No. 838,854. PATENTED DEC. 18, 1906.

G. P. FINNIGAN.

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS.

APPLICATION FILED AUG. 19, 1905.

4 SHEETS—SHEET 1.

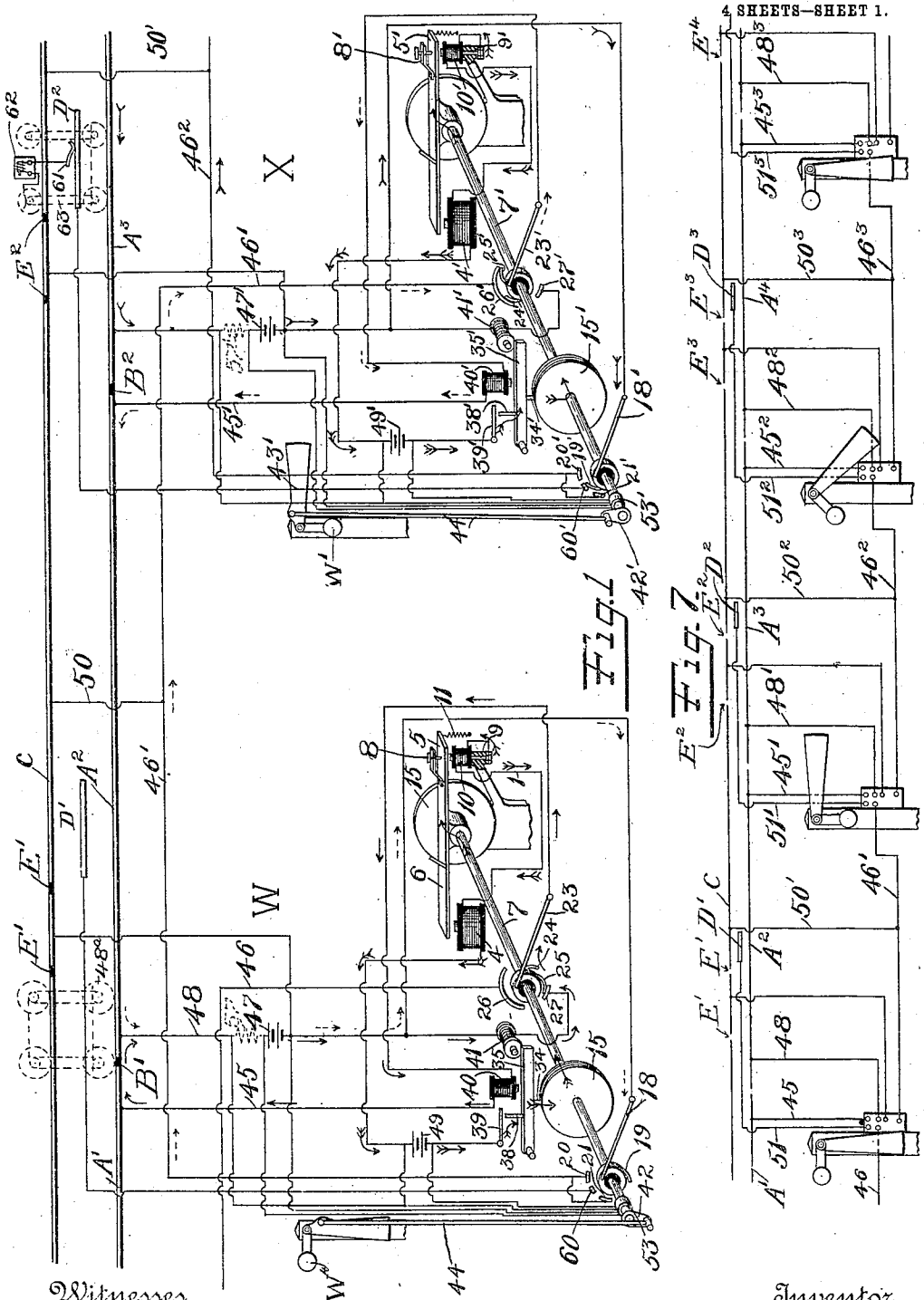

Fig. 1.

Fig. 2.

