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E. M. DE MONTE & C. JOST.

MEANS FOR PREVENTING RAILROAD COLLISIONS.

No. 505,669. Patented Sept. 26, 1893.

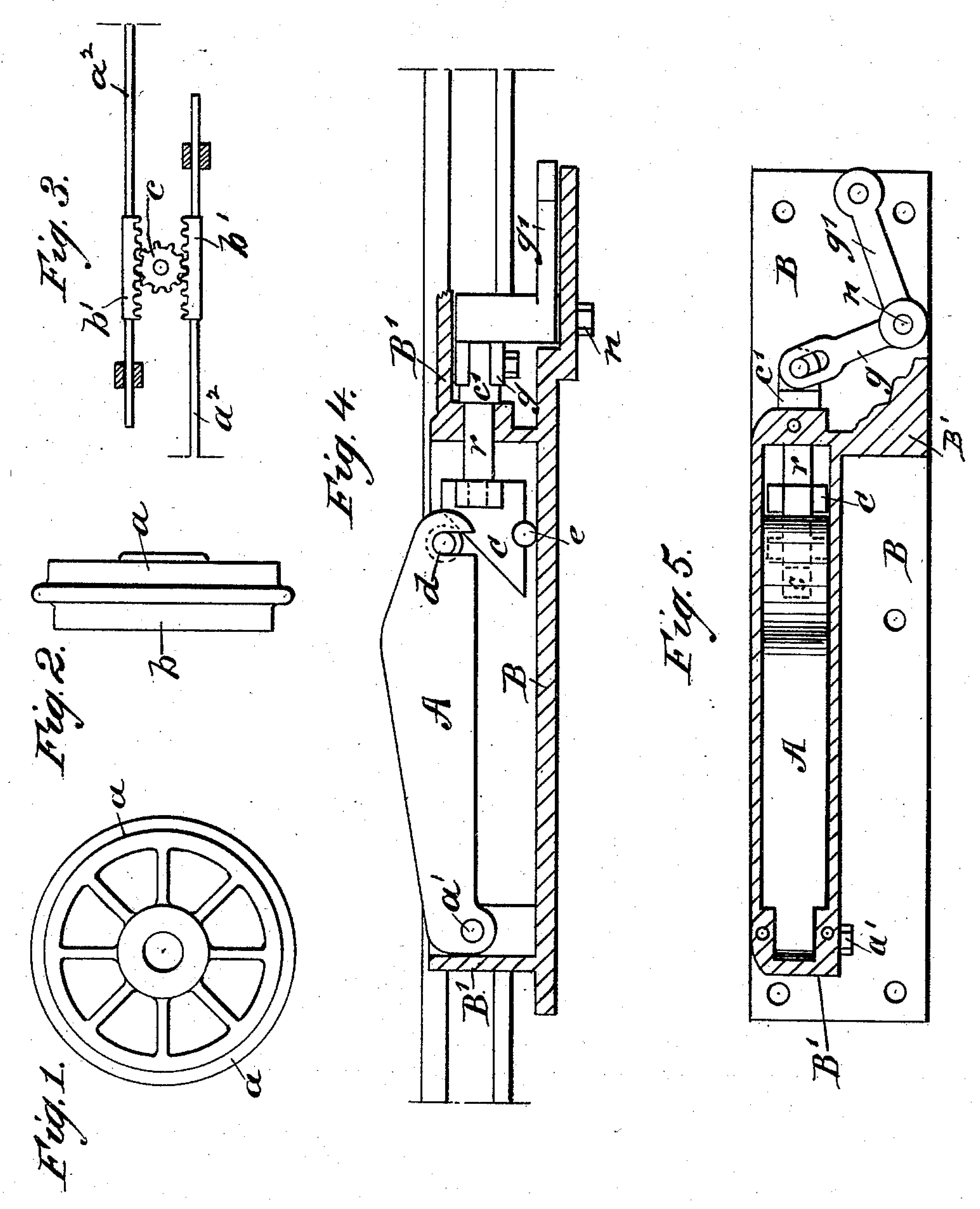

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Fig. 8.

