No. 747,967. PATENTED DEC. 29, 1903.

F. P. GREEN.

TRAIN CONTROLLING AND SIGNALING SYSTEM.

APPLICATION FILED FEB. 11, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

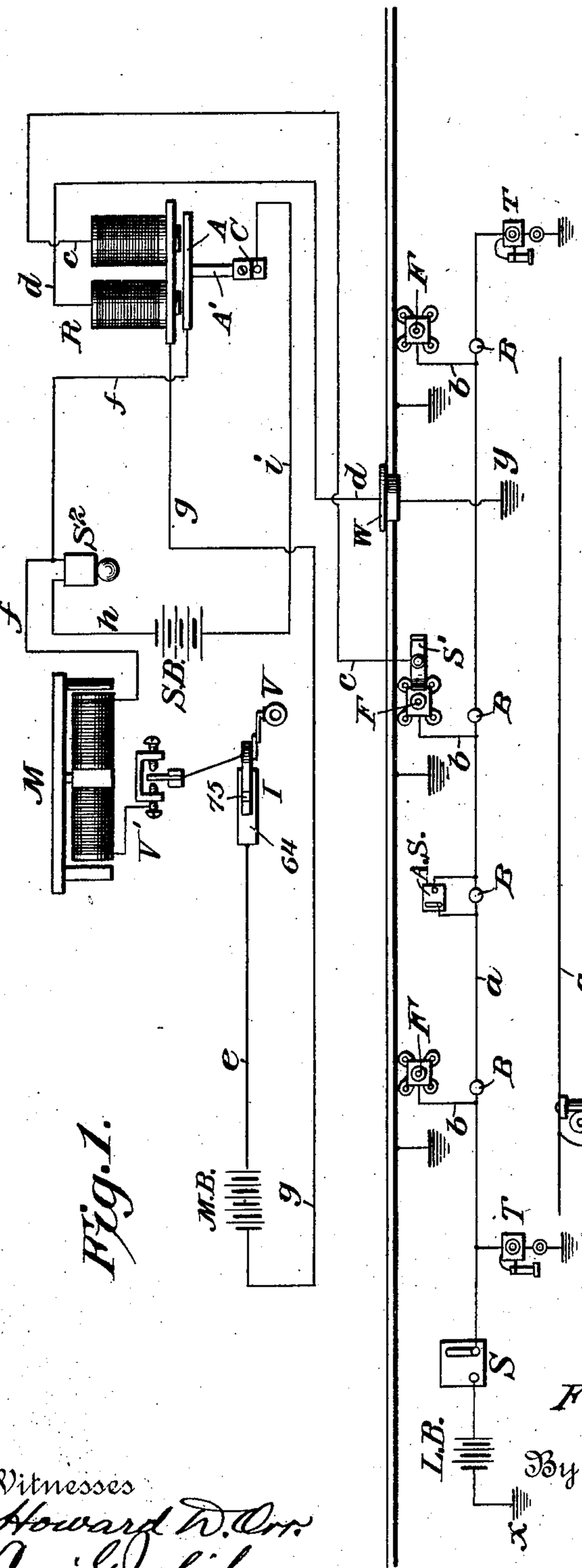

Fig. 1.

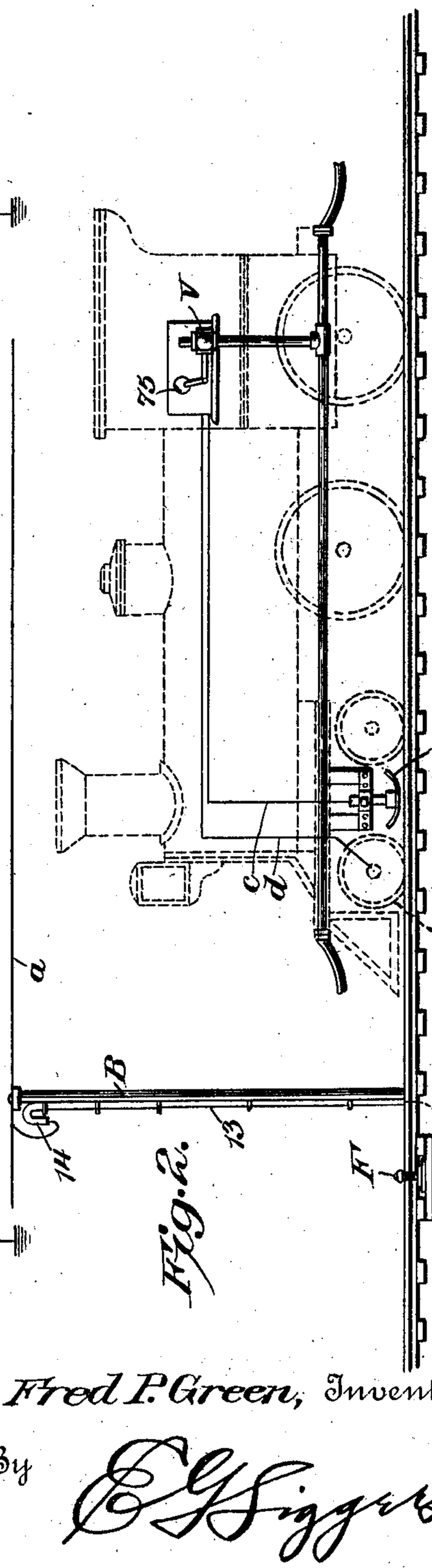

Fig. 2.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 10.

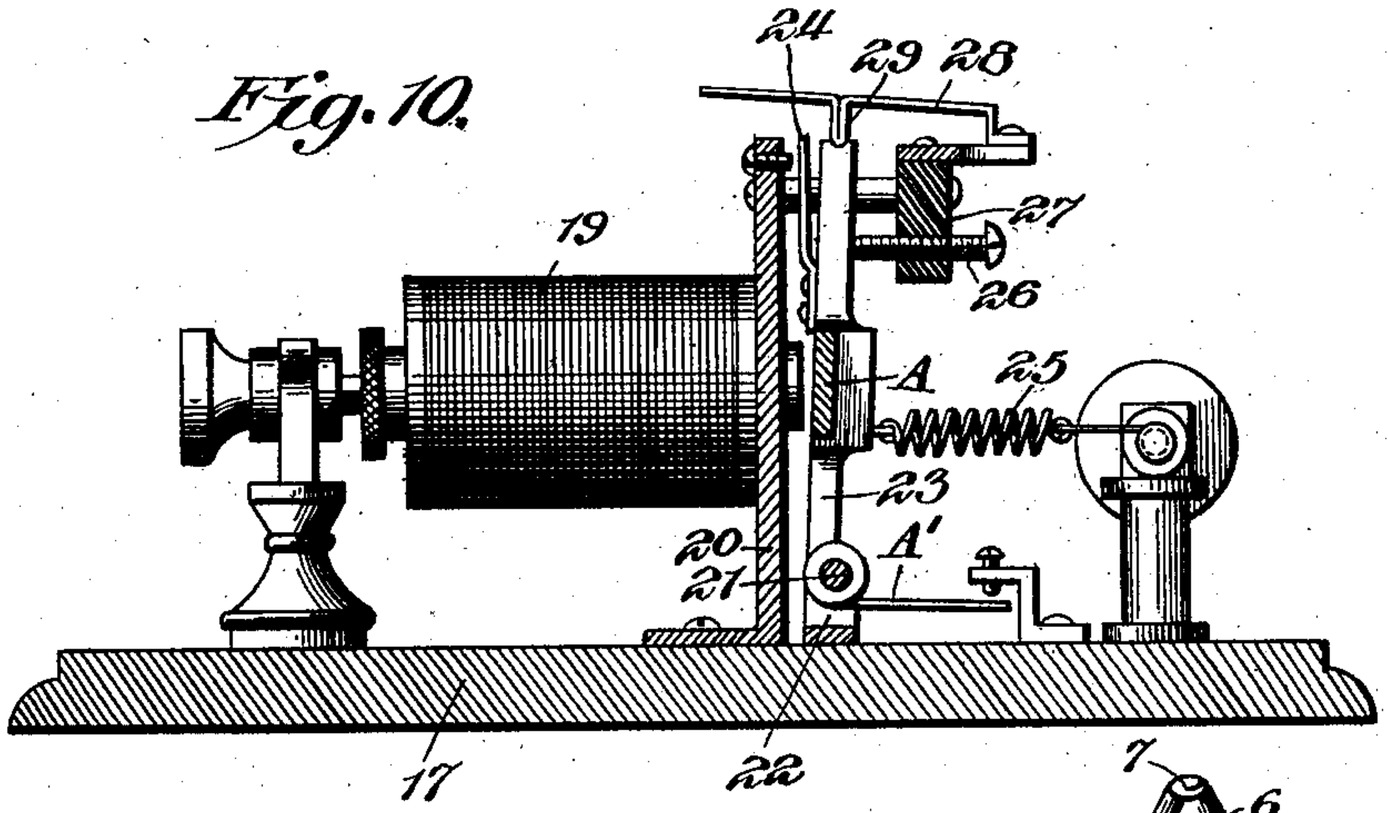


Fig. 11.