Witnesses
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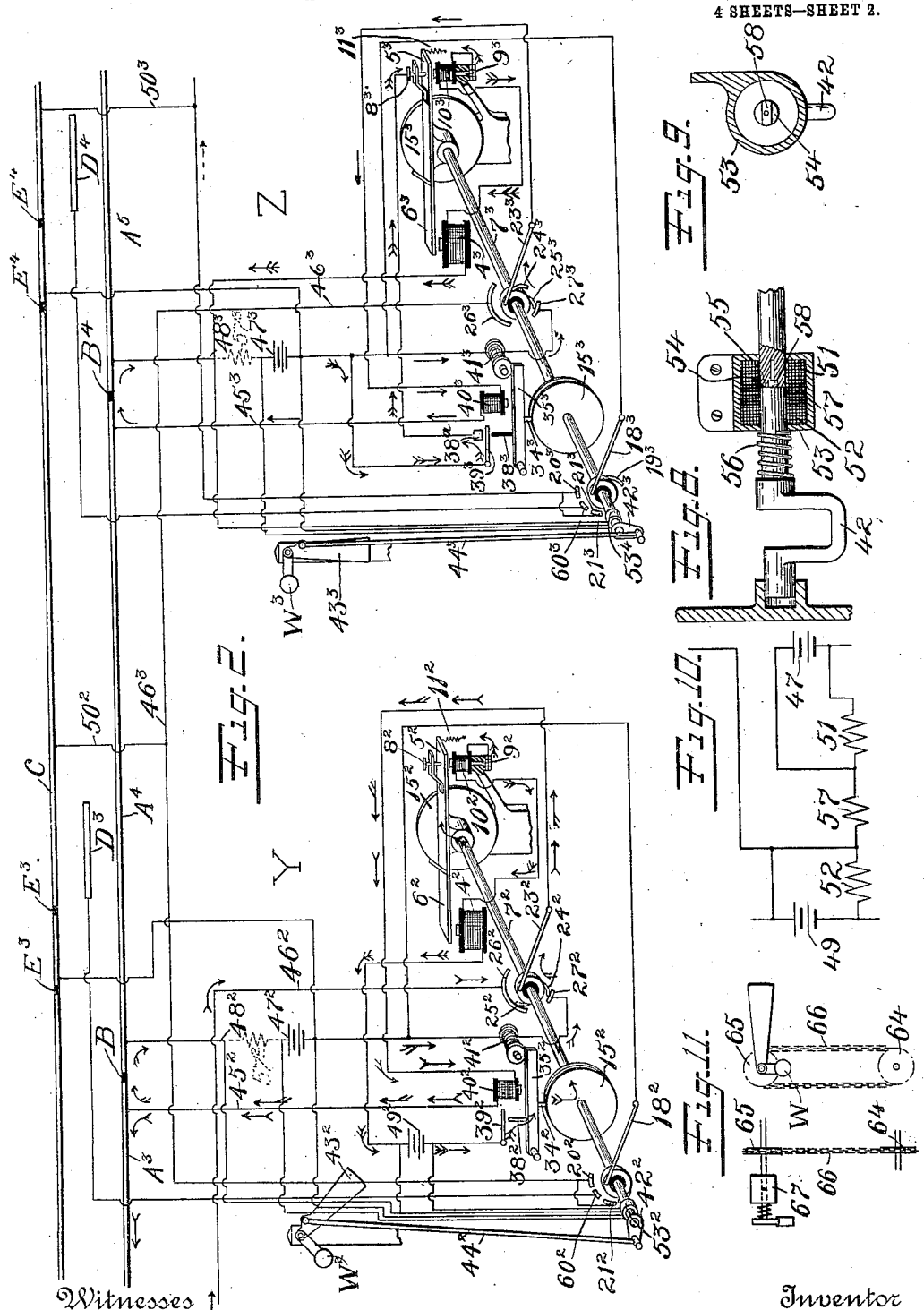

Fig. 2.

Fig. 9.

Fig. 8.

Fig. 10.

Fig. 11.

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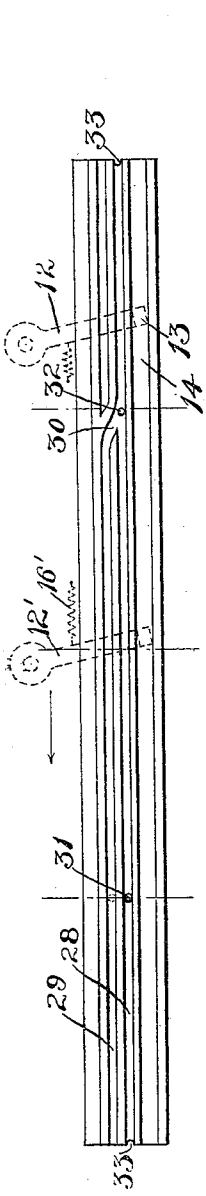

Fig. 5.

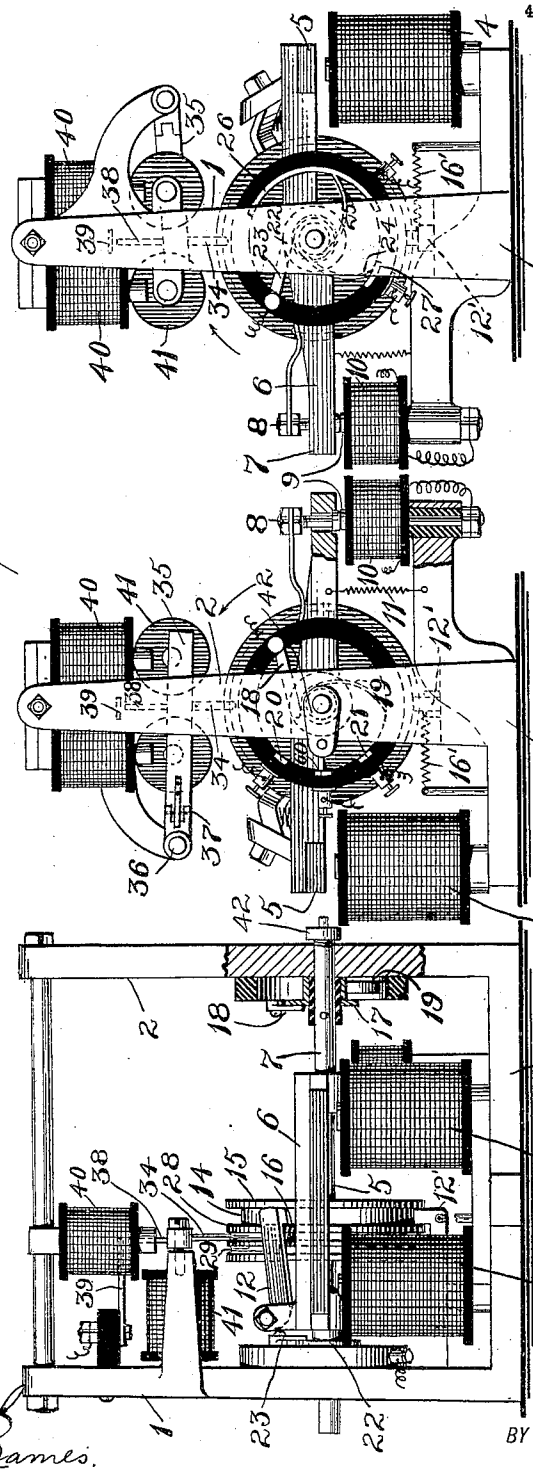

Fig. 4.

Fig. 3.

