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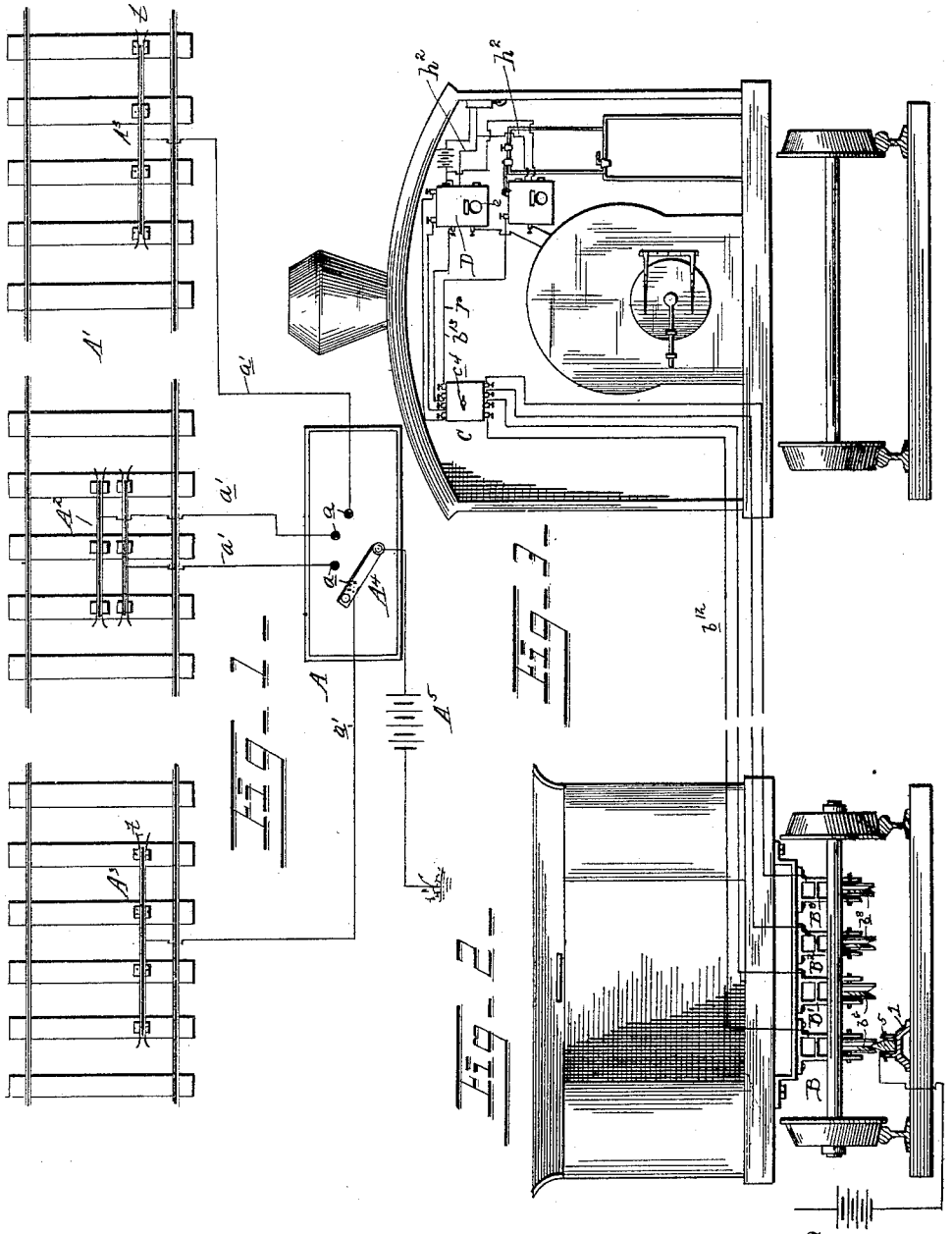
C. A. & J. F. COX.

ELECTRICAL SIGNAL OPERATING DEVICE.

No. 418,910. Patented Jan. 7, 1890.



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(No Model.) 6 Sheets—Sheet 2.

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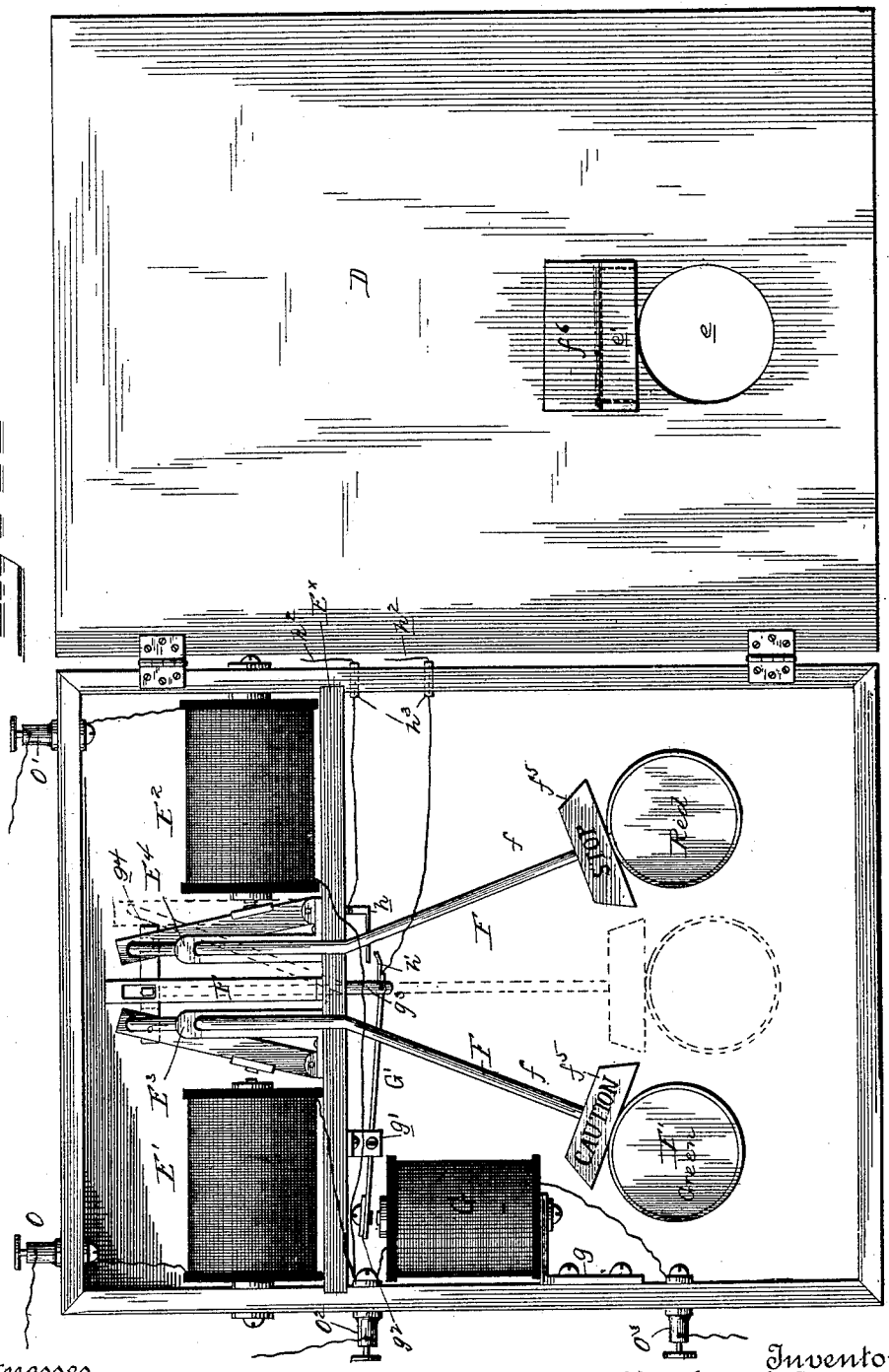
Fig. 4.