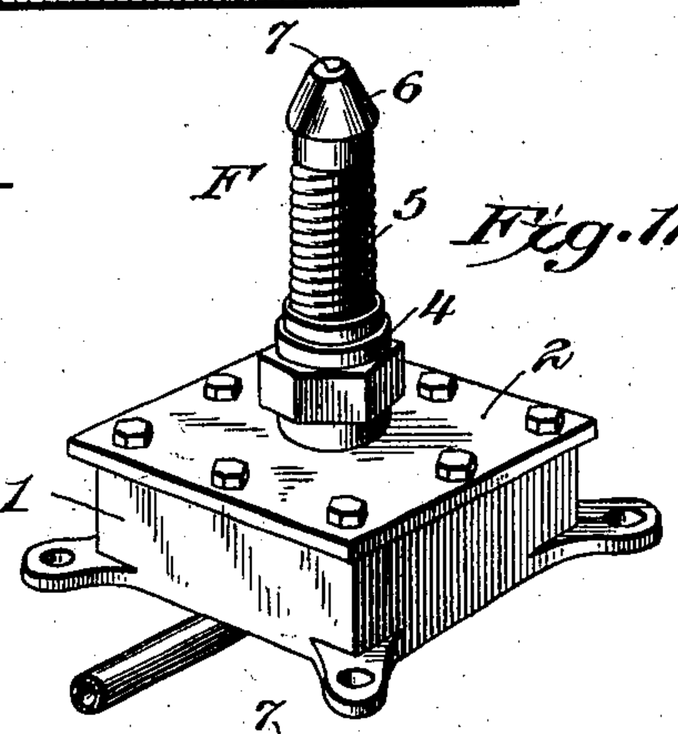


Fig. 3.

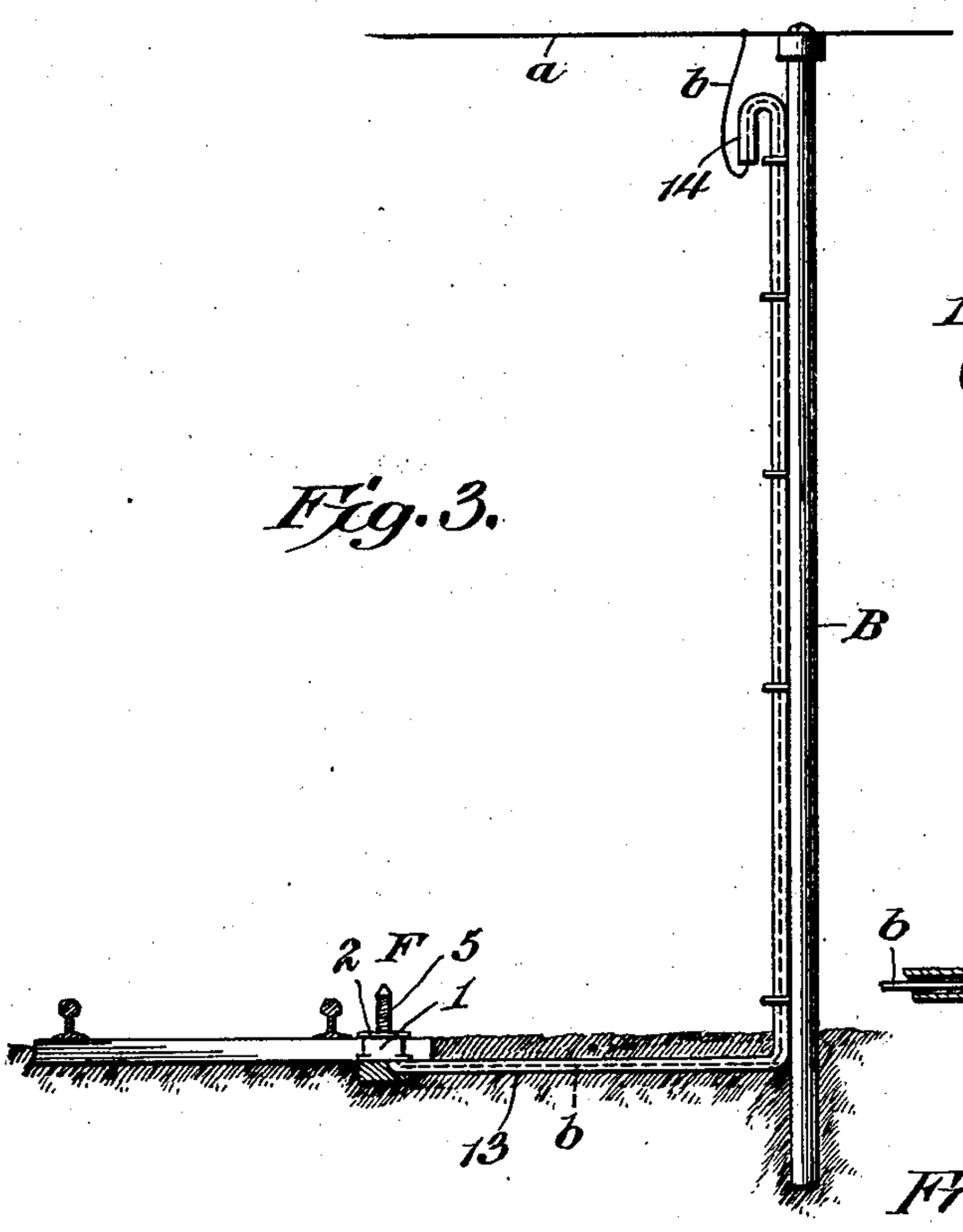
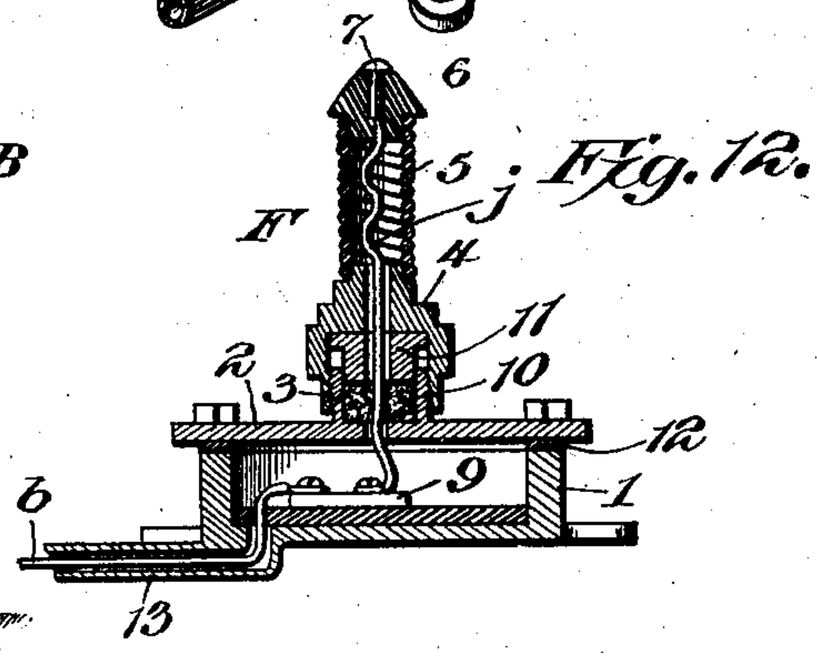