WITNESSES:

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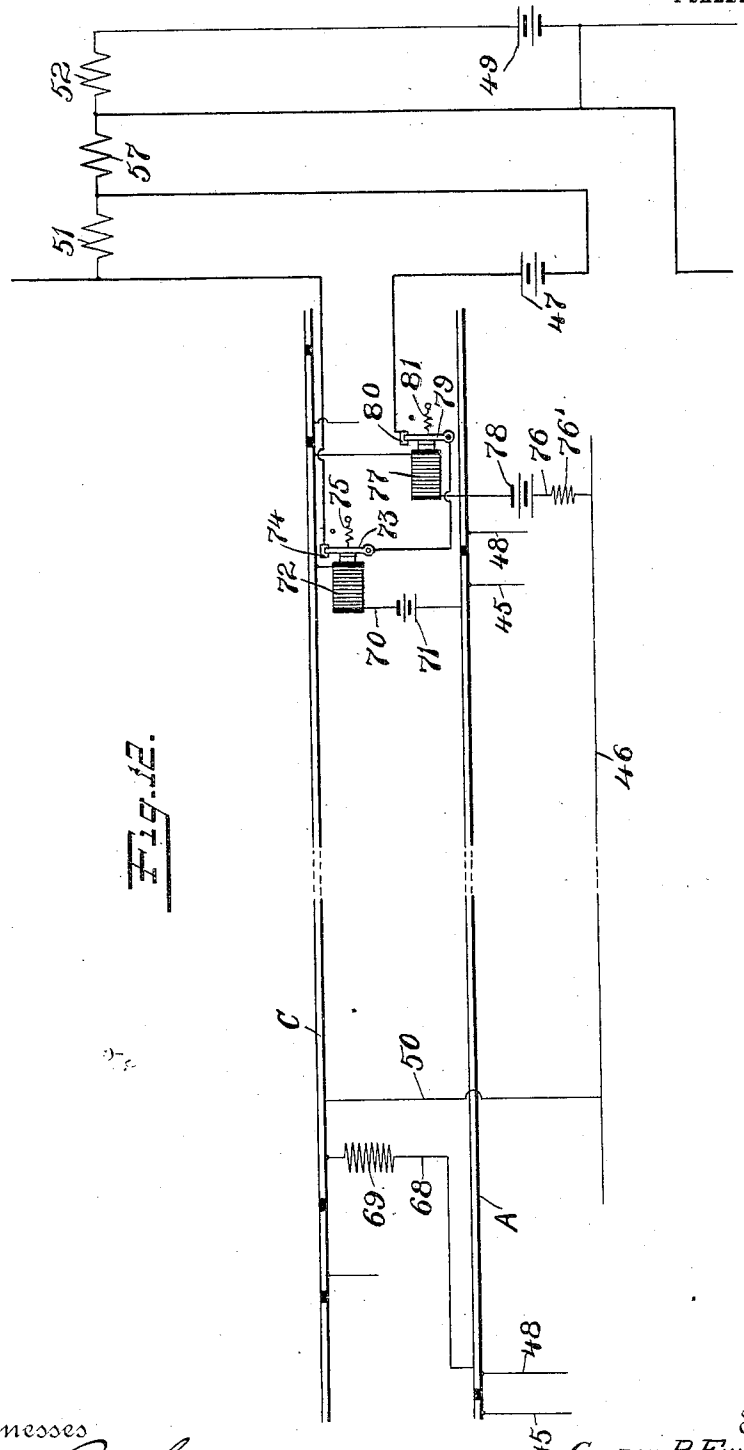

Fig. 12.

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UNITED STATES PATENT OFFICE.

GEORGE P. FINNIGAN, OF GREENE, NEW YORK.

ELECTRIC BLOCK-SIGNAL SYSTEM FOR RAILWAYS.

No. 838,854. Specification of Letters Patent. Patented Dec. 18, 1906.

Application filed August 19, 1905. Serial No. 274,892.

To all whom it may concern:

Be it known that I, GEORGE P. FINNIGAN, a citizen of the United States, residing at Greene, Chenango county, New York, have invented certain new and useful Improvements in Electric Block-Signal Systems for Railways, of which the following is a full, clear, and exact description.

This invention relates to electric block-signals, and has for its object to produce an electric block-signal system for railways in which the electric circuits are normally open-circuited, and in which the signals are automatically set and cleared.

In the system described below any particular signal is adapted under certain conditions to be actuated automatically by the next succeeding signal and under other conditions is adapted to be actuated directly by a passing train and under other conditions is adapted to be actuated either by the succeeding signal or directly by a passing train. The block-signals are automatically set and cleared, and if the source of electricity fails the proper block has its signal automatically set at "danger." Moreover, means may be provided for notifying the engineer through mechanism located upon the engine in case he should by oversight run by a signal in danger position. This notification may be through the operation of an alarm or the automatic shutting off of the power or the application of the brakes or by all of these operations.

The following is a description of a system embodying my invention, reference being had to the accompanying drawings, in which—

Figure 1 represents the mechanism and circuits for two blocks. Fig. 2 represents the mechanism and circuits for two preceding blocks. Fig. 3 represents a form of motor suitable for operating a signal, together with electromagnetic mechanism and contacts for controlling said motor. Fig. 4 is a right-hand elevation of the apparatus in Fig. 3. Fig. 5 is a left-hand elevation of the apparatus in Fig. 3. Fig. 6 is a development of certain controlling means of the mechanism of Fig. 3. Fig. 7 is a diagrammatic view showing the general arrangement of the external circuits of the system. Figs. 8 and 9 are detail views. Fig. 10 is a simplified diagram of certain circuits. Fig. 11 shows a modified connection between motor and signal-arm. Fig. 12 is a diagram of circuits showing means for indicating whether the rails or the line-wires between the blocks have been disconnected.