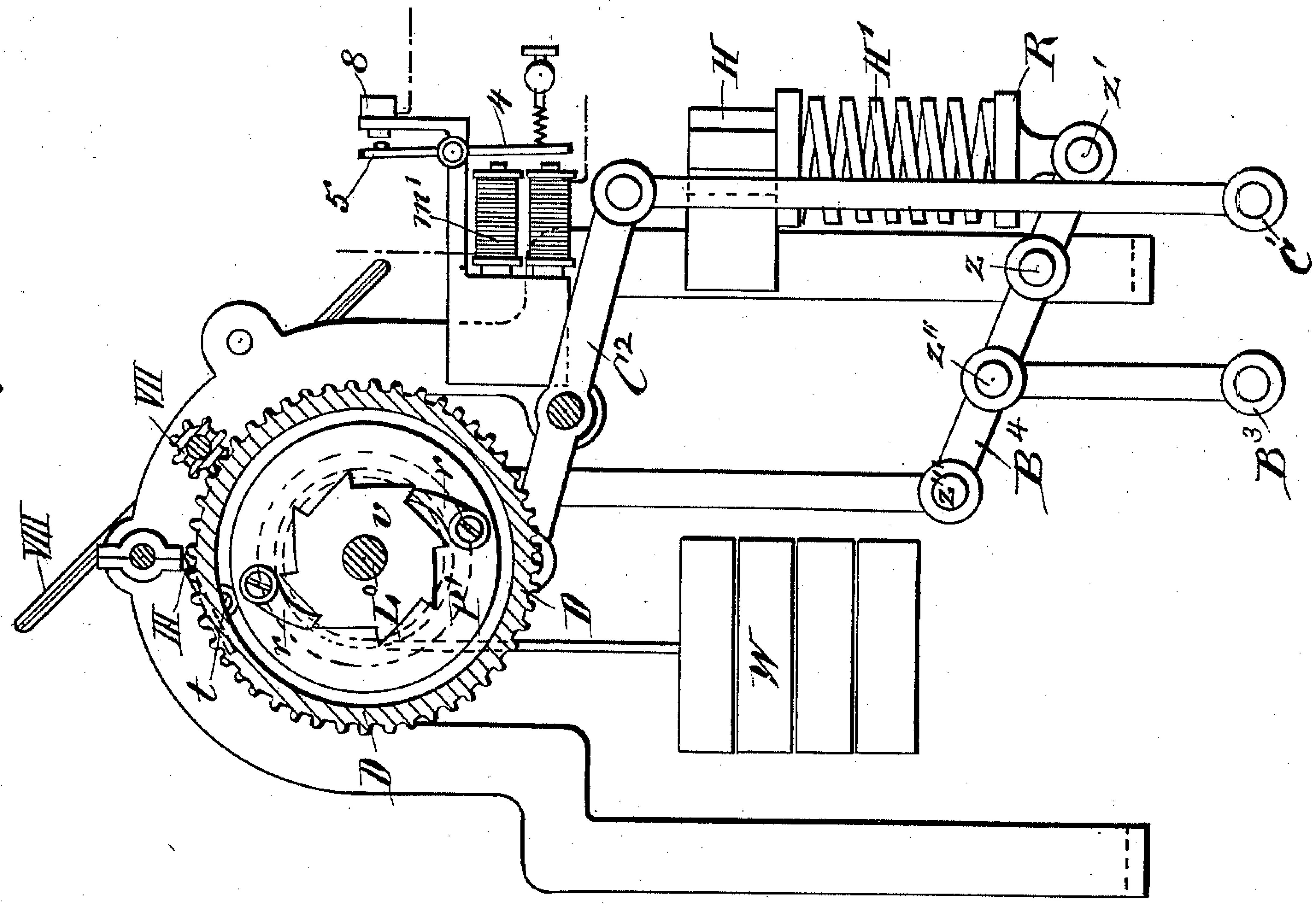
