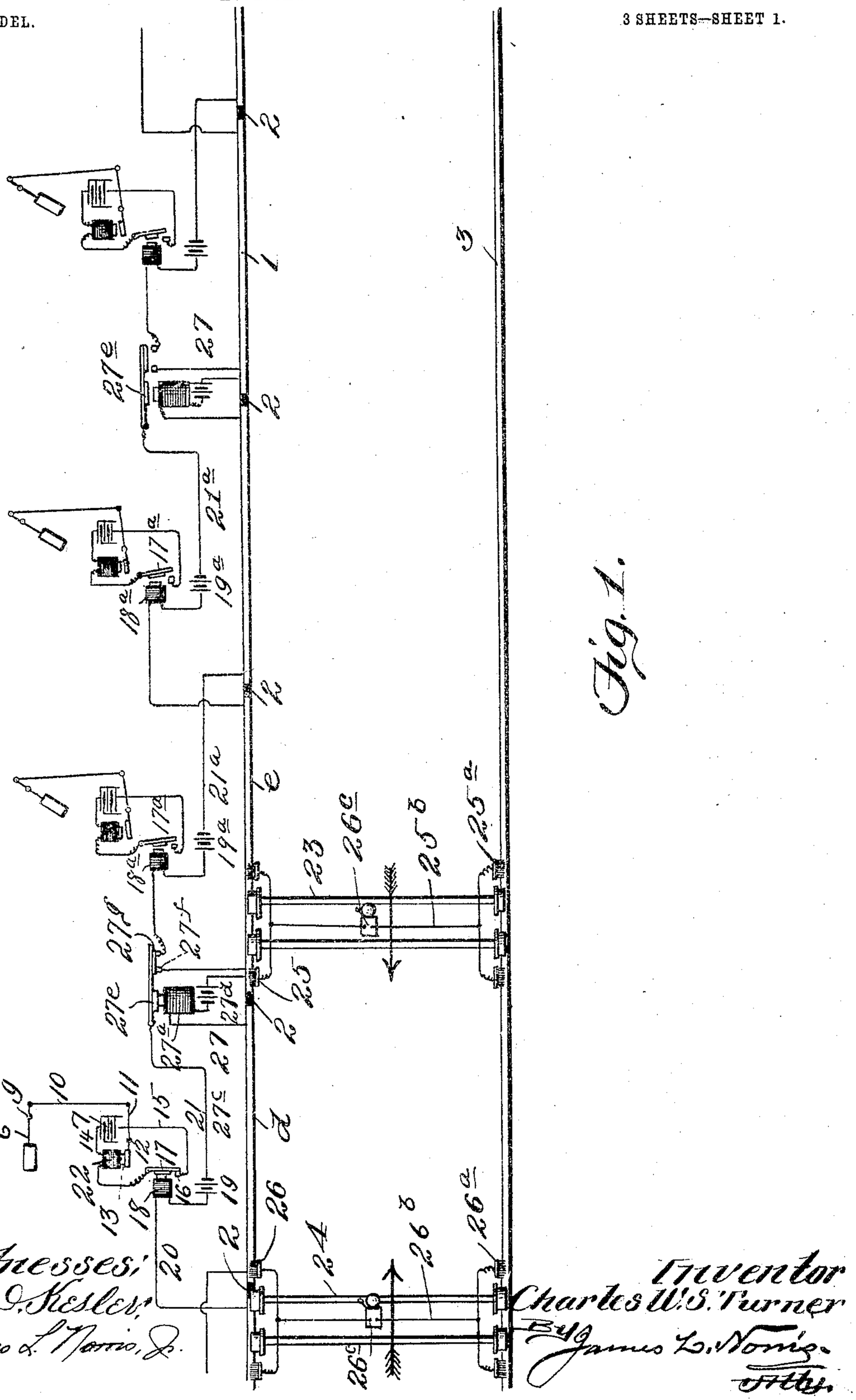

Fig. 1.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