Referring more particularly to the drawings, 1, 2, and 3 in Figs. 3, 4, and 5 are the side frames and base of an electric-motor device. On the base 3 is mounted an electromagnet 4 with its energizing-coils adapted to coact with the armature 5, carried by the frame or lever 6, mounted on a shaft 7, journaled in the supports 1 2. The frame 6 has an extension which carries a spring-supported magnetic contact-piece 8, which makes electric contact with an insulated contact member 9, to which one terminal of a supplemental magnetizing-coil 10 is electrically connected. The energizing-coils of the magnet 4 and the coil 10 are in series with one another, and when connected to a source of continuous current the magnet 4 is so energized that it attracts the armature 5 until the engagement between the contacts 8 and 9 is broken, whereupon the magnet 4 being thus deënergized the frame 6 is detracted by the spring 11 and the contacts 8 and 9 are again brought into engagement. This results in causing the frame 6 to vibrate. The supplemental coil 10, acting magnetically on the contact 8, keeps the contact 8 in engagement with the contact 9 until the frame 6 forcibly overcomes the attraction and brings about a separation. It results from this that the energizing circuit is maintained intact through a considerable movement of the frame 6. The frame 6 carries a pawl 12, which has a rectangular head 13, lying within the square groove 14 of a disk 15. This pawl is normally held away from the frame 6 by a compression-spring 16. When the frame 6 is attracted by the electromagnet 4, the head 13 of the pawl 12 binds against the sides of the slot 14 and compels the disk 15 to move a slight distance forward. A similar pawl 12′, normally retracted by the spring 16′, permits the disk 15 to move forward, but prevents it from being moved backward by binding against the sides of the slot 14 in a manner similar to the binding of the pawl 12. When the disk 15 has been moved forward and the pawl 12 is moved in reverse direction by the return movement of the frame 6, the pawl 12 does not bind in the groove 15, but moves freely, with the result that on its next downward movement the

pawl 12 grips the disk 15 at a new point. The successive vibrations of the frame 6 and pawl 12 thus compel the disk 15 to move continuously in one direction. The movement is slow, but powerful. The motor above described, for which any suitable motor may be substituted, is shown and described in patent to Frank H. Williams, No. 546,442, dated September 17, 1895.

Mounted on the shaft 7 and insulated therefrom is a collar 17 of conducting material against which bears brush 18, for the purpose hereinafter described. This collar 17 also carries a brush 19, which is adapted to engage the contacts 20, 21, and 60, for the purpose hereinafter described. The opposite end of the shaft 7 carries a collar 22 of conducting material, on which bears the brush 23. This collar is insulated from the shaft 7 and carries brushes 24 and 25, which make contact with plates 26 and 27, for the purpose hereinafter described. The disk 15, in addition to the groove 14, is provided with two grooves 28 and 29, one of which runs into the other at a point 30. The groove 28 is provided with three depressions 31, 32, and 33, into which the lower end of the pin 34, which is adapted to ride in the groove 28 or the groove 29, falls successively when riding in the groove 28. This pin 34 is carried by an armature 35, pivoted at the point 36 and provided with a pivot 37, so that its free end may have a universal movement. This armature 35 carries also a pin 38, which is adapted to make contact with the terminal 39, for the purpose hereinafter described. The armature 35 is acted upon by magnets 40 and 41, placed at an angle to one another. It will be seen that when the magnet 40 is alone energized the armature 35 will be lifted in a vertical direction. When the magnets 40 and 41 are both energized, the armature 35 will be pulled upward and to one side, so that the pin 34, carried by the armature 35, will not only be lifted out of the depression in the groove 28, in which it may be, but may also be pulled over, so that when released the pin 34 will engage with the groove 29. The energizing-circuit of the motor passes from some suitable source, such as a battery 49, to the contact 39 and the pin 38, thence through the pin 34 to the disk 15, thence through the shaft 7 and frame 6 to the contact 8, thence to the contact 9, through the coils 10 and 4, back to the battery. It is therefore made and broken by the engagement and disengagement of the pin 38 with the terminal 39, the pin 34 being at all times in electric contact with the disk 15. It will thus be seen that when contact is once made between the pin 38 and the terminal 39 the motor starts, and when it has started the disk 15 holds these two members in engagement, so that they are in engagement until the pin 34 reaches one of the depressions 31 32 33, and that the motor will continue to operate until the pin 34 reaches the next one of these depressions, at which time the energizing-circuit being then broken at contact 39 the motor is automatically stopped with the shaft 7 in a definite position. When, however, the armature 35 is moved to the left, Fig. 1, the pin 34 drops into groove 29 and does not find a depression until it reaches the switching-point 30, at which time it returns to the groove 28 and falls into the depression 32. The purpose of these features and this method of operation will be further explained in connection with the diagram. The motor-shaft 7 is provided with a crank-arm 42. To this crank-arm a semaphore-signal 43 is connected by a rod 44 or other suitable connection.

Referring now to Figs. 1 and 2, which show four blocks W X Y Z with their signals in position "clear," "danger," "caution," and "clear," respectively, and the electric circuits of the system, it will be seen that the circuits are made up partly of special conductors and partly by the track. A' A^2 A^3 A^4 A^5 represent track-sections insulated from each other at points B', B^2, B^3, and B^4. C represents the other track, which is broken by insulation at E' E', E^2 E^2, E^3 E^3, and E^4 E^4. The spaces between these insulating portions should be so long that at least one wheel of a passing train is always on the section. One terminal of the magnet 40 is connected by the conductor 45 with one track-section A'. The other terminal of the magnet 40 is electrically connected with the brush 23. The contact 26 is electrically connected by the conductor 46 with contacts of the next succeeding signal mechanism corresponding to contacts 20 and 21, to which the conductor 46′, leading to block X, is connected. One terminal of the magnet 41 is connected to a battery 47, whose other terminal is connected to the track-section A^2. The other terminal of the coil 41 is connected to the contact-plate 27. It will thus be seen that when the insulation B' is bridged by a passing train 48^a a complete local circuit is formed through the battery 47, electromagnet 41, contact 27, brush 23, electromagnet 40, the train, and conductor 48, back to the other terminal of the battery 47. This takes place when a train bridges the insulation while the signal is in a clear position, as shown in block W, or in the caution position, as shown in block Y. A train, therefore, running past a signal set at "clear" or at "caution" will cause the armature 35 to be lifted and pulled to one side, so that its pin 34 will drop into the groove 29. This will start the motor, which will continue to run until the pin 34 is switched to the groove 28 and reaches the depression 32, which corresponds to a position of the motor in which the crank-arm 42 is in a vertical position, as

shown in block X, resulting in the signal being set at "danger." By making the pin 34 travel in the groove 29 the pin 34 is enabled to pass the depression 31 when the signal is moving from "caution" to "danger."