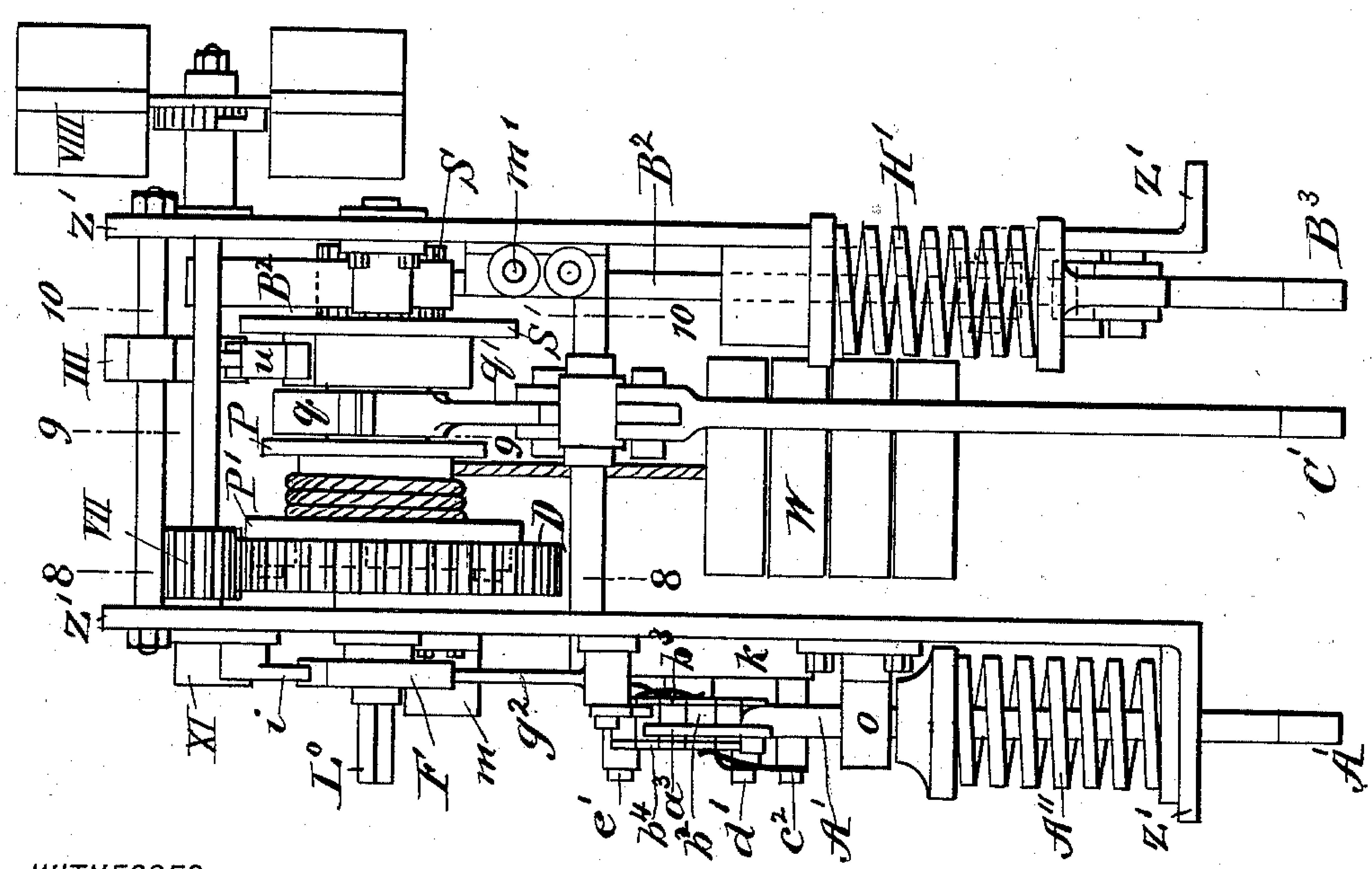