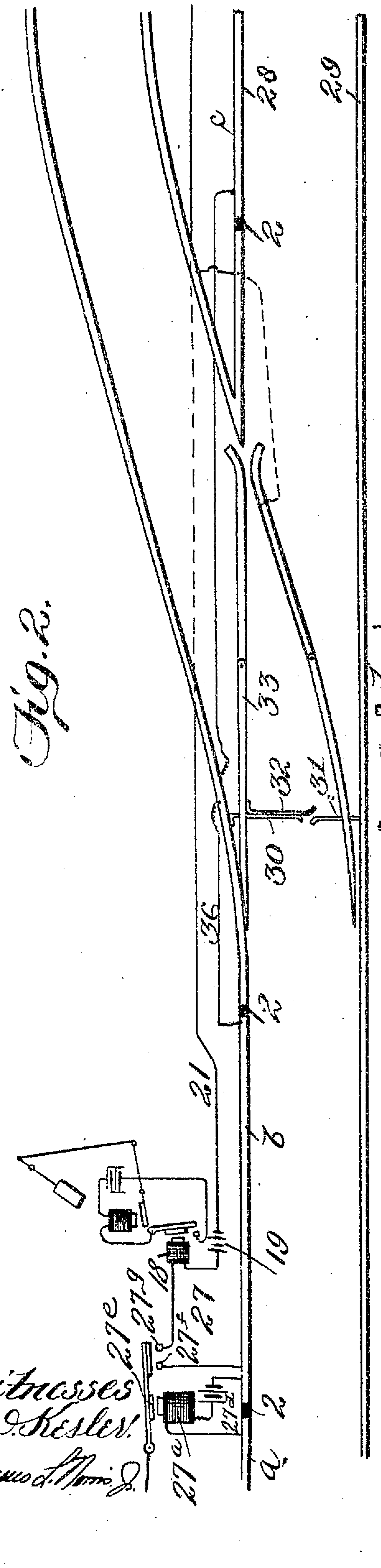
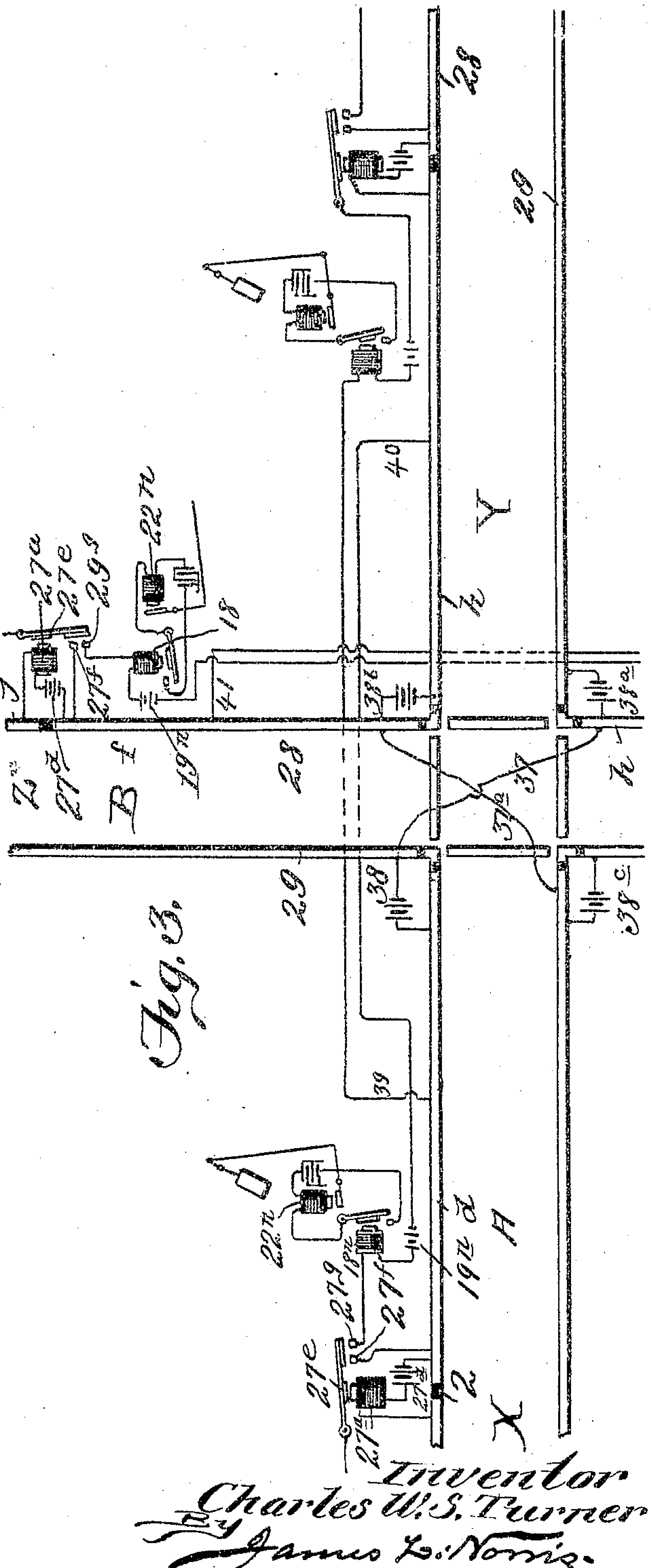


Fig. 3.