The course of the current through the magnets 40 and 41 when the local circuit is made by a passing train is shown in block W by full-line unbarbed arrows and in block Y by arrows having two barbs on one side. When a signal is at "danger," as shown in block X, and the train passes the next signal ahead in the clear position, as shown in block W, the circuit of the motor device of block W is closed by the train and the motor actuated so as to move its signal to the danger position. In so doing the contact-brush 19 passes the contact 20, which completes an extended circuit through the magnet 40′ of the block X, the current-flow being indicated by dotted unbarbed arrows, as follows: contact 20 of block W to contact 26′ of block X, brush 23′, magnet 40′, rail-section A^2, battery 47, brush 18, brush 19. This energizes the magnet 40′, so that it raises the armature 35 vertically, starting the motor of block X, which continues to run until the depression 33 is reached, whereupon the armature 35 is allowed to fall and the energizing-circuit of the motor of block X is broken at contact 39′. This operation moves the crank-arm 42′ of the mechanism of block X until it reaches a forty-five-degree position, which corresponds to the caution position of the signal 43′. As the motor of block X moves the signal from "danger" to "caution" the brush 19′ engages with the contact 21′. This completes the extended circuit through the controlling-magnet 40^2, as shown by arrows with single right and left barbs, as follows: contact 21′ to terminal 26^2, brush 23^2, magnet 40^2, rail-section A^3, battery 47′, brush 18′, brush 19′. The armature 35^2 is thus lifted vertically by the action of the magnet 40, so that the motor of block Y runs until the pin 34^2 reaches the depression 31. When the pin 34^2 reaches this depression, the armature 35^2 falls, and the circuit is broken at the terminal 39^2, so that the motor stops in the clear position, with the parts in the position shown in block Z.

When the signal is in the position of caution, as in block Y, and the insulation B^3 is bridged, the course of the current is from the battery 47^2 to the magnet 41^2, contact 27^2, brush 24^2, brush 23^2, magnet 40^2, conductor 45^2, the train, and back to the battery 47^2, as shown by the arrows having two barbs on one side in block Y. As before described, this causes the armature 35 to be lifted and drawn to one side by the magnets 40^2 and 41^2, so that the pin 34^2 drops in the groove 29 of the controlling device of the motor and is enabled to pass by the depression 31, so that the motor is not stopped until the depression 32 is reached. The apparatus in Figs. 3, 4, and 5 is shown with its parts in the position corresponding to "caution."

The track-section A^2 is connected to one terminal of the battery 47. The track-section between E′ E′ is connected to the other terminal of that battery. From this it results that when a train bridges the insulation B′ the battery 47 is short-circuited until the last truck has left the section between E′ E′, so that the motor is not started until the train has passed this point. In case two trains are in adjoining blocks the signals behind each train will se set at "danger." In order that if the forward train leaves its block the signal behind the rear train may not be moved to "caution," an electric connection 50 is provided between the conductor 46′ and the section of the track C between E′ and E^2. When a train is on section A^2, this connection 50 shunts the battery 47 so that its current does not energize either of the magnets 40′ or 41′ of the block X, so that the signal of that block is not changed. It will thus be seen that the signals of this system are automatically set and cleared and that the circuits are only temporarily closed. As long as a train is on the line there is a signal set at "danger" and a signal set at "caution," and as the train moves from block to block the signal set at "caution" is moved to clear position. If a train passes a caution-signal, that signal is at once moved to "danger." If two trains or more are on adjacent blocks, the signal behind each train is set at "danger," and two trains cannot get onto adjacent blocks without a danger-signal behind them.

A single battery may be used to supply the electric energy for both the controlling-circuit and the motor-actuating circuit, as shown in block Z, in which the battery 47^3 supplies current to said circuits. Moreover, as in block Z, an independent conductor-connecting contact 8^3 and a contact 38^a can be used instead of the shaft 7 to form part of the actuating-circuit. The pin 38^3, which simply moves contact 39^3 into engagement with 38^a, can be made of insulating material.

In describing the system and its operation attention has been more particularly confined to block W. It will be seen that the same reference-numerals have been applied to similar parts of the other blocks and that the description, when this fact is kept in mind, applies equally well to the blocks X and Y and also to Z when the slight difference above pointed out is taken into account. The blocks all operate in the same manner, and either arrangement can be substituted for the other in any block or series of blocks. As many blocks as desired can be equipped in the same manner, so as to cover the whole or any part of a railway system.

In order that any signal shall at once fly to danger position in case one or both of the

batteries gives out, an electrically-controlled clutch is provided having coils 51 52 in shunt to the batteries 47 49, respectively, these batteries being preferably of the gravity type. These coils 51 and 52 are surrounded by a separately-mounted magnetic casing 53 and when both energized hold the ends 54 and 55, which are provided with clutch-faces, into engagement against the action of the separating-spring 56. When either battery 47 or 49 fails, so that current through either of the coils 51 52 fails, the spring 56 separates the ends of the shaft, so that the signal is free to turn under the action of the weight W attached thereto. This weight throws its signal up to danger position. The signal remains in "danger" until inspected. Upon recharging the battery the clutch-faces are brought into engagement manually and are thereafter held in engagement electromagnetically. The connections around the battery protect all points between them, so that if a considerable portion of the circuit is included any break in that portion of the circuit as well as the failing of any battery will result in the signal going to "danger."