Fig. 6.



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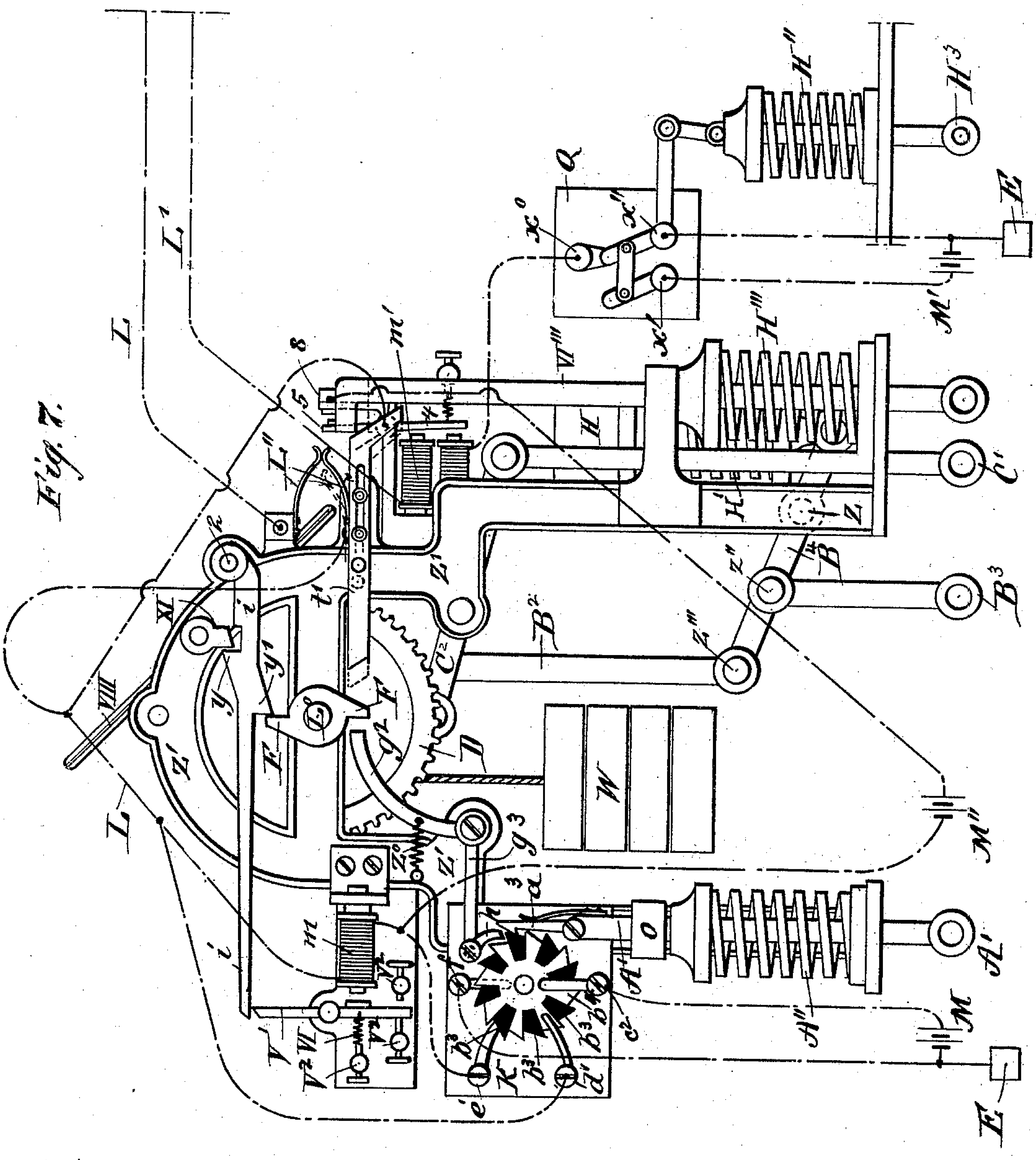

Fig. 7.