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Atty.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

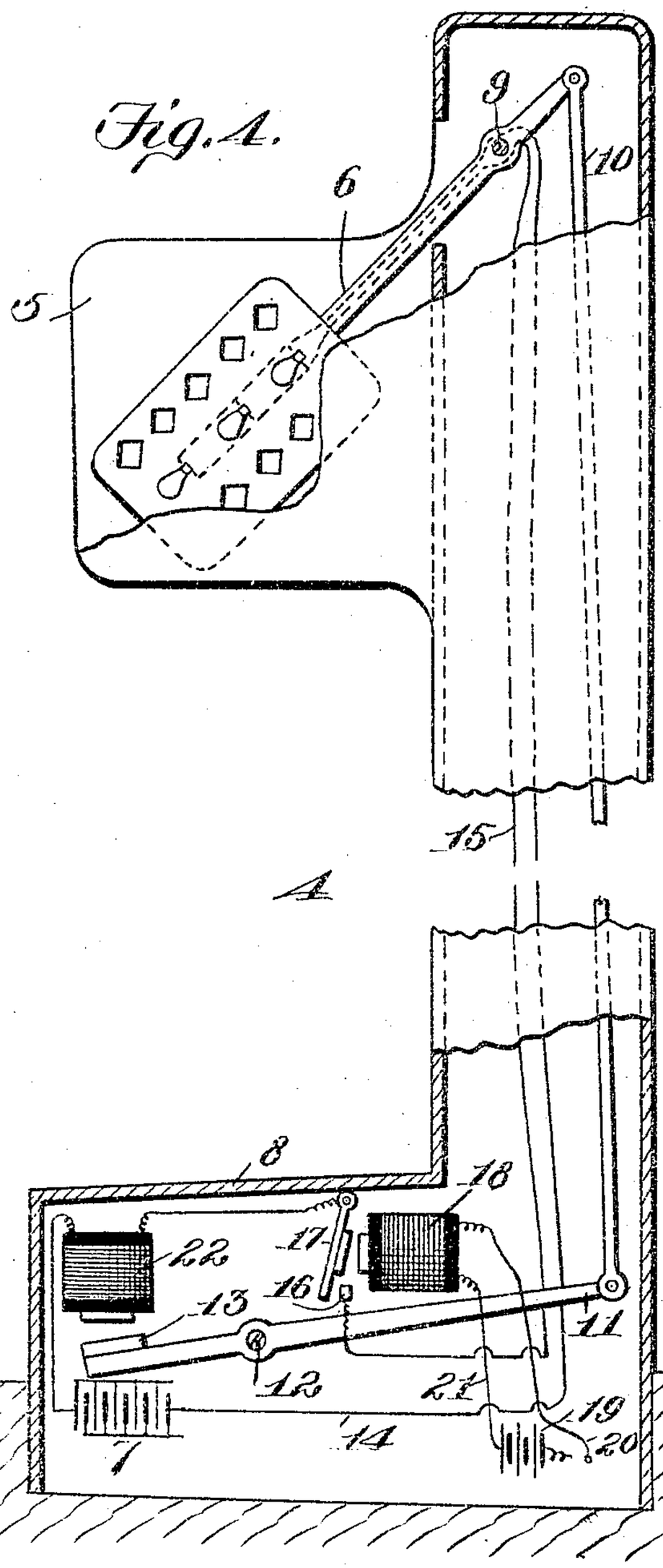
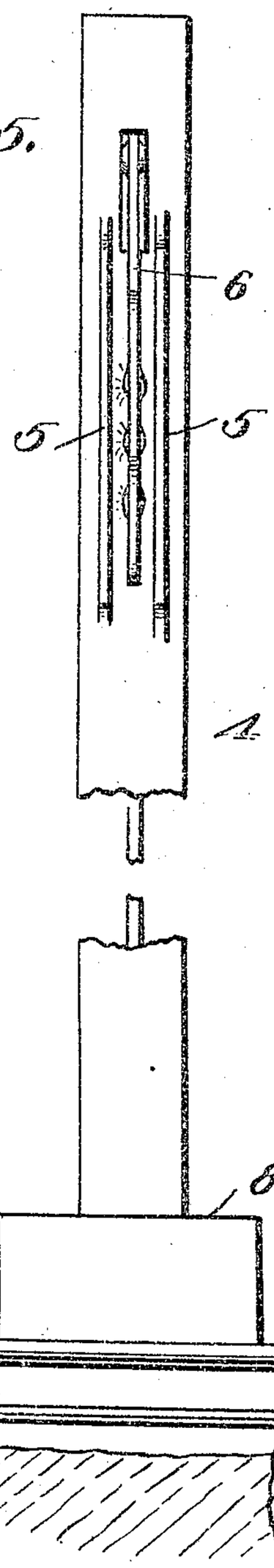


Fig. 5.