In order that the electromagnetic clutch shall not be released when the battery 47 is short-circuited by a train bridging the insulation B′ or by a train being on section A^2 when contact 21 of block W is engaged, the clutch is formed with a third coil 57, which is interposed between the battery 47 and the rail-section A^2. This results in the clutch being energized at or above normal even when the battery 47 is short-circuited by the train. The clutch is therefore held in engagement whenever the batteries are in condition and the circuits through the energizing-coils intact. In Figs. 1 and 2 I have shown this coil 57 in dotted lines to make it easier to trace the circuit.

In order to notify the engineer or motorman in case he passes by a signal set at "danger," I provide third rails D′ D^2 D^3 D^4. The rail D′ is connected to a contact 60, adapted to be engaged by the brush 19 when the signal is in danger position, as shown in block X, establishing an electric contact at that point. Under these circumstances when the rail D′ and rail-section A′ are electrically connected a current will pass from the battery 47. Similar connections are made with other third rails D^2 D^3 D^4 when the respective signals are at "danger." The locomotive or other traveling vehicle is provided with a contact-shoe 61, which is connected to one terminal of an electromagnetic device 62, the other terminal of which bears upon the axle 63. An electric circuit will in this manner be established through the electromagnetic device 62 whenever the vehicle passes a signal set at "danger," as shown at block X, and the electromagnetic device on the engine will be actuated.

Fig. 7 shows diagrammatically all the connections which it is necessary to have between the operating mechanism and the rails for the purpose of operating the signals of the blocks.

Figs. 8 and 9 show details of the magnetic clutch. The shaft 7 is of steel or iron, and so is the shell or casing 53. The casing and its coils are supported by any suitable means, so that both parts of the shaft rotate freely within them. One of the opposing faces of the shaft is provided with a diametrical rib 58, which when the faces are together enters a corresponding depression in the other face, so that the two parts are clutched together.

Fig. 11 shows a belt or sprocket-chain connected between the motor-shaft and the signal-arm, which may be used instead of a crank and pitman. This form of connection has advantages in that the parts cannot be on a dead-center when the clutch is released. In this form the clutch may be located on the shaft of the signal-arm itself, in which case it would be between the sprocket-wheel and the signal-arm, as indicated. In this form 64 is a sprocket-wheel on the shaft of the motor. 65 is a sprocket-wheel on the shaft of the signal-arm. 66 is a sprocket-chain. 67 is a clutch like that shown in Figs. 8 and 9, holding the two parts of the signal-arm shaft together. When the clutch members are released by the failure of the current through its energizing-coils, the arm can be brought up to "danger" without moving any parts other than a small portion of its own shaft.

In order that the semaphore-signal of any block shall go to danger position in case either the rails or the line-wire belonging to the block controlled by that semaphore should be displaced, I have provided additional features, which are shown in Fig. 12. These features consist of an electrical connection 68 between the ends of the main rail-sections C and A of each block. The connection contains a high resistance 69. The other ends of the rail-sections C and A are connected by an electric conductor 70, in which is inserted a battery 71 and a relay-magnet 72 of high resistance. This relay-magnet acts upon an armature 73 and when energized holds it in engagement with the contact 74 against the action of the spring 75. This armature is in series with the battery 47 and the coil 51 of the semaphore-clutch. When the parts are in the proper position, the circuit through the battery 71 is maintained by the conductors 68 and 70 and the rails A C. In case, however, either of the rails is broken, so that the circuit is interrupted, the magnet 72 is deënergized, whereupon the spring 75 retracts the armature 73 and interrupts the circuit containing the battery 47 and the coil 51. This releases the magnetic clutch controlling the semaphore, with the result that the semaphore at

once flies to "danger." The connections between the rails A and C being high-resistance connections do not interfere with the function of the connection 50, heretofore described, which only comes into play when the rails are short-circuited by a low resistance, such as would be formed by an engine or car truck.

In order to protect the line-wire 46, which extends between any two stations, this line-wire, which is already connected to the rail-section C by a conductor 50, (located in this instance near one end of the rail C,) is also connected with the rail C at the other end by a conductor 76, which contains a relay-magnet 77 and a battery 78. The circuit thus established by the rails C and the conductors 46, 50, and 76 is also of high resistance, the resistance being in the connection 76. The relay-magnet 77 is provided with an armature 79, which when the magnet is energized is held in engagement with the contact 80 against the action of the spring 81. The armature 79 is thus normally in series with the battery 47 and the coil 51 of the semaphore-clutch. If either the conductor 46 or the rail C is interrupted, the magnet 77 becomes deënergized and the circuit through battery 47 and coil 51 is broken at the contact 80. The coil 51 is thus deënergized and the semaphore-arm automatically goes again to "danger." By these means the semaphore-arm is put in the danger position if the circuits through either of the rails C A or the conductor 46 is interrupted for any cause. The batteries 71 and 78 are so connected that their electromotive forces oppose one another. The circuits thus act entirely independently. If, however, the rail C is interrupted, both the relays 72 and 77 are deënergized. If the rail A or the conductor 46 is interrupted, only one of the relays is deënergized. In case, however, either of the rails A C or the conductor 46 is interrupted the circuit through the coil 51 is interrupted, and the semaphore-clutch being deënergized the semaphore-arm is automatically placed in danger position. All the blocks are provided with similar devices, so that the main rail-sections and line conductors throughout the entire system are protected.

This invention permits of various modifications both as to circuit arrangements and operating mechanism and it is not to be understood as limited to the precise embodiment shown and described, but that various equivalents may be substituted for many of the elements thereof.