Fig. 12.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

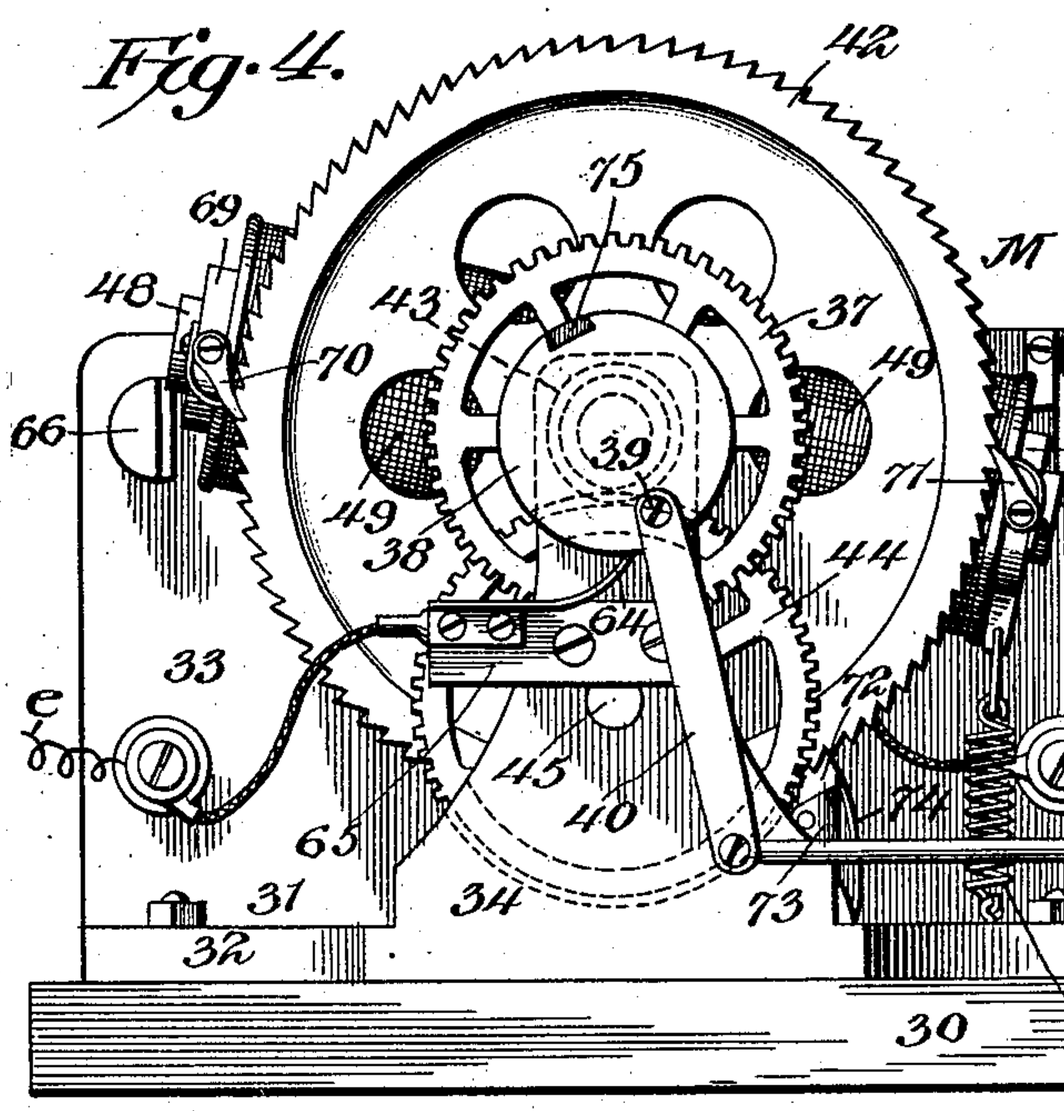


Fig. 8.

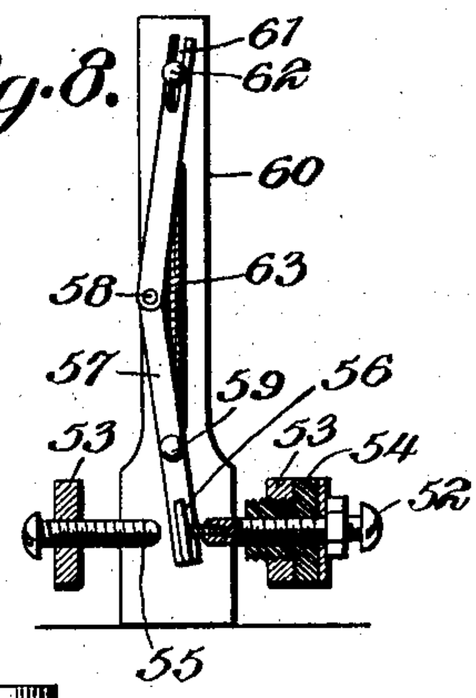


Fig. 5.

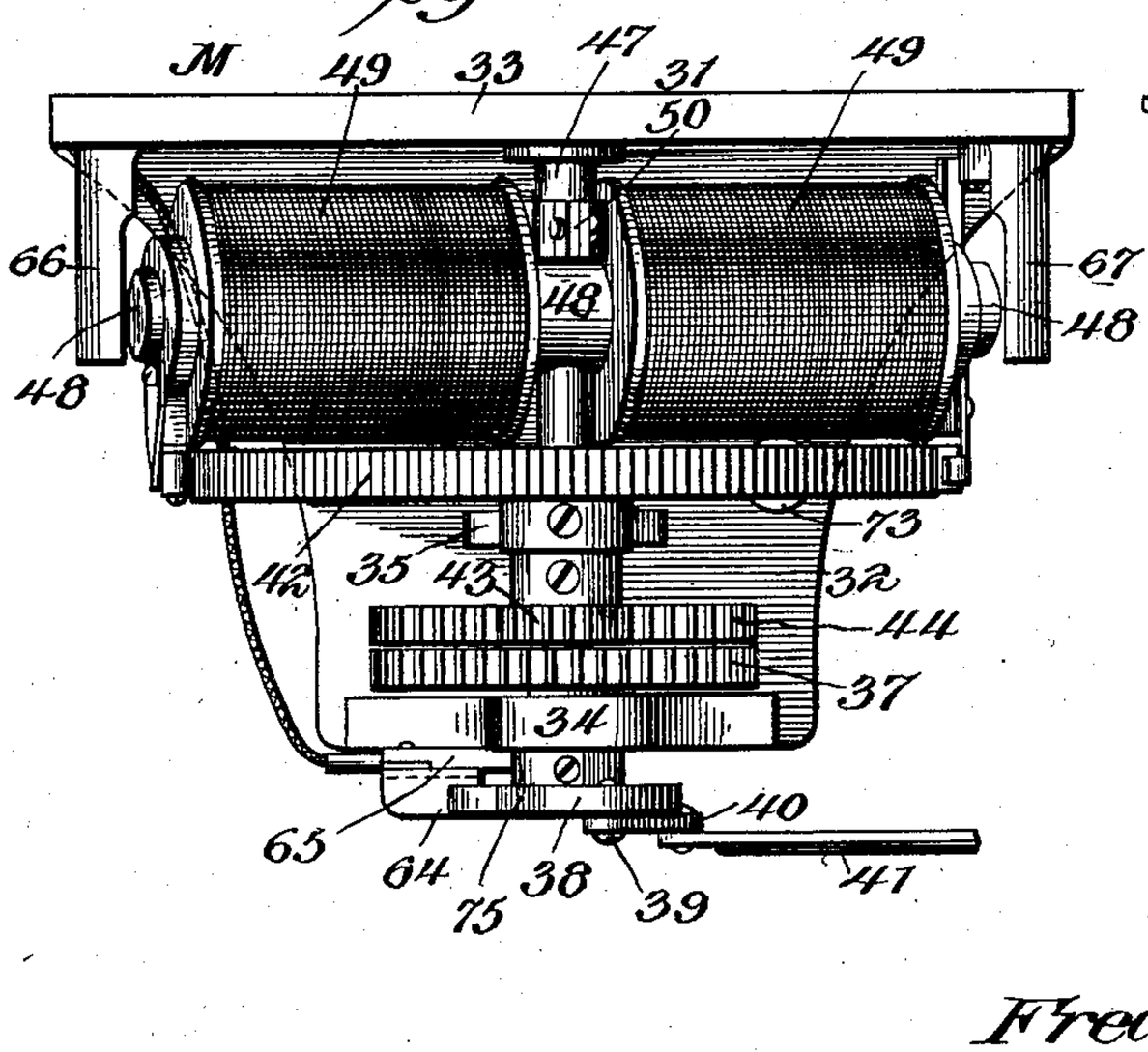
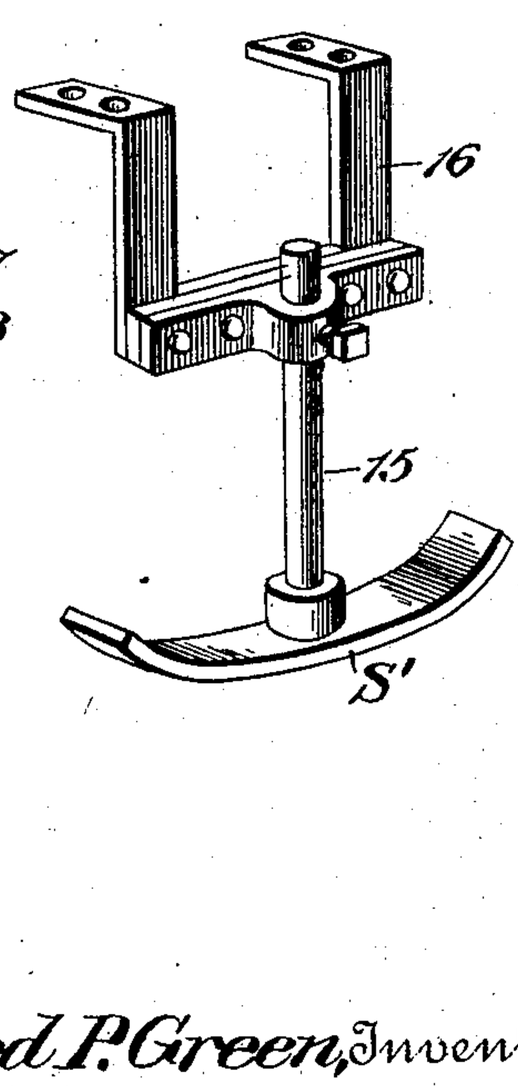