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No. 774,618. Patented November 8, 1904.

UNITED STATES PATENT OFFICE.

CHARLES W. S. TURNER, OF MOUNTVILLE, VIRGINIA.

ELECTRICALLY-OPERATED BLOCK-SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 774,618, dated November 8, 1904.

Application filed December 22, 1903. Serial No. 186,229. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. S. TURNER, a citizen of the United States, residing at Mountville, in the county of Loudoun and State of Virginia, have invented new and useful Improvements in Electrically-Operated Block-Signaling Apparatus, of which the following is a specification.

My invention relates to electrically-operated block-signaling apparatus for railways.

The object of the invention is to provide a novel arrangement of electrical apparatus that will with certainty inform the responsible officer or employee in charge of a train of the presence within the limit of recognized safety of another train whether two or more trains are approaching each other upon a single track or whether one or more trains are following one after the other upon the same track.

The invention has for its further object to cause both a visible and audible signal in such event or events.

The invention has for its further object to provide a novel arrangement of electrical signaling apparatus to notify an engineer in charge of a train of the existence of an open switch in time sufficient to enable him to stop his train before reaching such switch.

Furthermore, the invention has for its object to provide electrical signal mechanism arranged to warn the engineers of trains approaching a crossing.

The invention has for its further object to improve in detail of arrangement and mode of operation electrical signaling apparatus for railways.

To the ends stated the invention consists in a novel electrical apparatus and the arrangement and mode of operation of the elements thereof, as hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a view, partly in plan and partly diagrammatic, exhibiting sufficient stretch of railway-track and signaling mechanism combined therewith to an understanding of my invention. Fig. 2 is a view, mainly in plan, partially diagrammatic, exhibiting my invention as arranged in connection with a switch to advise the engineer in charge of a train if the switch be open. Fig. 3 is a diagrammatic view illustrating my invention as applied where two railway-tracks cross each other in order to advise the engineer in charge of a train on either track of the approach of a train on the other. Fig. 4 is a view in side elevation, partly in section, of the details of the semaphore or semaphore-circuit and connections for actuating the semaphore. Fig. 5 is an end view of the semaphore.

In the accompanying drawings, illustrating my invention, trucks are shown conventionally to designate locomotives or railway-trains merely for the purpose of conveniently illustrating and describing said invention.

In the practical installation of my invention where collectors in the form of brushes, as illustrated, are made use of the wheels would be insulated from their axles.

In the said drawings the reference-numerals 1 and 3 designate the rails of a railway-track, one of which—for instance, 1—is divided into a series of sections or blocks of suitable length which may be varied according to the dictates of safety upon a given road. The several sections or blocks of this rail are insulated from each other by means of interposed masses 2 of insulating material.

The numeral 27 designates a series of what I will for convenience designate "train-circuits," including batteries 27^{d} and electromagnets 27^{a}, arranged in the particular embodiment of my invention shown in the drawings at the juncture of alternate block-sections of the insulated rail and in electrical connection with adjoining block-sections of the rail. The several train-circuits are completed through the trains whenever two or more trains shall arrive at that stage of nearness to each other which according to recognized standard of safety is considered dangerous, as follows: The trains, which for convenience are represented by the forward engine-trucks 23 24, carry one of them pairs of brushes 25 25^{a}, one pair of which is designed to make contact with the insulated rail and the other pair with the continuous conductor-rail of the track and electrically connected by means of a conductor 25^{b}. As stated, the trains are represented by the forward engine-trucks.