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(No Model.) 6 Sheets—Sheet 3.

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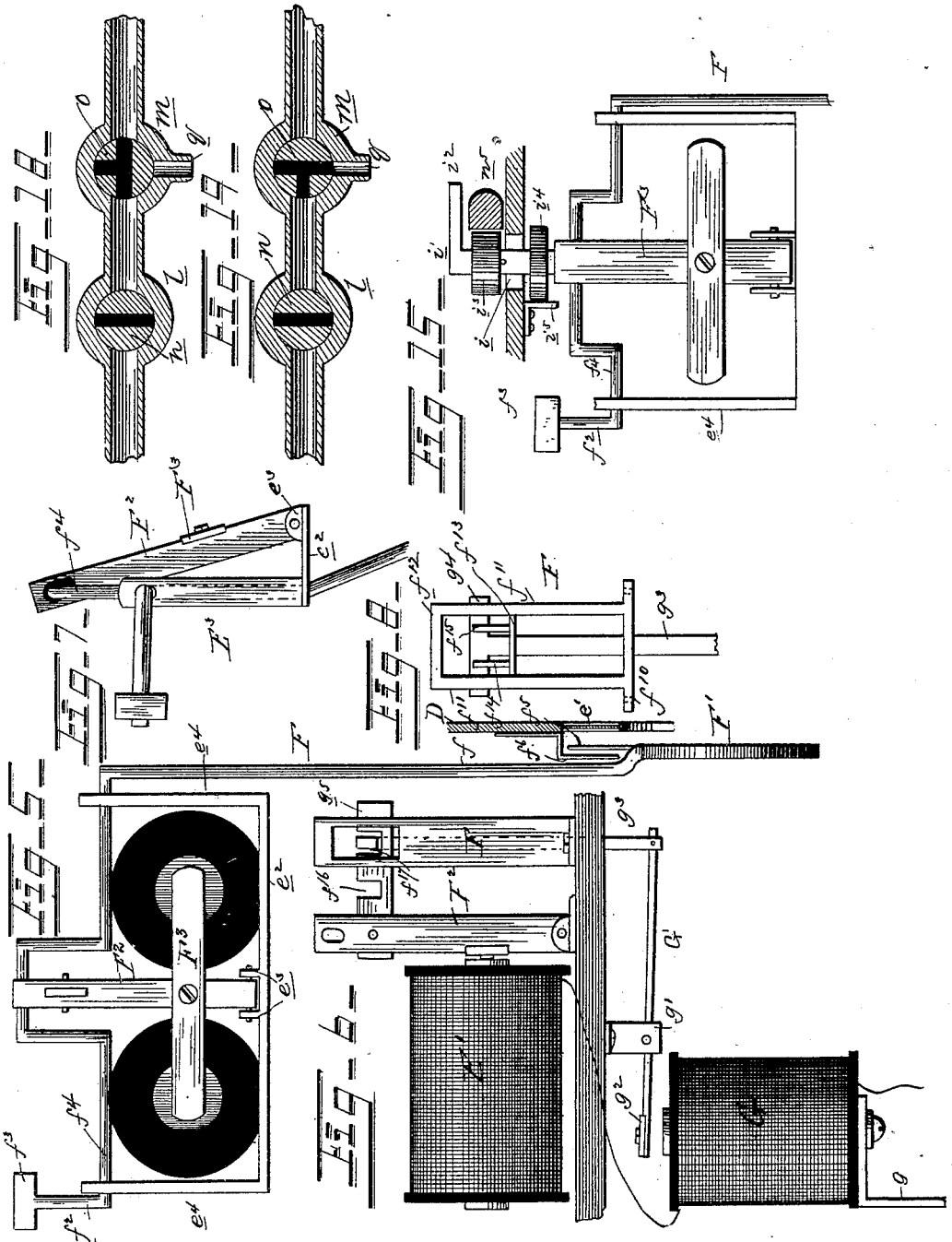

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(No Model.) 6 Sheets—Sheet 4.