Fig. 13.



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NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6.

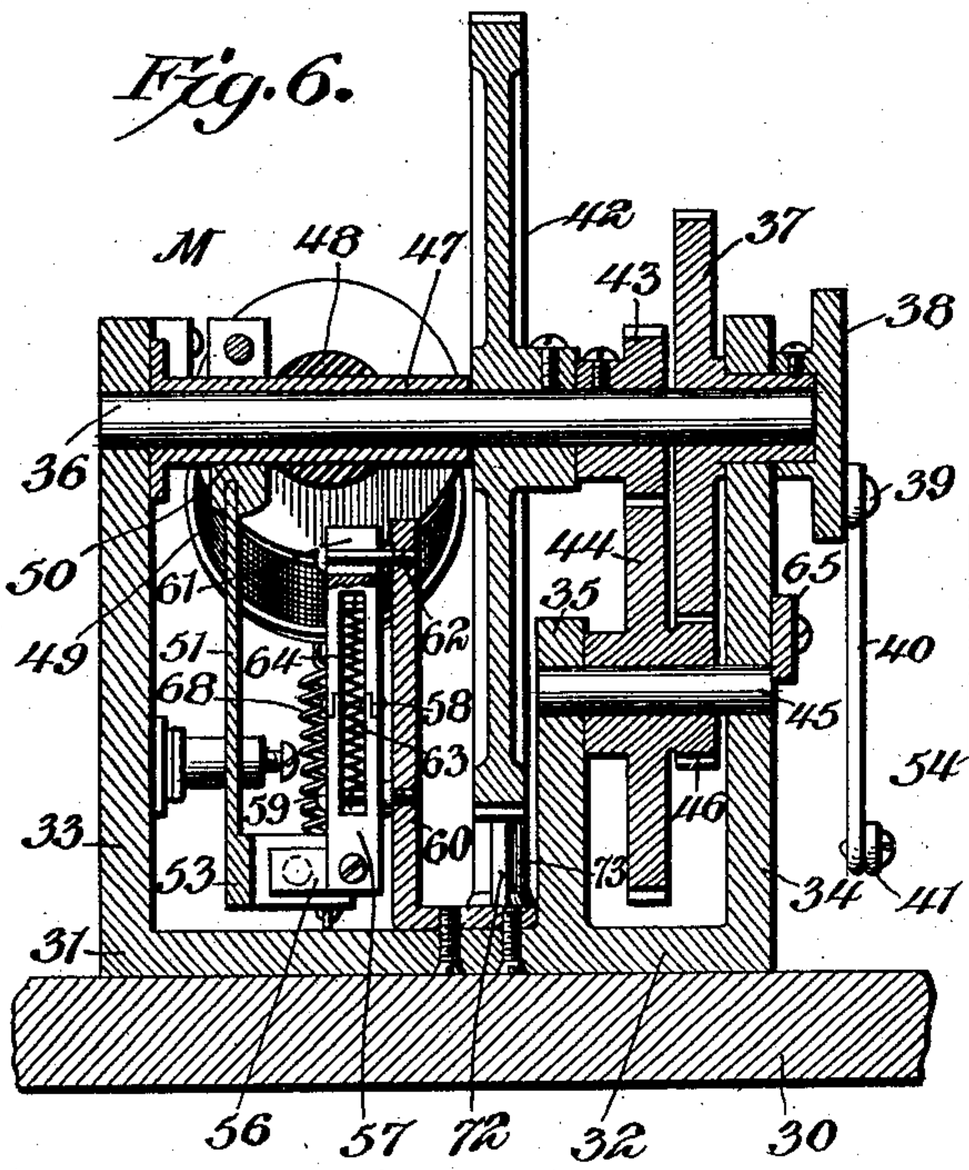


Fig. 7.

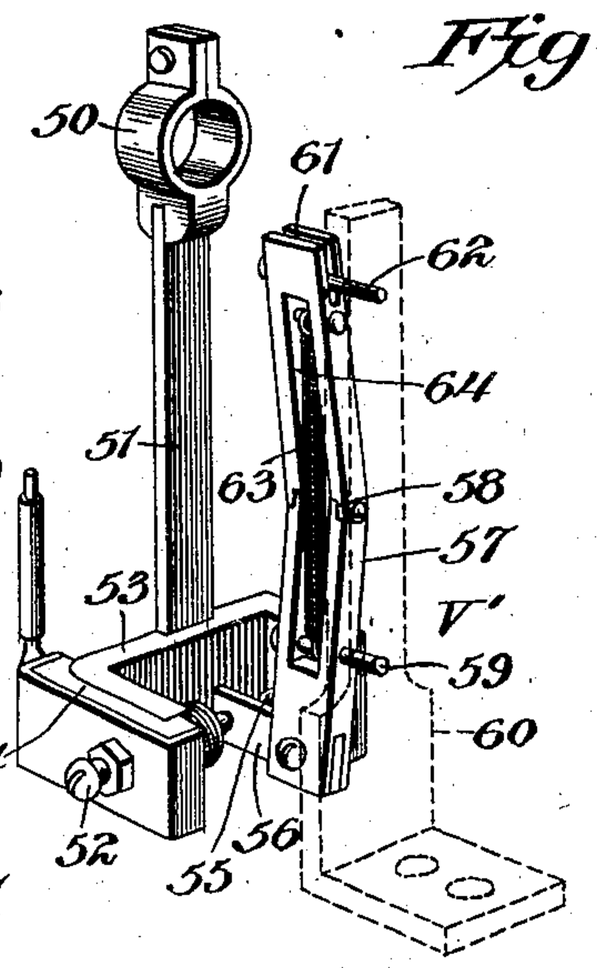
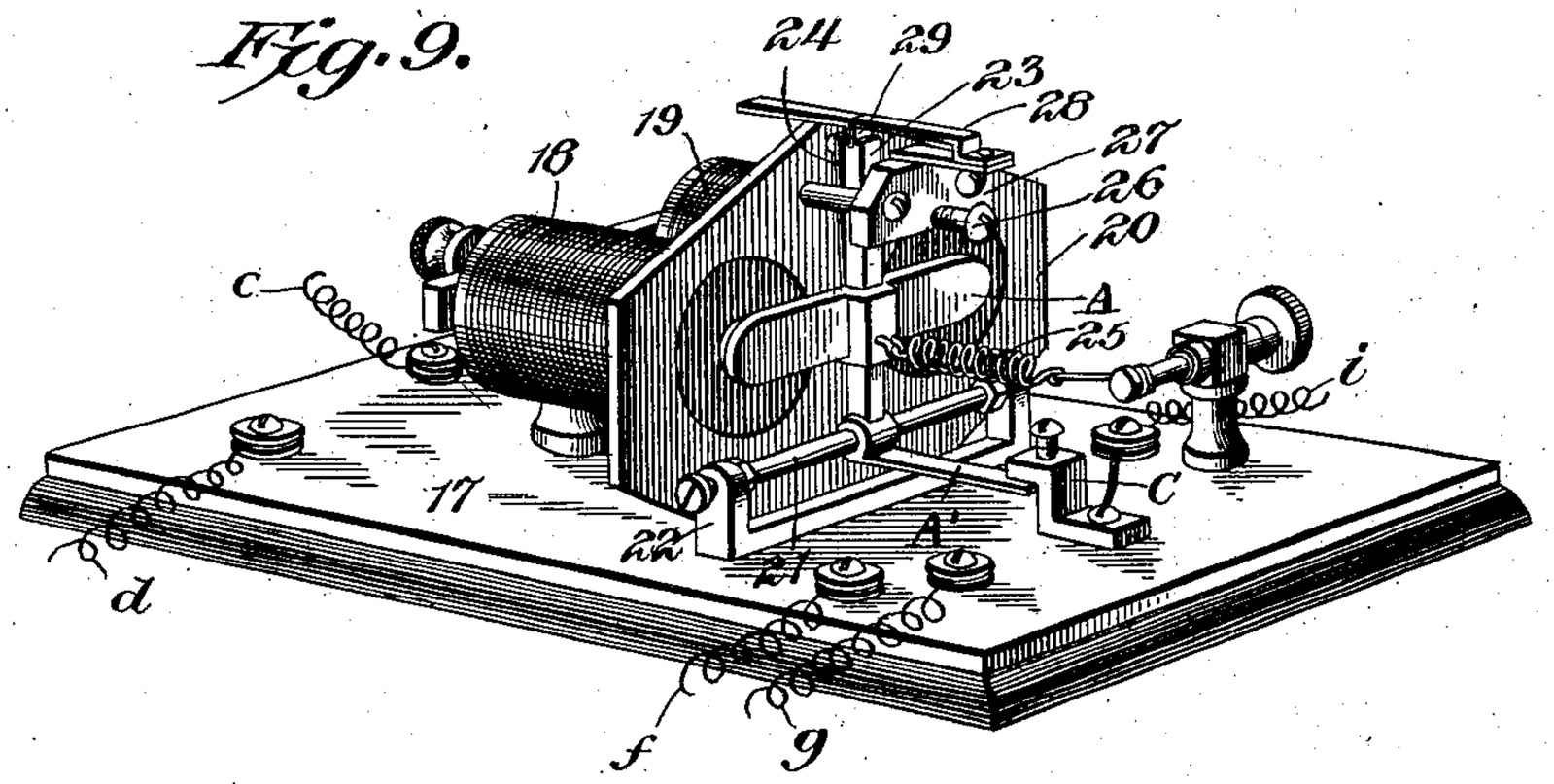