The collector-brushes 25 25[a] shown in connection with this conventional illustration may be arranged the forward members of each pair adjacent the locomotive-truck and the rear members of each pair at the rear of the train to insure a maintenance of the circuits involved in the system sufficiently long to perform the work required, and the other train or trains, all of which, of course, will be equipped with similar or suitable brushes or collecting devices, carry similar pairs of brushes, those of the train 24 being designated by 26 26[a], having contact, respectively, with the insulated and continuous rails of the track and being in electrical communication by means of a conductor 26[b]. In connection with each of said train-circuits is a shunt-circuit, including a battery 19, an electromagnet 18, connecting, by means of conductors 20 21, with alternate block-sections of the rail 1. In the shunt-circuits are armatures 27[e], coöperatively arranged with relation to the electromagnets 27[a]. The function of the shunt-circuits is, upon completion of the train-circuits, to establish local circuits, which for convenience will be hereinafter designated "semaphore-circuits," including electromagnets 22, local batteries 7, and armatures 17 appropriate to the electromagnets 18 of the corresponding shunt-circuits. In the circuit-wires 14 and 15 of the semaphore-circuits are included a series of electric lights carried by the semaphore-arm, as will be hereinafter described. One of the wires of each electric-light circuit, such as 15, terminates in a contact 16, with which the lever of the armature 17 of the electromagnet 18 of the corresponding shunt-circuit makes contact when said electromagnet 18 is energized, and thus the semaphore-circuit is completed. When the semaphore-circuit is thus completed, the electromagnet 22 thereof is energized and draws unto itself its armature 13, carried by one end of a lever 11, pivoted at 12, the other end of which lever is connected to one end of the semaphore-arm by means of a rod 10, whereby the semaphore-arm is operated to withdraw the semaphore from its blind 5, exposing it to the view of the engineers in charge of trains to be signaled. The details of the semaphore and the semaphore-circuit, together with sufficient of the shunt-circuit which establishes the former, is best shown in Fig. 4 of the drawings. The semaphore and the semaphore-circuit are preferably inclosed in a box or casing 8, as shown. These semaphore signaling devices may be arranged alongside of railways in any convenient relation to the block-sections. As shown, they are substantially midway of each block; but the location is optional and may be changed according to circumstances and convenience.

Now it will be observed that the circuits described are normally open, and they remain open and inactive until two trains, whether moving toward each other or one after the other, come within such nearness to each other as is considered dangerous, and this distance will be determined by the length of the insulated sections or blocks hereinbefore referred to. Assuming that the train represented by the truck 24 traveling toward the right in respect of Fig. 1 of the drawings is just entering upon the left-hand block or section *d* of the track (shown with the forward pairs of the brushes 26 26[b] in contact with the railway-rails included in said block) and assuming that another train (represented by the truck 23) is moving in an opposite direction or approaching the train 24, when the train 23 is on the block *e*, adjoining the left-hand block *d*, (shown in Fig. 1,) the train-circuit is established, the circuit running from one pole of the battery 27[d] by wire to block-rail *e* to brushes 25, carried by the train 23, to conductor 25[b] and brushes 25[a] to the continuous conductor-rail 3, thence to the brushes 26[a] of train 24, through conductor 26[b] to brushes 26, thence along the block-rail *d* to and through the electromagnet 27[a] to the other pole of the battery. The establishment of this circuit energizes said magnet, attracting its armature 27[e], the lever of which engages the contact 27[f] in the shunt-circuit, completing said shunt-circuit, which runs from one pole of the battery 19 through the conductor 21, including the armature-lever 27[e], to contact 27[f], and by wire to block-rail *e*, thence through the brushes 25, conductor 25[b], and brushes 25[a] of train 23 along the rail 3 to the brushes 26[a], thence through the conductor 26[b] and through the rearmost of the pair of brushes 26 on train 24 by way of conductor 20 through the electromagnet 18 to the other pole of the battery 19. The establishment of this shunt-circuit energizes the electromagnet 18, attracting the armature 17 thereof, the lever of which armature engages the contact 16 and establishes the semaphore-circuit. The course of this circuit is from one pole of the battery 7, through the conductor 14, through the light-circuit, (cutting the lights in,) and back by the conductor 15 through the armature 17 and electromagnet 22 to the other pole of the battery. The current in this circuit energizes electromagnet 22, which attracts its armature 13 and through the medium of the lever 11 and connection 10 operates to project the semaphore from its blind into view of the engineers of the trains to be signaled.

In order that observation of the visual signal to the engineer need not be depended upon and an auxiliary safeguard provided, audible signals 26[c] are arranged (shown for matter of convention upon the trucks 23 and 24) in the engineers' cabs, said signal being suitably connected in the circuit, as by way of connection with the conductors 25[b] and 26[b],

whereby upon the establishment of the train-circuit audible signals in the engineer's cab or any other suitable situation will be given.