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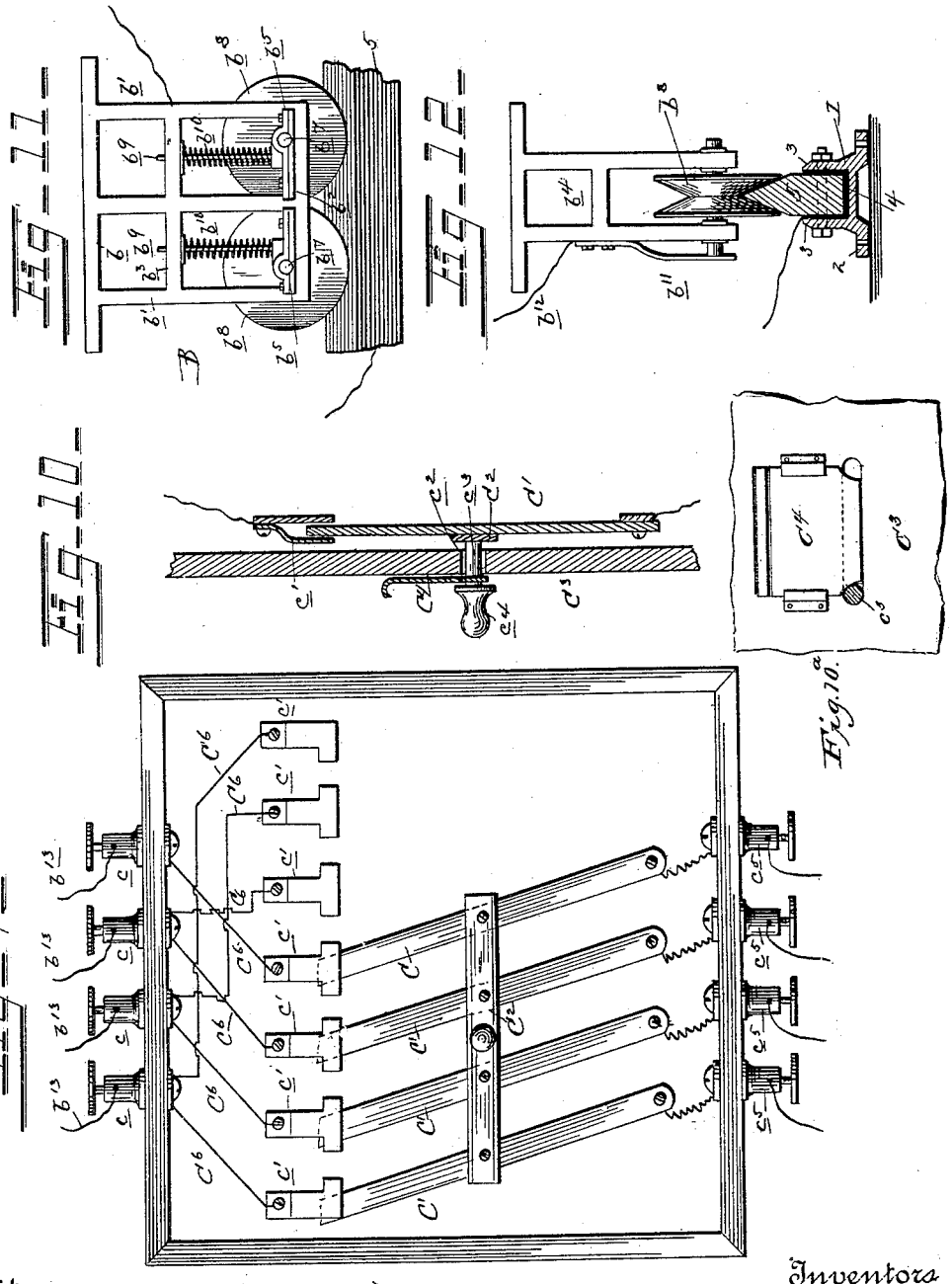

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ELECTRICAL SIGNAL OPERATING DEVICE.

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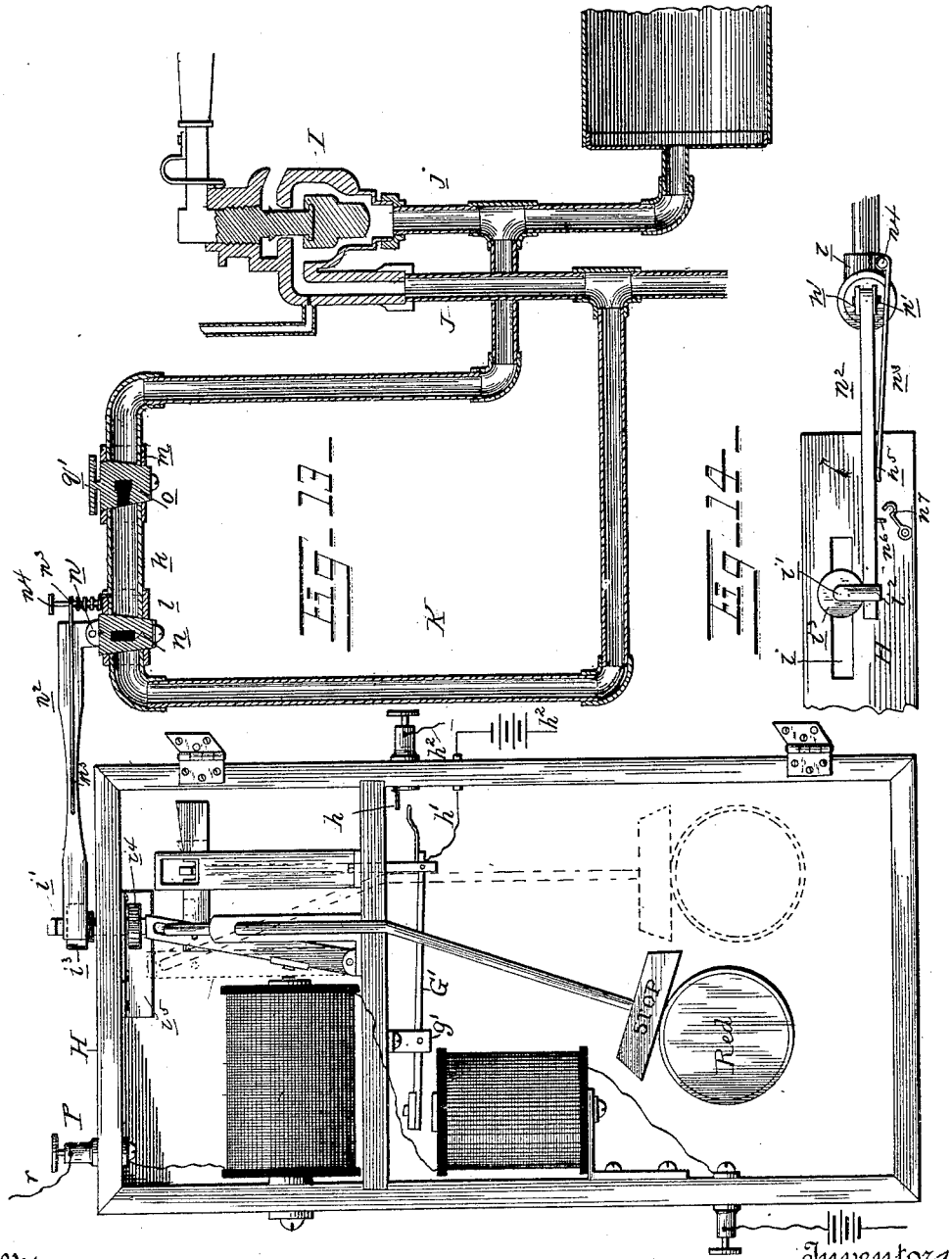