Fig. 9.



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No. 747,967. Patented December 29, 1903.

UNITED STATES PATENT OFFICE.

FRED PRATT GREEN, OF EAST AURORA, NEW YORK, ASSIGNOR OF TWO-THIRDS TO SHELLY S. ALDRICH AND DAVID UNDERHILL, JR., OF EAST AURORA, NEW YORK.

TRAIN CONTROLLING AND SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 747,967, dated December 29, 1903.

Application filed February 11, 1903. Serial No. 142,870. (No model.)

To all whom it may concern:

Be it known that I, FRED PRATT GREEN, a citizen of the United States, residing at East Aurora, in the county of Erie and State of New York, have invented a new and useful Train Controlling and Signaling System, of which the following is a specification.

This invention relates to a novel train controlling and signaling system for railways.

The primary object of the invention is to reduce to a minimum the element of human fallibility in the operation of railways by providing a signaling and controlling system whereby the train despatcher may in case of necessity operate a signal on and apply the air-brakes of a moving train located at any point in his division.

It sometimes happens that orders to hold a train are received at the signal-tower a few seconds too late for delivery. The signals themselves sometimes refuse to operate properly and in consequence of various other exigences a train may enter an obstructed section of the line, where the trainmen will be without means of being apprised of the approaching danger until it is too late to avoid an accident. By means of the present invention it is contemplated to place every moving train in a given division under the immediate and direct control of the train despatcher, so that in times of great danger requiring prompt action he may instantly by the manipulation of an electric switch located in his office apply the brakes of a moving train and operate a signal carried by the train to apprise the engineer of the danger ahead.

It is also the object of the invention to provide means whereby one or more sections of the line may be temporarily cut out of the system, so that any given train may be stopped without interfering with the running of such trains as are in no danger.

Various other objects of the invention directed more particularly to simplifying the apparatus and to the general efficiency thereof will appear during the course of the succeeding description of the illustrated embodiment of the invention.

In the accompanying drawings, Figure 1 is a diagrammatical view of the complete system. Fig. 2 is an elevation of a section of track, showing one of the contact-fingers connected to the line-wire and illustrating the arrangement of the apparatus on the locomotive. Fig. 3 is a sectional view through the road-bed, showing a contact-finger in its proper relation to the tracks and having connection with the line-wire. Fig. 4 is a side elevation of the motor, the emergency-valve of the air-brake system, and the intermediate connections. Fig. 5 is a plan view of the subject-matter of Fig. 4. Fig. 6 is a vertical sectional view of the motor. Fig. 7 is a detail perspective view of the make-and-break device of the motor. Fig. 8 is a detail view of the same with the parts shown in section. Fig. 9 is a perspective view of the relay and connected parts. Fig. 10 is a longitudinal sectional view through the relay and associated parts. Fig. 11 is a perspective view of one of the contact-fingers and its mounting. Fig. 12 is a sectional view through the subject-matter of Fig. 11, and Fig. 13 is a detail perspective view of the contact-shoe and its mounting.

Like characters of reference are employed to designate corresponding parts throughout the several views.

I will first describe the system generally and after a more specific description of the various features of the apparatus will briefly summarize the operation of the system for the stopping of a train in an emergency.

A line-wire *a* is extended along the road-bed and is preferably carried by poles B, which may or may not be the usual telegraph-poles following the lines of all railways; but the possibility of the use of such poles conduces to the economical installation of the system. One terminal of the wire *a* is grounded, as at *x*, and in said wire are located the normally open controlling-switch S and a source of electrical energy—as, for instance, a line-battery LB. The controlling-switch S is designed to be located in the office of the train despatcher or other official having the immediate supervision of the movement of trains over a division of the road.

The line-wire *a* is tapped at suitable inter-

vals by branch wires *b*, each of which is in electrical connection with a contact-finger F, located adjacent to the outer side of one of the rails, and with which is designed to contact a shoe S′, carried in the present instance by the locomotive, but adapted to be supported by any vehicle the control of which may be desired. The shoe S′ constitutes one terminal of a relay-circuit, including a relay R and the wires *c* and *d*, the former, *c*, leading from the shoe to one side of the relay, and the latter, *d*, leading from the other side of the relay and having electrical connection with one of the vehicle-wheels W, through which the circuit passes to the track and is grounded. This relay or controlling circuit, assuming the controlling-switch S to be closed, is as follows: from the line-battery LB, wire *a*, branch wire *b*, contact-finger F, contact-shoe S′, wire *c*, to relay R, thence from relay R through wire *d*, to wheel W, to track, and ground at *y*, and back to the line-battery.

The apparatus carried by the locomotive also includes an electromagnetic motor M and a signal S^2, the latter preferably being in the form of an electric bell, as indicated. The motor is designed when energized to operate through suitable connections the emergency-valve V of an air-brake system of any approved type with which the locomotive or the entire train is equipped. This valve V corresponds in function to the engineer's valve, since when opened it permits the exhaust of the air from the train-pipe to permit the automatic operation of the triple or other valve mechanism controlling the application of the brakes. The purpose of the motor, therefore, is to open the emergency-valve V for the purpose of applying the brakes to stop the train, and the purpose of the signal S^2 is to apprise the engineer of the emergency. The motor and the signal are included in independent circuits which, however, are designed to be simultaneously closed when the relay R is energized by the closing of the switch S and the engagement of the shoe S′ with one of the contact-fingers F.

The motor-circuit includes a motor-battery MB, from which a wire *e* is led through an interrupter I, a vibrator V′, and suitable connections to one terminal of the motor-solenoid, the other terminal of which is in electrical connection by a wire *f* with the armature A of the relay R. The other side of the motor-circuit is formed by a wire *g*, leading from the motor-battery to the frame of the relay R. Thus when the relay is energized in the manner heretofore stated the motor-circuit will be closed and the motor will operate to open the emergency-valve V, and thus apply the brakes. The motor also operates the interrupter I in a manner which will be hereinafter explained, so that when the valve has been opened the motor-circuit will be interrupted or broken to stop the motor, regardless of whether or not contact is maintained between the frame and armature of the relay.