It will be observed from the foregoing that the circuits making up the signaling apparatus are normally open and are established only when two or more trains in the course of traffic come upon adjacent blocks.

According to the preferred embodiment of my invention, to which, however, in its broader aspects the same is not restricted, it is not essential, and preferably for the sake of economy not desirable, to have an electromagnet 27^a in the train-circuit for every block. It will be sufficient to provide train-circuits including such electromagnet for alternate blocks, as shown in Fig. 1 of the drawings. This arrangement is, as stated, economical in respect of installation, and it is also economical in respect of maintenance. According to the arrangement shown the shunt-circuit is continued in a branch from contact 27^g through an electromagnet 18^a, having an armature 17^a arranged when the magnet 18^a is energized to establish the semaphore-circuit in the manner hereinbefore described. The shunt branch continues from the electromagnet 18^a through battery 19^a and conductor 21^a and makes connection with the block-section adjacent that on which the train 23 is moving, so that should a train come upon said adjacent block-section train and semaphore cirtuits will be established from one pole of the battery 19^a through the train connections to the continuous conductor-rail 3, along said rail to brushes 25^a of train 23, conductor 25^b, brushes 25 to block-rail *e* and by wire to contact 27^f, lever of armature 27^e to contact 27^g, thence by wire to and through electromagnet 18^a to the other pole of the battery 19^a, whereupon the electromagnet 18^a is energized and the semaphore-circuit established, as hereinbefore set forth. The next succeeding and all succeeding train, shunt, and semaphore circuits remain open until two trains enter upon adjoining blocks, whereupon the said circuits are established and signals given, as described. It will thus be seen that whenever two trains, whether approaching each other or following each other, come upon predetermined blocks both trains will be signaled, and should another train or trains follow the first-mentioned trains the latter will also be signaled, and this will follow throughout the entire system, thus guarding against the danger of not only head-on but rear-end collisions.

In Fig. 2 of the drawings is illustrated an installation of my invention in connection with a switch for the purpose of signaling the engineer in good time if the switch be open, so that he may stop his train before running onto the switch. In the block in which the switch is located are arranged contact-arms 30 31, which nearly bridge the space between the tracks 28 29, and one of the switch-points 33 has combined with it a movable contact 32, which when the switch is thrown open bridges the space between the contacts 30 31, and the elements have assumed proper position for the establishment of the train-circuit, which is completed when the train arrives at a point on the track where it is desired to advise the engineer of the open switch, and thereupon the circuit is completed through the train connections before described and the audible signal arranged in the engine-cab or other convenient place, which signal is made operative. The circuit thus established takes the following path, referring to Fig. 2: through the block-rail *a*, upon which the train is moving, to and through the electromagnet 27^a to one pole of the battery 27^d, thence to the block-rail *b*, along this rail to the conductor 36, thence through the contacts 30, 32, and 31, along the return-rail of the track, through the brushes and train connections and the signal included therein, thence to the insulated section of the block *a*, the starting-point. The audible signal arranged in the cab of the engineer is sufficient to warn the engineer of the open switch, and when this is the only thing of which he is to be advised it is designed that the shunt and semaphore circuits will not be established. It is intended that said shunt and semaphore circuits will be operative only when trains approach or follow each other in such nearness that the danger-point is reached. In the event of the occurrence of this nearness of two trains on the rail system generally the operation has been described. If this occurrence should take place in the vicinity of the switch-section, the shunt and semaphore circuits will be established and the semaphore projected into the view of both engineers. The shunt-circuit will be established as follows: the electromagnet 27^a will attract its armature, the lever of which bridges across the contacts 27^f 27^g, and the circuit will be from one pole of the battery 19 along the conductor 21, which has connection with the block-rail *c* on the opposite side of the switch, through the train connections, along the return-rail of the track, through the train connections on the train at the left of the switch to the block-rail *b*, by wire to contact 27^f, across the bridge referred to, through the electromagnet 18 to the other pole of the battery 19. The magnet 18 attracts its armature and the semaphore-circuit is established, as before described.