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(No Model.) 6 Sheets—Sheet 6.

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ELECTRICAL SIGNAL OPERATING DEVICE.

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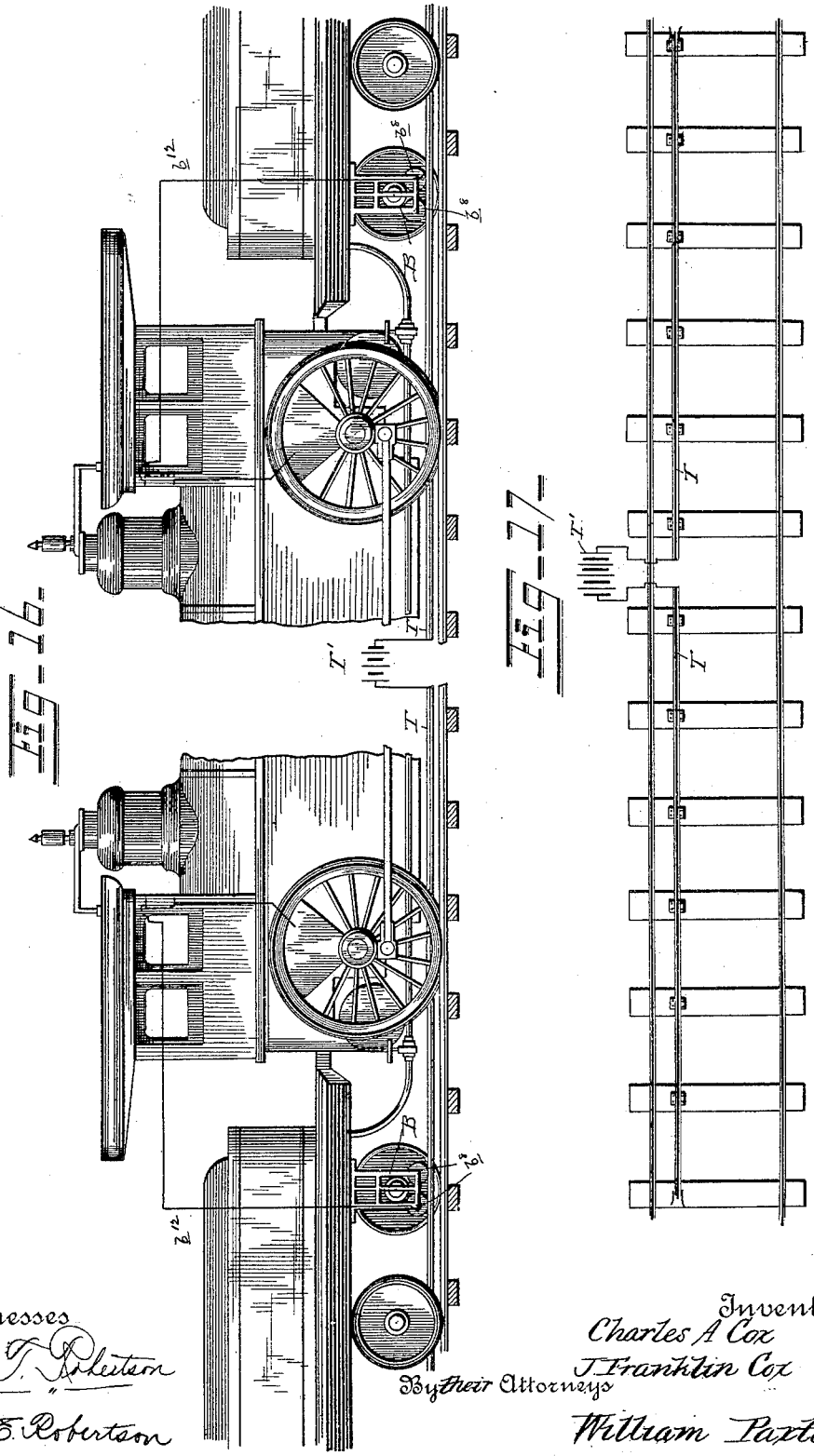

Fig. 16.

Fig. 17.

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UNITED STATES PATENT OFFICE.

CHARLES A. COX AND JOSEPH FRANKLIN COX, OF LOUISVILLE, KENTUCKY.

ELECTRICAL SIGNAL-OPERATING DEVICE.

SPECIFICATION forming part of Letters Patent No. 418,910, dated January 7, 1890.

Application filed May 11, 1889. Serial No. 310,405. (No model.)

To all whom it may concern:

Be it known that we, CHARLES A. COX and JOSEPH FRANKLIN COX, citizens of the United States, residing in Louisville, Jefferson county, State of Kentucky, have invented certain new and useful Improvements in Electrical Signal-Operating Devices, of which the following is a full, clear, and exact specification.