The signal-circuit includes the signal-battery SB, from which a wire *h* is led to one side of the signal or bell S^2, the other side of the bell being connected to the wire *f* at a point between the motor and the armature, it being observed, therefore, that that portion of the wire *f* extending from the bell to the armature is common to both the signal and motor circuits. From the other pole of the signal-battery SB a wire *i* is led to a contact-plate C, arranged to be engaged by a contact-arm A′, extending from the armature A. The relay-armature A is of the swinging type, as will be hereinafter described more fully, and it follows that when the relay is energized the armature proper will contact with the frame of the relay to close the motor-circuit and the armature-arm A′ will be swung up into contact with the plate C to close the signal-circuit. Thus if the despatcher closes the switch S the controlling or relay circuit will be completed as soon as the shoe S′, carried by the engine, comes into contact with one of the fingers F, located at the side of the road-bed, the result being the sounding of the alarm and the application of the brakes. It should be noted that the closing of the primary circuit to energize the relay from the line-battery LB is only momentary—that is to say, it lasts only while the shoe S′ is in contact with the finger F. As this brief interval would be too insignificant for an effective operation of either the signal or the motor provision is made for automatically locking or latching the armature A whenever it is moved to a position to close the motor and signal circuits. By reason of this provision the two local circuits on the vehicle remain closed after the contact between the shoe S′ and the finger F is broken, and while the motor operates the interrupter I to automatically open the motor-circuit as soon as the emergency-valve is completely opened the signal-circuit remains closed, so that the alarm will be continuously sounded until the attention of the engineer is attracted and he purposely releases the relay-latch, and thus permits the relay-armature to swing back to its normal position.

Since the system is particularly designed for use only in extraordinary emergencies, the entire division of the road will generally be embraced within the control of the operator through the closing of the switch S, because while all of the trains passing over such division will be stopped, or at least will have their brakes set and their alarms sounded by the closing of the switch, the inconvenience incidental to this result will be insignificant as compared with the results of a collision or other catastrophe, which prompt action by the train despatcher will prevent. However, I have provided for cutting out a portion or section of the road from the sys-

tem when the character of the emergency permits of sufficient time, so that the train or trains in a particular section of the division may be stopped without affecting such trains as are located at points too remote from the scene of accident to be in any danger. The means employed for the purpose stated is embodied in the form of one or more auxiliary switches AS, located at intervals in the line-wire *a*. Usually these switches would be located at signal stations or towers, so that if time permits the operator at any desired station can be advised by the train despatcher to open the auxiliary switch for the purpose of cutting out that part of the system located therebeyond. As a matter of fact, the time consumed by this proceeding would be no more than a few seconds, as it would simply involve the transmission of a single telegraphic symbol and the instant opening of the auxiliary switch by the operator at the signal-station, followed instantly by the closing of the controlling-switch S to stop any train not located beyond the open auxiliary switch. The practicability of this feature of the invention will be understood in connection with the operation of block systems. The blocks are usually from one to five miles in length, and a great many blocks may be embraced in a particular division of the road. If the despatcher should forward orders to hold a train at the end of one block and the train should have passed out of said block a few seconds before the receipt of the order, there would perhaps be sufficient time to have the auxiliary switch located beyond the train opened by the operator before operating the emergency system to stop the train, as several minutes would perhaps necessarily elapse before the train would reach a perilous position. While, however, the system is, as will thus be seen, of great utility in connection with block systems, the necessity for emergency precautions of the character contemplated by this invention is very much greater in connection with the operation of railways which do not employ the block system or which are equipped with a single track for the passage of trains in both directions.

I will now proceed to describe in detail the various devices which are complementary to the system.

The contact-fingers, which are, as I have heretofore stated, located at intervals along the outer side of one of the rails, are designed to yield laterally to permit the shoe S′ to ride thereover without endangering the integrity of the parts. By preference each finger is provided with a base in the form of a small casing 1, designed to be bolted to a cross-bar extending between a pair of ties and provided with an apertured cover-plate 2, having a threaded nipple 3, upon which is secured a coupling 4, provided with an axial opening in line with the opening through the cover-plate 2 of the casing. To the coupling is secured in any suitable manner the body portion of the finger. This body portion is preferably in the form of a closely-wound spring-wire spiral 5, within the upper end of which is fitted a cap 6, of insulating material, preferably of conical form, and having seated in its apex a contact-plug 7. To this plug is attached the upper end of a wire *j*, secured at its lower extremity to a contact-plate 9, located in but insulated from the casing 1 and having electrical connection with one of the branch wires *b*. Within the nipple 3 is located suitable packing 10, surrounding the wire *j* immediately above the cover 2 of the casing and designed to be compressed by a gland 11, located within the coupling 4 and arranged to be urged thereby against the packing. It will be observed that by reason of the arrangement of parts described the finger while normally standing upright will yield laterally to permit the passage of the shoe S′ thereover, and that not only will the wire *j* leading down from the plug 7 be protected from the weather, but the provision of the packing 10, compressed around the wire by the gland 11, will effect the absolute exclusion from the interior of the casing of such moisture as could by any possibility corrode the electrical connections therein. As an additional precaution a gasket 12 is located between the cover 2 and the walls of the casing, as shown. The branch wire *b* is also preferably protected by providing a conduit or tubing 13 therefor. (See Fig. 3.) This tubing leads from the casing 1 preferably underground to the adjacent pole B, along which it extends to a point adjacent to the line-wire *a*, where its upper extremity is turned down, as indicated at 14, as a protection from the weather.

The shoe S′, arranged to contact with the fingers F, is preferably in the form of a flat plate, having its front and rear ends upwardly deflected for an obvious reason and carried at the lower end of a vertically-disposed stem 15, adjustably retained by a bracket 16, rigidly or otherwise secured at a convenient point on the locomotive, preferably adjacent to the pony-trucks, as shown in Fig. 2.

The relay is generally of ordinary construction comprehending a base 17, above which are supported the coils 18 and 19, retained by a frame-plate 20 and arranged in proper relation with respect to the armature A. The armature is vertically disposed and is mounted to rock, its shaft 21 being journaled in a metallic armature-frame 22 in electrical communication with the wire *f*. A post 23 supports the armature proper, and upon one face thereof is arranged a contact-spring 24, which when the armature is drawn toward the magnet contacts with the frame-plate 20 to close the motor-circuit in a manner heretofore described. Extended horizontally from the lower end of the post 23 is the armature-arm A′, underlying an overhanging end of the con-

tact-plate C, with which the wire *i* is in electrical connection, as heretofore stated. Normally the armature is retained in the position shown in Fig. 10 by a spring 25, as usual, and its retractile movement is limited by a screw 26. The screw 26 is mounted in an insulating-strip 27, supported by a stud extending forwardly from the frame-plate, and this insulating-strip is employed for the support of a spring-catch 28, having a beak 29 normally resting upon the upper end of the armature-post, but designed to drop down to lock the armature when the latter is drawn toward the magnet in opposition to the spring 25. The spring-catch 28 therefore constitutes what may be termed an "armature-lock," its function being to lock the armature, so that the motor and signal circuits will be maintained closed even after the relay is de-energized by the passage of the shoe S′ beyond the contact-finger, through which the controlling-circuit was closed. Obviously when the relay is energized the spring 24 will contact with the frame-plate 20 to close the motor-circuit, and the arm A′ will contact with the plate C to close the signal-circuit. Ordinarily the relay, the signal, and the motor are all grouped within a small compass upon a common supporting-base 30, the relay being secured thereto at one end, the motor being mounted thereon at the opposite end, and the bell being attached at an intermediate point. Any other preferred arrangement may be adopted, however.

The specific description of the bell or signal is believed to be altogether unnecessary, since it has no novel characteristics and is simply illustrated for the purpose of showing one form of signal which may be utilized in connection with the system.