What I claim is—

1. In a railway system, the combination of a plurality of signal devices, a motor and motor-circuit for operating each signal device, a pair of normally open controlling-circuits for each of said motor-circuits, each pair consisting of a local circuit and an extended circuit, each of said motor-circuits being controlled through its extended circuit by a neighboring signal device and controlled locally through its local controlling-circuit, the local controlling-circuit of one motor being connected in multiple arc with the extended controlling-circuit of the next motor to a common source of current.

2. In a railway signal system the combination of a plurality of signal devices each having motors for actuating the same, two normally open circuits for each signal; one of said circuits being local for locally controlling the motor of its signal and the other being extended to a preceding signal for controlling the motor of said preceding signal, said circuits being connected in multiple arc to a common source of current, both of said circuits being in part made up of portions of track, the track portion of one circuit being adjacent to the track portion of the other circuit, contacts in said local circuit adapted to be closed by a passing train and contacts in said extended circuit adapted to be closed by the signal device ahead of that controlled by said extended circuit.

3. In a railway signal system the combination of a plurality of signal devices each having motors for actuating the same, two normally open circuits for each signal, one of said circuits being local for locally controlling the motor of its signal and the other being extended to a preceding signal for controlling the motor of said preceding signal, said circuits being connected in multiple arc to a common source of current, both of said circuits being in part made up of portions of track, a track portion of one circuit being electrically connected to a track portion of the other circuit, contacts in said local circuit adapted to be closed by a passing train and contacts in said extended circuit adapted to be closed by the signal device ahead of that controlled by said extended circuit, a local energizing-circuit for each of the motors of said signal devices and means for closing said local energizing-circuit and maintaining it closed until the signal reaches "danger" position whenever said local controlling-circuit is completed.

4. In a block-signal system, the combination of a plurality of blocks, a signal and motor for each block, each motor when not in "clear" position being under the control of the motor of the block ahead through a normally open electric circuit, a local energizing-circuit for each of said motors, contacts therefor closed by said controlling-circuit, and means actuated by said motor for holding them closed until the signal reaches its next position.

5. In a block-signal system, the combination of a plurality of blocks, a signal and motor for each block, each motor when in "clear" position being controlled by a nor-

mally open circuit adapted to be closed by a passing train, a local energizing-circuit for each of said motors, contacts therefor, closed by said controlling-circuit, and means actuated by said motor for holding them closed until the signal reaches the "danger" position.

6. In a block-signal system, the combination of a plurality of blocks, a signal and motor for each block, each motor when in "caution" position being controlled by a normally open circuit adapted to be closed by the motor ahead, and cause said first motor to move its signal to the next position, and also controllable by a normally open circuit adapted to be closed by a passing train, and cause said signal to be moved to "danger" position, a local energizing-circuit for each of said motors, contacts closed by either of said controlling-circuits, and means actuated by said motor for holding them closed until the signal reaches the position determined by which one of said controlling-circuits closes said contact.

7. In a block-signal system, the combination of a plurality of blocks, a signal and motor for each block, each motor when in "caution" position being controlled by a normally open circuit adapted to be closed by the motor ahead, and cause said first motor to move its signal to the next position, and also controllable by a normally open circuit adapted to be closed by a passing train, and cause said signal to be moved to "danger" position, a local motor-energizing circuit for each of said motors, contacts controlled by said controlling-circuits, means actuated by said motor for holding said contacts closed when one controlling-circuit is used until the signal reaches its next position, and means for holding the said contacts in engagement until the signal reaches "danger" position when the other of said controlling-circuits is closed.

8. In an electric block-signal system, a plurality of blocks each having a motor, an energizing-circuit therefor and two controlling-circuits connected in multiple arc to a common source of current, said circuits being made up in part of portions of the track, a track portion of one of the multiple-arc circuits being directly connected to a track portion of the other one of said multiple-arc circuits, one of said multiple-arc circuits operating to close the energizing-circuit of the motor of one block and the other multiple-arc circuit operating to close the motor-energizing circuit of the motor of a neighboring block, means actuated by each of said motors respectively for automatically opening its said energizing-circuit at a time dependent upon the controlling-circuit employed to close it and signals actuated by said motors.

9. In an electric block-signal system, a motor, a normally open motor-energizing circuit, an armature for closing said circuit when actuated, means actuated by said motor for holding said armature in actuated position until the motor reaches a position corresponding to the next position of the signal, means actuated by said motor for holding said armature in actuated position until the motor reaches a position corresponding to the "danger" position of the signal, and two controlling-circuits, one adapted to bring said armature into operative relation with said first means and the other adapted to bring said armature into operative relation with said second means.

10. In a block-signal system, a motor for each block, a disk carried thereby having a groove which has recesses corresponding to the positions of the signal, an armature having an extension adapted to ride in said groove and enter said recesses, a local energizing-circuit for said motor controlled by said armature, and electromagnetic means acting upon said armature for withdrawing said extension from said recesses and causing it to ride in said groove until the next depression is reached.

11. In a block-signal system, a motor for each block, a disk carried thereby having two grooves, the first of which has recesses corresponding to the positions of the signal and the second of which opens into the first, an armature having an extension adapted to ride in said grooves and enter said recesses, a local energizing-circuit for said motor controlled by the armature, and electromagnetic means acting upon said armature for withdrawing said extension from said recesses and causing it to ride in said second groove.

12. In a block-signal system, a motor for each block, a disk carried thereby having two grooves, the first of which has recesses corresponding to the positions of the signal and the second of which opens into the first, an armature having an extension adapted to ride in said grooves and enter said recesses, a local energizing-circuit for said motor controlled by the armature, an electromagnet for withdrawing said extension from said recesses so as to cause it to ride in said first groove, and an angularly-disposed electromagnet for moving said extension laterally so as to cause it to ride in said second groove.