Our invention has reference to railroad-signals; and it consists in the improved constructions and arrangements of parts hereinafter described and set forth.

In the accompanying drawings, forming part of this specification, Figure 1 is a plan view of a section of the track, showing in diagram the position of the signal-operator's connections and the relative arrangement of circuit connections and contacts. Fig. 2 is an end elevation of a coal-tender, showing the contacts and circuit-wires leading therefrom. Fig. 3 is a like view of the locomotive-cab, disclosing the signal device located therein and the circuit-wires connected therewith. Fig. 4 is a front elevation of the signal device, its hinged front being shown as swung open to disclose the interior. Figs. 5, 6, 7, and 8 are detail views of the latch mechanism of the device and parts adjacent thereto. Figs. 9 and 10 are detail views of other parts of the signal device, showing the means employed for reversing the circuit-connections when the position of the locomotive and tender is changed on the track. Fig. 10^a is a detail front view of parts shown in Fig. 10. Figs. 11 and 12 are respectively side and end views of one of the rolling contacts carried by the tender or locomotive. Fig. 13 is a front elevation showing an enlarged view of the auxiliary device illustrated in Fig. 3. Figs. 14 and 15 are respectively plan and end sectional details of the signaling devices with the air-brake appliances. Figs. 16 and 17 are respectively a plan and side view illustrating the application of our improvements to a curve. Figs. 18 and 19 are detail sectional views of the valve portions of the air-brake connections.

Some of the disadvantages connected with signals arranged along the way are well known, and consist, principally, in the inability of the engineer to always determine and remember the character or purpose of the signal. By our improvements we remedy these defects and reduce liability of carelessness or inefficiency on the part of the engineer.

By reference to Fig. 1 it will be seen that the house or station A, in which the signal-operator is located, is positioned at any suitable point with reference to the track or way A′. At the station A are arranged a series of contacts a, four being shown, which form the terminals of a series of wires a'. Between the track-rails and at a point about opposite to the station A are located two contact-rails A^2, which extend parallel with the main track-rails and with each other, and at some distance out on the track in both directions is also located a contact-rail A^3. As will be seen, the wires a' lead, respectively, to the rails A^2 A^3, as shown, and within the station A is a pivoted switch-lever A^4, adapted to complete the connection from any of the contact-rails to a main battery A^5, and from the latter the connection is grounded.

Each of the contacts A^2 A^3 consists of a base or chair 1, having the lateral portions 2 perforated vertically for the passage of the securing-spikes to hold said chair in position upon the ties. Upon its upper side said chair is provided with two vertical parallel extending ribs 3, which form between them a longitudinal space, in which is arranged an insulating substance 4 of any suitable character, and serving to electrically insulate the central contact-rail 5, seated and bolted in said chair. The upper or working face of the rail 5 is made taper in cross-section, for a purpose to be fully explained hereinafter. Each of the contact-rails A^2 A^3 occupies a different longitudinal position in the way from that occupied by the others.

From the under side of the tender depends a series of metallic hangers B B′ B^2 B^3, each consisting of a metallic frame having the top plate b, by which it is bolted to the tender, and the vertical parallel side sections b' b', each terminating at its lower portion in the horizontal side bar b^2. An intermediate horizontal bar serves to brace each frame and perform other functions. Transversely the frames are connected together by a cross-bar

b^4. (See Figs. 2, 11, and 12.) On the upper side of each bar b^2 rest bearing-boxes b^5, each receiving one of the ends of a small shaft b^7, spanning the hanger and carrying between the frames b' b' a wheel b^8, grooved to conform to the shape of the upper part of the contact 5. As above stated, each bearing-box b^5 merely rests upon the bar b^2 below; hence it is adapted to move vertically, and to provide for such movement each box has connected therewith the lower end of a vertical rod b^9, the upper part of which plays through an opening therefor in the bar b^3. A coiled spring b^{10} embraces said rod and has one end bearing against the bar b^3, while the other exerts a downward pressure upon the box b^5 below. In order to guide each box in any vertical movement, its ends are recessed to receive the adjacent portions of the vertical end parts of the sections b', so that it is not only guided, but it is prevented from becoming laterally displaced.

There are two shafts b^7 in each hanger, and hence two wheels b^8. On one side each hanger carries two leaf-springs b^{11}, each secured at its upper end, the lower portion being bent outward, so that its free extremity bears with a yielding contact upon the projecting end of the adjacent shaft. The secured portion of each spring b^{11} is provided with a binding-post or other medium by which a wire b^{11*} can be connected thereto.

It will be sufficient for a proper comprehension of the invention to trace out the circuit and connection of one hanger B with relation to the other devices and parts to be described hereinafter. The said wire b^{12}, having suitable provision for insulation, is led to the cab of the locomotive, within which it first connects with the current-switch device C. This latter is most clearly shown in Figs. 9 and 10, to which reference may be had at this point. A rectangular case has a series of binding-posts c located on its top, each of which posts is electrically connected with one of a number of contacts c', located on the inner side of the back, and each in the form of a metallic bracket secured at its top and having its depending portion bent outward. The number of contacts c' is greater by three than that of the binding-posts c. Four metallic arms C′ are each pivoted at their lower ends, near the bottom of the case, and are centrally connected by a transverse bar C^2, of suitable insulating material. The front C^3 of the case is provided with a curved slot c^2, through which extends a stud c^3, connected centrally to the bar C^2 and carrying on its outer projecting end an operating-knob c^4. A metal plate C^4 is mounted upon the front C^3 to slide vertically thereon and is suitably guided, so that as the pin c^3 is moved to the limit of the slot in either direction the plate can be dropped so as to retain said pin thereat. The upper portion of the plate is bent outwardly to facilitate its manipulation. Four binding-posts c^5 depend from the bottom of the case C and are in electrical connection with the bars C′. It will be noticed that the intermediate wires c^6, connecting with the posts c and hangers c', are peculiarly disposed. For instance, the post to the extreme left connects directly with the contact c' to the extreme left, but also to the contact c' to the extreme right. The next post connects with the two contacts next adjacent to those mentioned, the next post to the two contacts at either side of the central one, while the post to the extreme right is connected by a single wire to the central contact.