In Fig. 3 is illustrated an arrangement whereby trains approaching a crossing on tracks running at angles to each other will be signaled, so that collision at the crossing may be guarded against. This installation involves the system of electric signaling described with reference to Fig. 1, modified to meet the particular conditions and augmented by connections between the signaling systems of the

two lines of railway. The supplemental connections consist of conductors 37 37[a] from the insulated block-section of one line of railway contiguous to the crossing to the continuous rail of the other line of railway and batteries 38 38[a] 38[b] 38[c], connecting meeting or abutting rails of the two lines of railway. The modifications of the system illustrated in Fig. 3 are obvious extensions of the idea of the system of Fig. 1 to afford lines of conductors to establish a cross-circuit. The arrangement may be best illustrated by a description of the circuits established, first, under the conditions of two trains approaching or following each other and arriving at the predetermined nearness to each other along the same track and then where two trains are approaching the crossing on different lines of railway and come within the predetermined distance of the crossing where it is desirable to notify the engineer in charge of such approaching trains. In the first instance, assuming train No. 24 to have arrived at the point *x* at the left of Fig. 3 and train No. 23 to have arrived at the point *y* at the right of Fig. 3 on the opposite side of the crossing, the train-circuit will be established as follows: from one pole of the battery 27[d] to the block-rail *d*, along said rail, through battery 38, conductor 37, battery 38[a], to rail 29, through the connections of train 23 to block-rail *h*, battery 38[b], conductor 37[a], and along the rail 29 of the track at the left of the crossing in Fig. 3, through the connections of train 24, thence to electromagnet 27[a] to the other pole of the battery 27[d]. This completes the train-circuit, which makes the signals in the engine-cabs operative and attracts the armature 27[e], the lever of which bridges the contacts 27[f] and 27[g] and establishes the shunt-circuit, the course of which is from one pole of the battery 19[n], through conductor-wire past the crossing, along the block-rail *h* at the right of the crossing, through battery 38[b], conductor 37[a], the continuous rail of the track to the left of the crossing, through the connections 29 of train 23 to insulated block-section *d*, to the contact 27[f], connected therewith, across the bridge to the other contact 27[g], through the electromagnet 18[n], to the other pole of the battery, completing the shunt-circuit and energizing the magnet 22[n], which attracts its armature, establishing the semaphore-circuit, as before described, and projecting the semaphore-arm into the view of both engineers. Assuming now the approach of trains on the tracks of the railways A and B of Fig. 3. When train No. 24 reaches the point X and train No. 23 the point Z, train-circuit will be established as follows: from one pole of the battery 27[d], along insulated block-section *d*, through battery 38 to continuous conductor-rail 29 of railway B, through connections of train 23, at point Z to block-section *j*, thence by wire to electromagnet 27[a], and to and through battery 27[d], through block-section *f*, conductor 37[a], continuous conductor-rail 29 of railway A, through connections of train 24 at the point X, to electromagnet 27[a], and to the other pole of the battery 27[d], thus completing the train-circuit and energizing the signals in the engine-cabs. The shunt-circuit of railway A to energize the corresponding semaphore-circuit and expose the semaphore-signal to the engineer in charge of the train on railway A is established by the energizing of the electromagnet 27[a] of said railway, which attracts the armature 27[e] to bridge the contacts 27[f] and 27[g], and the shunt-circuit is then from pole of the battery 19[n], through conductor-wire, past the crossing to and along block-rail *h*, battery 38[b], conductor 37[a], continuous conductor-rail of the railway A, through train connections of the train moving on railway A, to insulated block-section *d*, thence by wire to the contact 27[f], through the bridge to contact 27[g], through electromagnet 18[n] to the other pole of the battery 19[n]. The energizing of the magnet 18[n] establishes the semaphore-circuit by way of electromagnet 22[n]. This throws the semaphore-signal for the engineer in charge of the train on railway A. The corresponding shunt-circuit to throw the corresponding semaphore-signal for the engineer in charge of the train on railway B is established in like manner, and, briefly stated, is from one pole of the battery 19[n] of the railway B, through conductor to the opposite side of crossing to block-section *h* of railway B, through conductor 37, to the continuous contact-rail 29 of the railway B, through connections of train at Z to block-section *f* and by wire to contact 27[f], through the bridge, to contact 27[g], to and through electromagnet 18[n] to the other pole of the battery 19[n] of the railway B, attracting the armature of said magnet 18[n] and establishing the semaphore-circuit and exposing the semaphore to the view of the engineer in charge of the train on railway B.

By my invention I provide an electrical signaling apparatus or system for railways which is economical of installation and maintenance and efficient and certain in operation, and which, furthermore, possesses an auxiliary arrangement for use in notifying the engineer of an open switch and auxiliary and additional arrangements adapted to railway-crossings to notify engineers in charge of trains on the different railways of the near approach to the crossing of trains on said railways.