The motor M includes a metal frame 31, comprising a bottom plate 32, from which rise a back plate 33, a front standard 34, and a rear standard 35. A horizontal motor-shaft 36 extends between the upper ends of the back plate 33 and the front standard 34 and is loosely journaled in the former. The front end of the shaft 36 is journaled loosely within the hub of a spur gear-wheel 37, said hub being mounted to revolve freely within a suitable opening in the standard 34. Secured to the front extremity of this hub is a disk 38, constituting an element of the interrupter I and provided at an eccentric point with a wrist-pin 39, having connection by means of a link 40 with the end of a valve-lever 41, connected to the emergency-valve V. In the normal positions of the parts—that is to say, when the valve V is closed—the wrist-pin 39 will occupy substantially the position shown in Fig. 4; but if now the disk 38 is rotated the pin 39 will be raised in an obvious manner, thus swinging the valve-lever 41 and opening the emergency-valve V to release the air in the train-pipe, and thus effect the application of the brakes. This rotary movement is imparted to the disk by means of the following mechanism: Upon the motor-shaft 36 is keyed or otherwise secured a comparatively large ratchet-wheel 42, designed to be moved step by step to rotate the shaft 36. The shaft is geared to the spur gear-wheel 37 by a train of gearing including a pinion 43, keyed to the shaft, a spur gear-wheel 44, meshing therewith and mounted to rotate on a short shaft 45, carried by the front and rear standards, and a second pinion 46, fixed to and preferably integral with the gear 44 and meshing with the gear 37. Thus it will be seen that movement imparted to the ratchet-wheel 42 will be communicated to the disk 38, but will be reduced by the intermediate train of gears. Between the ratchet-wheel 42 and the back frame 33 a sleeve 47 is rotatably mounted on the shaft 36 and is passed transversely through the core 48 of a solenoid 49, midway between the ends of the latter. The sleeve is fitted tightly in the opening in the core to constitute an elongated bearing. To the sleeve 47 is fixed in any suitable manner, as by a split collar 50, a depending arm 51, constituting the primary element of the vibrator V′, one terminal of the solenoid having electrical connection with a contact-screw 52, carried at one side of a rectangular frame 53, mounted at the lower end of the arm 51, to swing back and forth as the arm 51 vibrates with the rocking solenoid. The contact-screw 52 is insulated from the frame 53 by suitable insulation, as indicated at 54. At the other side of the frame 53 is located a stop-screw 55, and between the screws 52 and 55 is mounted a contact-plate 56, carried at the lower end of a toggle-lever 57, having a joint 58 at its middle and pivoted, as indicated at 59, upon a bracket 60, upstanding from the bottom of the frame. The upper end of the toggle-lever 57 is provided with a longitudinal slot 61 for the accommodation of a pin 62, projecting from the bracket 60. The contact-plate 56 is designed to be retained at either limit of its movement by a spiral spring 63, connected to the lever 57 above and below its joint 58 and accommodated within a longitudinal slot 64 in the lever. (See Fig. 7.) Thus the lever 57 will be retained in the position shown in Fig. 8 until by the vibration of the arm 51 it is thrown to the reverse position, where it will be retained by the spring 63 until the vibration of the arm in the opposite direction restores the contact-plate to its initial position. Thus it will be seen that the toggle-lever 57 will be in contact with the screws 52 and 55, alternately.

Attention may now be directed to a contact-spring 64, mounted upon a strip of insulation 65 and bearing against the periphery of the disk 38. (See Fig. 4.) This contact-spring is in electrical communication with the wire *e* of the motor-circuit, and when said circuit is closed by the attraction of the relay-armature the current will pass from the motor-battery MB through the wire *e* to the

contact-spring 64, thence to the disk 38 and through the frame of the machine to the toggle-lever 57. We have seen that the contact-plate 56, carried by the lever 57, is designed to contact with the screw 52, connected to one terminal of the solenoid. This is the normal position of the parts, (see Fig. 8,) and it follows that when the motor-circuit is closed the current will pass from the battery to the contact-plate 56 in the manner stated, thence to the screw 52, and through the coils of the solenoid and wire *f* to the frame of the relay to complete the circuit by way of the wire *g*. The core of the solenoid being highly magnetized will be attracted to the soft-iron cheek-pieces 66 and 67, extending forwardly from the back plate 33. The cheek-piece 66 is normally located in a plane slightly below one end of the core 48, and the other cheek-piece is normally in a plane slightly above the opposite end of said core. (See Fig. 4.) By reason of this attraction the solenoid will be rocked, this movement being accompanied by the vibration of the arm 51 and the movement of the toggle-lever 57 out of contact with the screw 52. The circuit will thus be broken, and the solenoid will move back to its normal position, being aided in this movement by a spring 68. This return movement of the solenoid will swing the arm 51 in the opposite direction, causing the screw 55 to move the toggle-lever so that the spring 63 thereof will again present the contact-plate 66 to the screw 52. The circuit being thus reëstablished, the operation just described will be repeated. As long, therefore, as the motor-circuit is otherwise closed the alternate making and breaking thereof by the vibrator V′ will cause continued oscillation of the solenoid. In order to utilize this vibratory movement for the turning of the ratchet-wheel 42, which, as we have seen, is connected with the emergency-valve, I provide at the opposite ends of the core 48 suitable brackets 69, upon which are mounted pawls 70 and 71, engaging the teeth of the wheel 42. To prevent reverse movement of the wheel 42, a dog 72 is pivotally mounted in a bracket 73, upstanding from the base, and is retained in position to engage the wheel by a spring 74. (See Fig. 4.)

It has been stated that the interrupter I is provided for the purpose of opening the motor-circuit to stop the motor automatically as soon as the emergency-valve has been completely opened. To accomplish this result, an insulating-block 75 is set into the periphery of the disk 38. This block is normally disposed as indicated in Fig. 4; but when the disk has been rotated a sufficient distance to open the valve V said block will arrive opposite the contact-spring 64, thus interrupting the circuit at this point and stopping the motor.

As an added precaution I employ a permanent test set for the purpose of testing the main line at frequent intervals, the instruments of the test set being indicated in Fig. 1 and designated by the letter T.

Briefly, the operation of the system is as follows: A locomotive or other vehicle designed to travel upon the tracks is equipped with an air-brake apparatus, a motor for opening the emergency-valve thereof, a signal, a relay controlling independent signal and motor circuits, and a contact-shoe forming a terminal of the relay-circuit, the other side of which is designed to be grounded through a wheel of the vehicle and one of the tracks. Along the track extends a line-wire including a battery, a controlling-switch, and auxiliary switches and having branch wires equipped with contact-fingers. If the controlling-switch has been closed by the train despatcher or other authorized official, the contact-shoe on the vehicle when it contacts with the next contact-finger passed by the vehicle will close a circuit through the relay R, which will in turn close the motor and signal circuits to sound an alarm and to put in motion a motor which will open the emergency-valve of the brake apparatus, and thereby effect the release of the air and the application of the brakes to stop the train. As soon as the motor has performed its work the interrupter I will open the motor-circuit; but the signal-circuit will remain closed until the relay-armature is released by the lifting of the armature-lock 28. Thus in an emergency the train despatcher may stop a train at any point on the line and may operate the signal carried by a train to apprise the trainmen of the unusual danger. By opening any auxiliary switch the contact-fingers beyond the same will be cut out of the main line, and a portion of the road will thus be cut out of the system to enable the operator to stop a train or trains located within a given section of the road without interfering with the operation of trains over other portions of the railway system.

It is thought that from the foregoing the construction and operation of my system will be clearly apparent; but while the illustrated embodiment of the invention is believed at this time to be preferable I do not wish to be understood as limiting myself to the structural details defined, as, on the contrary, I reserve the right to effect such changes, modifications, and variations of the illustrated structure as may be embraced within the scope of the protection prayed.

What I claim is—

1. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit normally open including the motor, and a normally open controlling-circuit including the following elements— a line-wire having a controlling-switch and a series of contact-fingers, a relay carried by the vehicle and controlling the motor-circuit, one side of the relay being grounded,

and a contact-shoe electrically connected with the other side of the relay and carried by the vehicle for presentation to the contact-fingers to close the controlling-circuit.

2. In a system of the character described, the combination with a vehicle equipped with air-brake apparatus including an emergency-valve, a valve-operating motor, and a normally open motor-circuit, of a controlling-circuit including a relay controlling the motor-circuit, means carried by the vehicle for closing the controlling-circuit by engagement with a contact exterior to the vehicle, and means independent of the controlling-circuit for automatically opening the motor-circuit after the emergency-valve is opened.

3. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor-circuit including a motor and an interrupter operated by the motor, a controlling-circuit including a relay controlling the motor-circuit and having one side grounded, a contact-shoe movable with the vehicle and electrically connected to the other side of the relay, a series of contact-fingers to which the shoe is presented by the movement of the vehicle, a line-wire having electrical connection with the fingers, a controlling-switch in the line-wire, and an auxiliary switch in said wire for cutting one or more of the fingers out of the system.

4. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a valve-operating motor, a normally open motor-circuit including the motor, a normally open signal-circuit including a signal, and a normally open controlling-circuit including the following elements—a relay controlling the motor and signal circuits and having one side grounded, a contact-shoe in electrical connection with the opposite side of the relay, a line-wire having a series of contact-fingers arranged to be successively engaged by the shoe as the vehicle advances, and a controlling-switch in the line-wire.

5. In a system of the character described, the combination with a vehicle equipped with air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit including an interrupter operated by the motor to open said circuit, a signal-circuit including a signal, a controlling-circuit including a relay common to both the motor and signal circuits, and means for locking the armature of the relay to maintain the motor and signal circuits closed after the controlling-circuit is opened.

6. In a system of the character described, the combination with a vehicle equipped with air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit including an interrupter operated by the motor, a signal-circuit including a signal, a controlling-circuit including the following elements—a relay controlling both the motor and signal circuits and having one side grounded, a contact-shoe movable with the vehicle and in electrical connection with the other side of the relay, a line-wire having a series of contact-fingers arranged to be engaged by the contact-shoe as the vehicle advances, and a controlling-switch in the line-wire, and means for locking the armature of the relay to maintain the motor and signal circuits closed after the controlling-circuit is opened, the interrupter in the motor-circuit serving to stop the motor when the valve is opened, and the locking device of the relay-armature serving to maintain the signal-circuit closed to compel the continuance of the signal until the attention of the engineer or other trainman is attracted and the lock released.

7. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor including an oscillatory solenoid, gearing connected to the valve and operatively related to the solenoid to be advanced step by step, a motor-circuit including the solenoid, and means carried in part by the vehicle and in part independently thereof for effecting the closing of the motor-circuit to start the motor.

8. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor including an oscillatory solenoid provided with pawls, a ratchet-wheel arranged to be engaged by the pawls for step-by-step advance as the solenoid is oscillated, gearing between the ratchet-wheel and the emergency-valve, a motor-circuit including the solenoid, and controlling means for said circuit carried in part by the vehicle.

9. In a system of the character described, the combination with an air-brake apparatus including an emergency-valve, of a motor including a disk operatively connected to the valve and provided with an insulating-block, a contact-spring disposed to normally engage the disk and to be engaged by the insulating-block to break the electrical connection when the valve is opened, an oscillatory solenoid, a vibrator operated thereby and having one of its elements in electrical connection with the disk and the other in connection with the solenoid, a ratchet-wheel geared to the disk to operate the same, pawls carried by the solenoid to engage the ratchet-wheel, a motor-circuit including the contact-spring and the solenoid, and means carried in part by the vehicle for closing the motor-circuit.

10. In a system of the character described, the combination with a controlling-circuit including a relay and a contact-arm extending from the armature thereof, of a contact-plate arranged to be engaged by the arm when the armature is attracted, a motor-circuit including a motor and having its terminals connected to the armature and frame, respec-

tively, of the relay, a signal-circuit including a signal and having its terminals connected to the contact-plate and to the relay-armature, respectively, and an air-brake apparatus including an emergency-valve operatively connected to the motor, whereby the motor and signal circuits are simultaneously closed when the armature is attracted.

11. In a system of the character described, the combination with a controlling-circuit including a relay and a contact-arm extending from the armature thereof, of a contact-plate arranged to be engaged by the arm when the armature is attracted, a motor-circuit including a motor and having its terminals connected to the armature and frame, respectively, of the relay, a signal-circuit including a signal and having its terminals connected to the contact-plate and to the relay-armature, respectively, an air-brake apparatus including an emergency-valve operatively connected to the motor, means for closing the controlling-circuit, and a locking device designed to lock the armature of the relay against retraction to maintain the motor and signal circuits closed after the controlling-circuit is opened.

12. In a system of the character described, the combination with a line-wire, and a series of yielding contact-fingers in electrical connection therewith, of a shoe carried by a vehicle to contact with the yielding fingers, a relay having one side connected to the shoe and its other side grounded, and a signal-circuit also carried by the vehicle and controlled by the relay, and a signal device located in the signal-circuit.

13. In a system of the character described, the combination with a line-wire, of a series of yielding contact-fingers adapted to be arranged at one side of the track, and each having an exposed contact-plug, and a branch wire connecting said plug with the line-wire, a shoe designed to be carried by a vehicle to engage the contact-plugs of the fingers, a signal designed to be also carried by the vehicle, and suitable electrical connections between the signal and shoe.

14. In a system of the character described, the combination with a line-wire, of a series of yielding contact-fingers each having a flexible spiral body portion and an exposed contact-plug, a branch wire connecting the line-wire with the contact-plug and inclosed by the body portion of the finger, and electrically-controlled signal mechanism having a contact-shoe arranged to be moved into contact with the plugs of the fingers.

15. In a system of the character described, the combination with a line-wire, of a series of yielding contact-fingers each comprising a base, a coiled-wire body upstanding therefrom, an insulating-cap secured in the upper end of the body, a contact-plug fitted in the cap, and a branch-wire connection from the contact-plug to the line-wire.

16. In a system of the character described, the combination with a line-wire, of a series of yielding contact-fingers each including a casing provided with a nipple, a coupling secured upon the nipple, a coiled-wire body rising from the coupling, an insulating-cap secured at the upper end of said body, a contact-plug located in the cap, a wire inclosed within the finger and extending from the contact-plug to the interior of the casing, packing located in the nipple of the casing and surrounding the wire, a gland located within the coupling to compress said packing, and a branch wire extending from the line-wire and having connection within the casing with the wire leading from the contact-plug.

17. In a system of the character described, the combination with a line-wire; of a series of contact devices, each comprising a laterally-yielding body portion having an insulating-cap and a contact-plug at its upper end.

18. In a system of the character described, the combination with a line-wire; of a series of contact devices each comprising a base, a superposed laterally-yielding hollow body portion having the form of a closely-wound spiral, and a contact-plug located at the upper end of the body portion but insulated therefrom.

19. In a system of the character described, the combination with a line-wire; of a series of contact devices each comprising a base, a wire spiral constituting a hollow body portion, a coupling connecting said body portion with the base, an insulating-cap seated in the upper end of the spiral, and a contact-plug in said cap.

20. In a system of the character described, the combination with a line-wire; of a series of contact-fingers each including a casing provided with a nipple, a coupling secured upon the nipple, a coiled-wire body rising from the coupling, an insulating-cap secured at the upper end of said body, a contact-plug located in the cap, a wire inclosed within the finger and extending from the contact-plug to the interior of the casing, packing located in the nipple of the casing and surrounding the wire, and a gland located within the coupling to compress said packing.

21. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit including the motor, and a normally open controlling-circuit including the following elements; a line-wire having a series of contact-fingers, a controlling-switch therefor, auxiliary switches in said wire for cutting one or more fingers out of the system, a relay carried by the vehicle and controlling the motor-circuit, one side of the relay being grounded, and a contact-shoe electrically connected with the other side of the relay and carried by the vehicle, for presentation to the contact-fingers to close the controlling-circuit.

22. In a system of the character described,

the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit including an interrupter operated by the motor to open said circuit, a signal-circuit including a signal, and a controlling-circuit including a relay common to both the motor and signal circuits.

23. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit, means for closing the motor-circuit to start the motor, and means for automatically opening the motor-circuit after the valve is opened.

24. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor for operating the valve, a motor-circuit, means for closing the motor-circuit to start the motor, and means operated by the motor for opening the motor-circuit after the valve is opened.

25. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor including an oscillatory solenoid and cheek-pieces, and gearing connecting the solenoid to the valve.

26. In a system of the character described, the combination with a vehicle equipped with an air-brake apparatus including an emergency-valve, of a motor including an oscillatory solenoid and cheek-pieces, gearing connecting the solenoid to the valve, a motor-circuit including the solenoid, and means for closing said circuit.

27. In a system of the character described, the combination with a normally open controlling-circuit including a relay, of a contact-arm extending from the relay-armature, a contact-plate arranged to be engaged by the arm when the armature is attracted, a normally open circuit including a motor and having its terminals connected to the armature and frame respectively, of the relay, a signal-circuit including a signal and having its terminals connected to the contact-plate and to the relay-armature respectively, an air-brake apparatus including an emergency-valve operatively connected to the motor, and means for closing the controlling-circuit.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FRED PRATT GREEN.

Witnesses:

SHELLEY S. ALDRICH,

DAVID UNDERHILL, Jr.