13. In a railway-signal, the combination of a signal-arm, means tending to throw said arm to "danger" position, a motor device for positively controlling said arm, a source of energy for said motor, and electromagnetic means permanently in circuit with said source of energy for disconnecting said arm and motor in case the source of energy fails.

14. In a railway signal system, the combination of a signal-arm, means tending to throw said arm to "danger" position, a motor for positively actuating said arm, a circuit containing a source of current for controlling said motor, and permanently in circuit with

said source of current for disconnecting said arm from said motor in case said source fails.

15. In a railway signal system, the combination of a signal-arm, means tending to throw said arm to "danger" position, a motor positively actuating said arm, a circuit containing a source of current for controlling said motor, a source of current for actuating said motor, and means for disconnecting said arm from said motor in case either of said sources of current fails.

16. In a railway signal system, the combination of a signal-arm, means tending to throw said arm to "danger" position, a motor for positively actuating said arm, a circuit containing a source of current for controlling said motor, and means for disconnecting said arm from said motor in case said source fails, and maintaining said connection in case said source is short-circuited in normal operation.

17. In a railway-signal, a semaphore-arm weighted so as to automatically come to "danger" position when released, and operating mechanism therefor, a magnetic clutch between said semaphore-arm and said operating mechanism, a battery energizing said electromagnetic clutch, and an energizing-coil connected permanently across the terminals of said battery.

18. In a railway-signal, a semaphore-arm, means tending to cause said arm to come to "danger" position, when released, and operating mechanism therefor, a magnetic clutch between said semaphore-arm and said operating mechanism, a battery energizing said electromagnetic clutch, the energizing-windings of said clutch being part in shunt with said battery and part in series to said battery.

19. In a railway-signal, a semaphore-arm, means tending to cause said arm to come to "danger" position when released, and operating mechanism therefor, a magnetic clutch between said semaphore-arm and said operating mechanism, a plurality of batteries energizing said electromagnetic clutch, said clutch having said energizing-windings in shunt to a plurality of batteries.

20. In a railway-signal, a semaphore-arm weighted so as to automatically come to "danger" position when released, and operating mechanism therefor, a magnetic clutch between said semaphore-arm and said operating mechanism, a plurality of batteries energizing said electromagnetic clutch, said clutch having a plurality of energizing-windings, part in shunt to a plurality of said batteries, and part in series with one of said batteries.

21. In a railway-signal, a signal-arm, a weight tending to throw said arm to "danger" position, an electric motor for positively actuating said arm, a source of current for controlling said motor, a magnetic clutch for connecting said arm to said motor and windings for said clutch permanently connected in shunt to said source of current.

22. In a railway-signal, a signal-arm, a weight tending to throw said arm to "danger" position, an electric motor for positively actuating said arm, a source of current for controlling said motor, a magnetic clutch for connecting said arm to said motor, and windings for said clutch, part in shunt to said source and part in series therewith.

23. In a railway-signal, a signal-arm, a weight tending to throw said arm to "danger" position, an electric motor for positively actuating said arm, a source of current for actuating said motor, a magnetic clutch for connecting said arm to said motor, windings for said clutch permanently connected in shunt to said source of current.

24. In a railway signal system, the combination of a shaft, a signal-arm mounted thereon, a weight tending to throw said arm to "danger" position, an electric motor positively actuating said arm, said motor having its shaft out of alinement with the shaft of said arm, sources of current for controlling said motor and actuating the same, a magnetic clutch mounted on the motor-shaft and connections between one member of said clutch and the shaft of said arm for operatively connecting said arm to said motor through said clutch, said clutch having energizing-windings connected to said sources respectively.

25. In a railway signal system, the combination of a plurality of signal-operating electromagnetic devices, a plurality of line conductors whereby a preceding operating device is controlled from the next succeeding device, a plurality of pairs of rail-sections, an electric connection between one of each of said pairs of rail-sections and its preceding operating device, and an electric connection between the other of each of said pairs of rail-sections and the corresponding one of said line conductors so that a train on said rail-sections between said signal-operating devices short-circuits each preceding device relatively to the succeeding device.

26. In a railway-signal, a signal-clutch, a circuit therefor normally energizing said clutch, a track-rail, a conductor contiguous thereto, connections between said rail and said conductor forming a circuit, a source of current and an electromagnetic device in said circuit, and means for opening said first-mentioned circuit when said electromagnetic device is deënergized by the interruption of said second circuit.

27. In a railway signal system the combination of the main conductor, a pair of rails, one of which rails coöperates with said main conductor to form a circuit connecting two signal-stations, a source of current for said circuit, a connection between said conductor

and the other of said rails, two high-resistance connections between said rails, a battery and an electromagnetic device in one of said high-resistance connections and in series with the other of said high-resistance connections, a clutch-energizing circuit and means actuated by said electromagnetic device for controlling said energizing-circuit.

28. In a railway signal system, the combination of three conductors, A, C, 46, a plurality of high-resistance connections, 68, 70, between two of said conductors, a low-resistance connection, 50, and a second connection, 76, between one of said two conductors and the third, one of said high-resistance conductors containing a battery, 71 and an electromagnetic device, a second battery and an electromagnetic device located in said connection 76, and a clutch-energizing circuit controlled by each of said electromagnetic devices.

GEORGE P. FINNIGAN.

Witnesses:
H. B. BROWNELL,
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Correction in Letters Patent No. 838,854.

It is hereby certified that in Letters Patent No. 838,854, granted December 18, 1906, upon the application of George P. Finnigan, of Greene, New York, for an improvement in "Electric Block-Signal Systems for Railways," an error appears in the printed specification requiring correction, as follows: On page 7, lines 46–47, "clutch having said energizing windings in shunt to a plurality of batteries," should read *clutch having a plurality of energizing windings in shunt to said batteries;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of January, A. D., 1907.

[SEAL.]

D. H. Bruce
acting chief Div. B.

F. I. ALLEN,
Commissioner of Patents.