Having thus described my invention, what I claim is—

1. In an electrical signaling apparatus, a railway-track one rail of which is composed of block-sections insulated from each other, and the other rail of which constitutes a continuous

conductor-rail, normally open train-circuits including electromagnets and batteries the poles of which are connected to the block-sections, normally open shunt-circuits including electromagnets and batteries the poles of which are connected to insulated block-sections, and visual signal-operating mechanism made operative by a current in a shunt-circuit when such circuit is closed by connections on trains to be signaled.

2. In an electrical signaling apparatus, a railway-track one rail of which is composed of block-sections insulated from each other, and the other rail of which constitutes a continuous conductor-rail, normally open train-circuits including electromagnets and batteries the poles of which are connected to the block-sections, normally open shunt-circuits including electromagnets and batteries the poles of which are connected to insulated block-sections, train connections including audible signals bridging over between the block-sections and the continuous rail, and visual signaling mechanism made operative by the current in a shunt-circuit when such a circuit is closed by the train connections.

3. In an electrical signaling apparatus, a railway-track one rail of which is composed of block-sections insulated from each other and the other rail of which constitutes a continuous conductor-rail, a train-circuit including a battery in electrical connection with said block-sections, means for bridging over between a block-section and the continuous conductor-rail, and train connections also bridging over between a block-rail and the continuous conductor-rail, to close the circuit and operate the signal.

4. In an electrical signaling apparatus, the combination of a railway-track comprising insulated block-sections and a continuous conductor-rail, train-circuits including batteries in electrical connection with said block-sections, means for bridging over between a block and the continuous conductor-rail comprising stationary contacts and a movable contact connected to a switch, and train connections also bridging over between a block-rail and the continuous conductor-rail to close the circuit and operate the signal.

5. In an electrical signaling apparatus for railways, the combination with a railway-track consisting of insulated block-sections and a continuous conductor-rail, a train-circuit in electrical connection with said block-rails and including a battery and an electromagnet, train connections having collectors in contact with said block-sections and said continuous conductor-rail for completing the train-circuit, a semaphore-circuit including a semaphore-operating magnet, a shunt-circuit in electrical connection with the block-sections, the said shunt-circuit being established by the action of the electromagnet of the train-circuit and including an electromagnet which operates to establish the semaphore-circuit.

6. In an electrical signaling apparatus for railways, the combination with a railway-track consisting of insulated block-sections and a continuous conductor-rail, a train-circuit in electrical connection with said block-sections and including a battery and an electromagnet, train connections having collectors adapted to contact with said block-sections and said continuous conductor-rail for completing the train-circuit, audible signals included in said train connections, a semaphore-circuit including a semaphore-operating magnet, a shunt-circuit in electrical connection with the block-sections, the said shunt-circuit being established by the action of the electromagnet of the train-circuit and including an electromagnet which operates to establish the semaphore-circuit.

7. In an electrical signaling apparatus, a railway-track one rail of which is composed of block-sections insulated from each other, and the other rail of which constitutes a continuous conductor-rail, normally open train-circuits including electromagnets and a plurality of block-sections, normally open shunt-circuits including electromagnets and a plurality of block-sections, and a visual signal-actuating mechanism made operative by the current in a shunt-circuit when such circuit is closed by connections on trains to be signaled.

8. In an electrical signaling apparatus adapted for railway-crossings, the combination of railway-tracks including insulated block-rails and continuous conductor-rails, electrical connections between said railway-tracks, train-circuits in electrical connection with the insulated block-rails of said railways and including batteries and electromagnets, train connections comprising collectors in contact with said block-rails and continuous conductor-rails, semaphore-circuits including semaphore-operating magnets, and shunt-circuits including electromagnets and arranged to be established by the action of the electromagnets of the train-circuits, and, in turn, to establish the semaphore-circuits.

9. In an electrical signaling apparatus for railways, the combination of a railway-track consisting of insulated block-rails and a continuous conductor-rail, a train-circuit including an electromagnet, means for closing said circuit, a shunt-circuit, including an electromagnet, completed by the action of the electromagnet of the train-circuit, and a semaphore-circuit including a semaphore-operating magnet, established by the electromagnet of the shunt-circuit.

10. In an electrical signaling apparatus for railways, the combination of a railway-track consisting of insulated block-rails and a continuous conductor-rail, a train-circuit includ-

ing an electromagnet, train connections for closing said train-circuit, a shunt-circuit, including an electromagnet, completed by the action of the electromagnet of the train-circuit, and a semaphore-circuit including a semaphore-operating magnet established by the electromagnet of the shunt-circuit.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CHARLES W. S. TURNER.

Witnesses:

JAMES L. NORRIS,

GEO. W. REA.