The bars C′, as shown, provide for connections as follows: from the first post above to the corresponding one below, and so on. Now, however, should the arms be moved upon their pivots so that the arm to the extreme right is thrown against the contact to the extreme right, then the circuit will be established from the upper binding-post to the extreme left through the arm and lower binding-post to the extreme right. Thus it will be seen that any circuits established through the several parts are reversed with reference to the binding-posts. The wires b^{12} connect with the lower binding-posts, and the circuit is continued from the upper posts c by wires b^{13} and r, which connect with the signal device and brake-controlling mechanism, which are relatively arranged as shown in Fig. 3. The object in reversing the connections through the medium of said switch is that the electro-magnets operating the signal disks and arms (described hereinafter) may always take the current from their corresponding contact-rails located in the track or way, notwithstanding the fact that the position of the locomotive may be changed relative to the track when it reaches the terminal point of its travel, and thus changing the position of the rolling contacts in respect to their former position on the track.

The signal device is best shown in Figs. 4 to 8. It is likewise contained in a case, the front of which is constituted by a door D, hinged and provided with a circular opening e, with or without a glass panel and a horizontal slot e' above and near said opening. A horizontal plate $E^\times$ extends across the upper portion of said case, and upon said plate are secured two pairs of horizontal magnets E′ E^2, each with its outer end bearing against the side of the case, to which it is suitably secured. Upon the plate $E^\times$, and between the magnets E′ E^2, are two brackets E^3 E^4, each consisting of a transverse base portion e^2, having centrally the short vertical ears e^3 and vertical side standards e^4. The latter are perforated to form bearings for a rod F, the front depending portion f of which is extended and carries at its lower end the signal-disk F′. The rear portion, beyond the other standard e^4, is bent to form a short inclined arm f^2, which carries a small counter-weight f^3, as shown.

By reference to Fig. 7 it will be seen that

the base e^2 of each bracket is of such size that the ears e^3 and standards E^3 E^4 are respectively located on different sides of said base, and in the ears e^3 is pivotally seated the lower end of a vertically-inclined bar F^2, the upper portion of which is pierced for the passage of the crank f^4, formed in the rod F. The position of each bar F^2 is such that it is centrally between the magnets of each pair, and upon the bar F^2 is secured a transverse horizontal armature F^3, the extremities of which set opposite the poles of the magnets. The depending portion of the signal-rod F is bent in the form of an obtuse angle, the lower member of the angle being of greater length than the upper. Normally the rod occupies the position shown in Fig. 4. A small horizontal plate f^5 is connected to each rod F immediately above the signal-disk, and each of the said plates carries a word or legend indicative of the character of the signal-disk below. Thus the plate of the disk located to the left of the opening e, and which is intended to refer to the cautionary signal, will contain the word "Caution," while the disk to the right of the said opening, designed to act as the danger-signal, will be accompanied by a plate containing the word "Stop." Each disk sets in a vertical plane slightly in advance of the rod carrying it, so that there is a small space between the rod and the plate carried on the upper side of the disk. An angular plate F^6 extends rearwardly from the upper edge of the opening e', and its vertical portion carries on its front face some word indicative of the way or track being clear and corresponding with the white signal in existing systems. The relative position of the parts is such that when one of the rods is swung to display its signal its plate will pass to a position in front of the vertical part of the plate F^6, and not only mask the word thereon, but exhibit its word in lieu thereof.

On one side of the case is secured a bracket g, upon which is mounted a pair of vertical electro-magnets G, each having its pole upon the upper side. A bracket g' depends from the under side of the plate $E^\times$, and in this bracket is pivotally mounted a horizontal lever G', the free end of which carries an armature g^2 immediately over the pole-piece of each magnet G. The inner end of this lever has connected thereto the lower end of a vertical bar g^3, which plays through an opening therefor in the plate $E^\times$.

Upon the plate $E^\times$ and upon the brackets E^3 E^4 is secured a vertical frame F, Fig. 8, which comprises a base f^{10}, perforated at each side to enable the frame to be secured in position, two vertical side bars f^{11}, connected together at their top and centers by cross-bars f^{12} f^{13}. As will be seen in Figs. 4, 6, and 8, the bar g^3 plays through an opening in the base f^{10} and cross-bar f^{13}, above which said bar g^3 carries a cross-head g^4, the extended ends of which pass through vertical slots g^5 in the side bars f^{11}. Upon the cross-bar f^{13} rest two horizontal bars f^{14} f^{15}, which are arranged with their broad sides parallel and vertical, and each bar f^{14} f^{15} carries in its upper edge two notches f^{16} f^{17}. Each bar f^{14} f^{15} has one of its ends connected to the upper part of one of the bars F^2, the connection being an alternate one, so that the movement of one of the bars F^2 only actuates one of the bars f^{14} f^{15}.

A small metal bracket h is secured on the under side of the plate $E^\times$, and is so positioned that a spring-extension h' on the end of the lever G' is adapted to contact therewith whenever the armature end of said lever is depressed. An alarm-bell circuit has its respective wires h^2 h^2 led through suitable insulated bearings h^3 in the side of the case and connected to the bracket h and extension h'.

The main portion of the brake-controlling mechanism is a case containing parts in most particulars like those in the signal-case. The differences consist, principally, in the fact that in the case of the brake mechanism but one pair of magnets is provided above the dividing-plate and other features are reduced to a basis only required to operate a single signal-rod and its disk. Of course this admits of the case being of reduced width, resulting in the inspection-opening in the front being located at one side. The top H of the case is provided with an extended slot i, (see Figs. 14 and 15,) through which extends a stem i', carried integrally by the armature-carrying bar below, and the upper end portion of this stem i' is bent to form an engaging-ear i^2. An anti-friction roller i^3 is supported in position by a shoulder formed on the stem. As is generally well known, and particularly to those acquainted with the construction and operation of the "Westinghouse air-brake system," the brakes are automatically applied by exhausting air from the main brake-pipe, either from a valve located in the engine-cab or from what is known as a "conductor's valve." The brakes are operated non-automatically only when the air from the main reservoir is liberated directly through the main brake-pipe and operates directly upon the pistons in the brake-cylinders. This being understood, it will only be necessary to specify those parts more immediately located and operated with the brake-controlling mechanism in conjunction with the signal device in order to secure a proper understanding of the relative importance of the construction.

I refers to the engineer's valve, connected by pipe j to the main reservoir. As usual, the main brake-pipe J leads from the valve I, and the latter, as will be remembered, is so arranged that it can be operated to admit air direct to the pipe J from the main reservoir or cut off the supply from said reservoir and then exhaust the air in the pipe J by discharging it to the atmosphere.

In order to adapt our improvements to ex-

isting requirements, we provide what may be termed a "loop branch pipe" K, one end of which taps the pipe j, while the other end connects with the main brake-pipe. The upper horizontal portion k of the loop contains two bosses l m, designed to contain plug-valves n o. The arrangement of ports on said valves is best shown in the detail sectional plan views, Figs. 13 and 19, wherein it will be seen that the valve n has simply a transverse port, while the valve o has a T-shaped or three-way port. The boss m is provided with a discharge-opening q at one side. The valve o is simply provided with a thumb-nut or head q' to enable it to be turned. The valve n has on its upper side two ears n', in which is pivoted an angular handle n^2, the extended portion of which is intended to extend beneath the ear i^2 and in contact with the anti-friction roller i^3. The side of the handle n^2 is plane-faced in order that it may have a proper bearing against the roller. A torsion-spring n^3 embraces and is secured to a short standard n^4, mounted on the boss l, and the free end n^5 of said spring is extended horizontally to bear against the handle n^2, and tends to throw said handle in the direction indicated by the arrow, Fig. 14. An eye n^6 on the side of the handle enables a hook n^7 on the top of the case to engage the handle and retain it in the position in which it is represented in the several figures when the automatic action of the valve n is not desired.

The several circuits for actuating the signal device and brake-operating mechanism may be traced as follows: Two binding-posts O O′ on the top of the case and a post O^2 on the side thereof have each connected thereto one of the signal-wires. Take, for instance, the circuit controlling the cautionary-signal disk. The wire passes from the binding-post O to the coils of the magnets E′ of that signal, and from the latter through the coils of the latch-operating magnets G, through the post O^3, also on the side of the case, then through the metal of the engine and track-rails, and from the latter to a suitable grounding-wire. The circuit for the other pair of magnets E^2 is similarly formed, the latch-operating magnets being also included therein. The circuit that is led from the post O^2 only passes through the coils of the magnets G and to ground through post O^3, so that it only operates the latch to liberate the signal previously exposed, allowing it to return to a normal position and enable the unobstructed opening and the indicator back of the same to serve as the white or "clear" signal. Of course but a single circuit is required to operate the brake-operating mechanism, and this is secured by wire passing to post p, from this through coils of signal and latch magnets, and grounded from the latter, as in the previous case.

From the detailed description furnished up to this point it will not be difficult to understand the method of operation. The signal-operator, desiring to give a passing train the red or "stop" signal, moves the switch-lever A^4, so as to complete the circuit at this point. As soon as the contact in circuit with the red signal passes over the rail A^3 the circuit is instantly completed, the magnets E^2 and G energized, the inner end of the lever G′ elevated to lift the cross-head g^4 out of the notches of the bars f^{14} f^{15}, and the notched bar connected to the armature-bar adjacent to the poles of the magnets E^2 will be drawn with said armature-bar in the direction of the pole of the magnet until the second notch arrives at the point lately occupied by the first one, and yet registering with the first notch of the undisturbed bar of the other pair of magnets. The rapid movement of the locomotive and its tender results in but a momentary completion of the circuit, and hence it is that the instant the second notch has come into position the magnets E^2 and G have lost their energy, and the cross-bar g^4 of the latch, through its intermediate connections, is permitted to drop transversely into the notches and thus lock the red signal devices in an exposed position. As soon thereafter as the latch is raised for the purpose of operating the cautionary or the "clear" signal the counter-weight f^3 carries the red-signal rod and its disk to their first position. The crank and inclined portions of each signal-rod are what secures the necessary positions of the signal-disk under the power exerted by the movement of each bar F^2. The elevation of the inner end of the lever G′ causes the extension thereon to contact with the bracket, and thus close the circuit through the local battery and bell, and providing an audible signal to attract the attention of the engineer to the signal given. The wire r, connecting with the post p of the brake-operating mechanism, is led from the track-contact, arranged independent of the engineer's control. When the brake system is to operate automatically, the valve-plugs are in the position shown in Fig. 19. The moment the latch and signal of the brake-operating devices are operated within the case the stem, with its anti-friction roller, is thrown to the position represented by dotted lines, Fig. 13, clearing its contact with the handle n^2, and enabling the spring to throw the latter so as to shift the port of the valve n in line with the pipe, thus allowing the air from the main brake-pipe to be discharged out of the opening q in the side of the boss. When operating upon the non-automatic principle, the valve o will be turned, as shown in Fig. 18, so that its port will afford a direct passage through the pipe, the opening q being closed, and the stem will be thrown as before to turn the handle and its valve n and open a direct passage to the brake-pipe for the admission of air from the main reservoir. It will thus be seen that the operation of the valve n is automatic whether the brakes are to be actu-

ated on the automatic or non-automatic principle. The hinge feature of the handle enables it to be disengaged at any time from the stem.

The completion of the circuit through the signal and brake operating device, as before stated, is so brief that the counter-weight of each signal-rod tends to effect the recession of the bar F^2 and latch-bar f^{14} and f^{15} simultaneous with the descent of the cross-head of the latch. Unless some special provision were made there would be a liability at times of the cross-head not dropping squarely into the notch below, but of catching on the sides thereof. This, we have found, can be avoided by making the movement of the bar f^{14} f^{15} toward its magnet such that it carries its notch slightly beyond the point beneath the cross-head, or by making the notch a little larger than the said cross-head. This arrangement insures that the slight receding movement undergone by the bar f^{14} f^{15} before the cross-head has reached it in its descent will be sufficient to secure the perfect action of the cross-head in dropping into the notch. In Fig. 13, where the latch-retaining bar has only one notch, the cross-head would be liable to bind upon the upper face of the notch-bar were it not for the fact that the said upper face is inclined toward the notch, and thus assists in guiding the cross-head back into the notch.

In Figs. 16 and 17 we have represented our improvements in connection with a railroad-curve. In such case a contact-rail T is located in the way at each end of the curve, and these said rails are connected with a local battery T′, located adjacent to the track and suitably protected from the weather, &c. Now, as soon as a locomotive passes onto the contact-rail at each end of the curve a circuit is completed through the rails T and battery T′, locomotives, and one of the track-rails, and the brake-operating mechanism in both locomotives simultaneously operated, and the two locomotives brought to a full stop before they will have reached a point in the curve where a collision would have been imminent.

It will be noticed that the two contact-rails T are so extended that the engineer of a locomotive will be assured a prolonged protection until the engine will have reached such a point in the curve that the balance can be passed over with safety.

By having the upper working-faces of the contact-rails tapering, as stated, and the grooves in the contact-wheels corresponding therewith, all accumulations of ice, snow, or dirt will be readily cut or crushed therefrom, so that a perfectly-operating circuit will always be assured. The presence of two contact-wheels in each hanger enables a contact at all times, for should some foreign substance lodge on the rail while the forward wheel was cutting and crushing it from the rail the succeeding wheel would still be in operative contact and be performing a circuit-maintaining function.

From the foregoing it will be apparent that by the improvements herein set forth a complete signaling system can be established and maintained on the most extensive lines of railroad, and that while the devices themselves are small and inexpensive they can be relied upon to operate effectively at all times and under all conditions. What is most important of all, the engineer can be signaled within his cab, so that the signal will be permanently before him.

We do not limit ourselves to the particular arrangement and construction of devices herein described, as it will be evident that numerous modifications and changes may be resorted to without departing from the spirit of our invention. The contact-rails may be located at any suitable point or points in the road or way. Referring again to Fig. 1, it will be seen that each contact-rail is provided at each end with a guard-flange, which insures the contact-wheel passing properly onto the tapering portion of the rail. The said flange or guard comprises two outwardly-diverging portions t t. To co-operate with these guards, we hang each contact-wheel so that it will have a limited lateral play, and thus be enabled to be properly adjusted with reference to the contact portion of the rail.

A second anti-friction roller i^4 is mounted on the stem l' below the slotted top of the case, and this said roller bears against a longitudinal plate i^5, secured on the inner face of the top of the case. This arrangement not only serves to brace the stem in its relative position in the slot, but also adds to the easy movement of the same.

We do not herein specifically claim the devices and appliances for controlling the brakes, nor the application thereof in automatically stopping locomotives, as the same forms the subject-matter of a separate application for Letters Patent filed May 18, 1889, Serial No. 311,214, granted November 5, 1889, No. 414,295.

We claim—

1. The combination, in a railroad signaling system, of a track or way, a locomotive or car moving thereon, a plurality of partial electric circuits having their terminals included in the track or way, a battery external to the locomotive or car, switch-connections for including said battery in any of said partial circuits, an electrically-operated device having a plurality of visual signals and independently-operated actuating means therefor, and lower contacts to complete the partial circuit through the signal-operating devices corresponding therewith, substantially as set forth.

2. The combination, in a railroad signaling system, of a track or way, a locomotive or car moving thereon, auxiliary contact-rails in the track or way and having tapering working-faces, a plurality of partial electric circuits

each having terminals connected with one of the contacts and including a battery external to the locomotive or car, an electrically-operated device on the locomotive or car containing a plurality of independently-operated signals, and contacts corresponding with each signal to close the circuit through its respective contact-rail, substantially as set forth.

3. The combination, in a railroad signaling system, of a track or way, a locomotive or car moving thereon, auxiliary contact-rails located in said track or way and each having a tapering working-face, a plurality of partial electric circuits, each having terminals connected with one of the contacts, and a battery therefor external to the car or locomotive, an electrically-operated device on the car or locomotive provided with a plurality of independently-actuated signals, and contacts corresponding with said signals, and each having successive rollers adapted to close the circuit through the particular contact-rail and signal, substantially as set forth.

4. The combination, in an electrically-operated railroad signal device, of an armature-bar carrying a notched plate, a vibrating signal-rod and its signal-disk operated by said armature-bar, an electro-magnet, and a latch for locking said notched plate at the limit of its movement in either direction, substantially as set forth.

5. The combination, in an electrically-operated signal device, of distinct signal rods and disks adapted to vibrate, as described, magnets and armature-bars for independently operating said rods, and independent notched plates connected to said armature-bars, and a latch common to the notched plates, substantially as set forth.

6. The combination, in an electric railroad-signal, of a case having an aperture for both signal-disk and indicator-plate, a signal-rod and a disk in a different vertical plane, and an angle-plate secured to the rear of the case-door and having its vertical indicator portion adapted to be masked by the indicator-plate when the signal-disk moves into position, substantially as set forth.

7. The combination, in an electric signaling device, of an electro-magnet, armature-bar, and disk-carrying rod, a frame F, having cross-bar f^{13}, a vertical latch-bar playing in said frame and having an engaging portion, and a notched bar connected to the armature-bar and supported upon the bar f^{13} beneath the engaging portion of the latch, substantially as set forth.

8. The combination, in an electrically-operated signaling device, of an armature-bar carrying a notched plate, a vibrating signal-rod, and its signal-disk operated by said armature-bar, an electro-magnet, and a latch for locking said armature-bar, as described, together with a contact portion for closing a local alarm-circuit upon the movement of the latch, substantially as set forth.

9. The combination, in an electrically-operated signaling device, of the independent magnets E′ E^2 and signal rods and disks operated thereby, notched bars, magnet G, in circuit with both magnets E′ E^2, latch operated thereby, and a distinct circuit through the magnet G only, substantially as set forth.

In testimony whereof we have signed our names in the presence of two witnesses.

CHARLES A. COX.
JOSEPH FRANKLIN COX.

Witnesses:
L. R. McCLEERY,
WILLIAM CAXTON.