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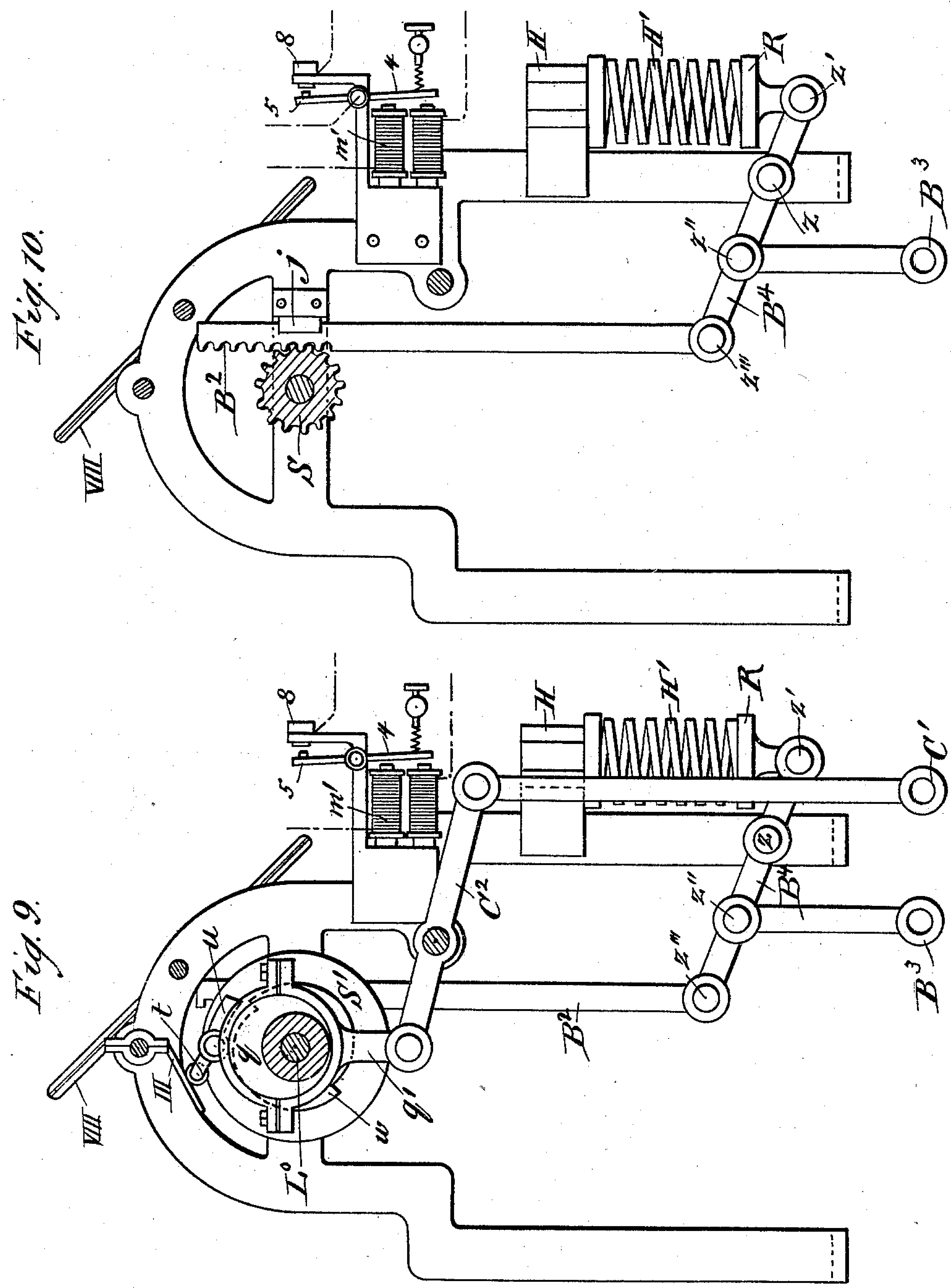
MEANS FOR PREVENTING RAILROAD COLLISIONS.

No. 505,669. Patented Sept. 26, 1893.



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(No Model.)

6 Sheets—Sheet 5.

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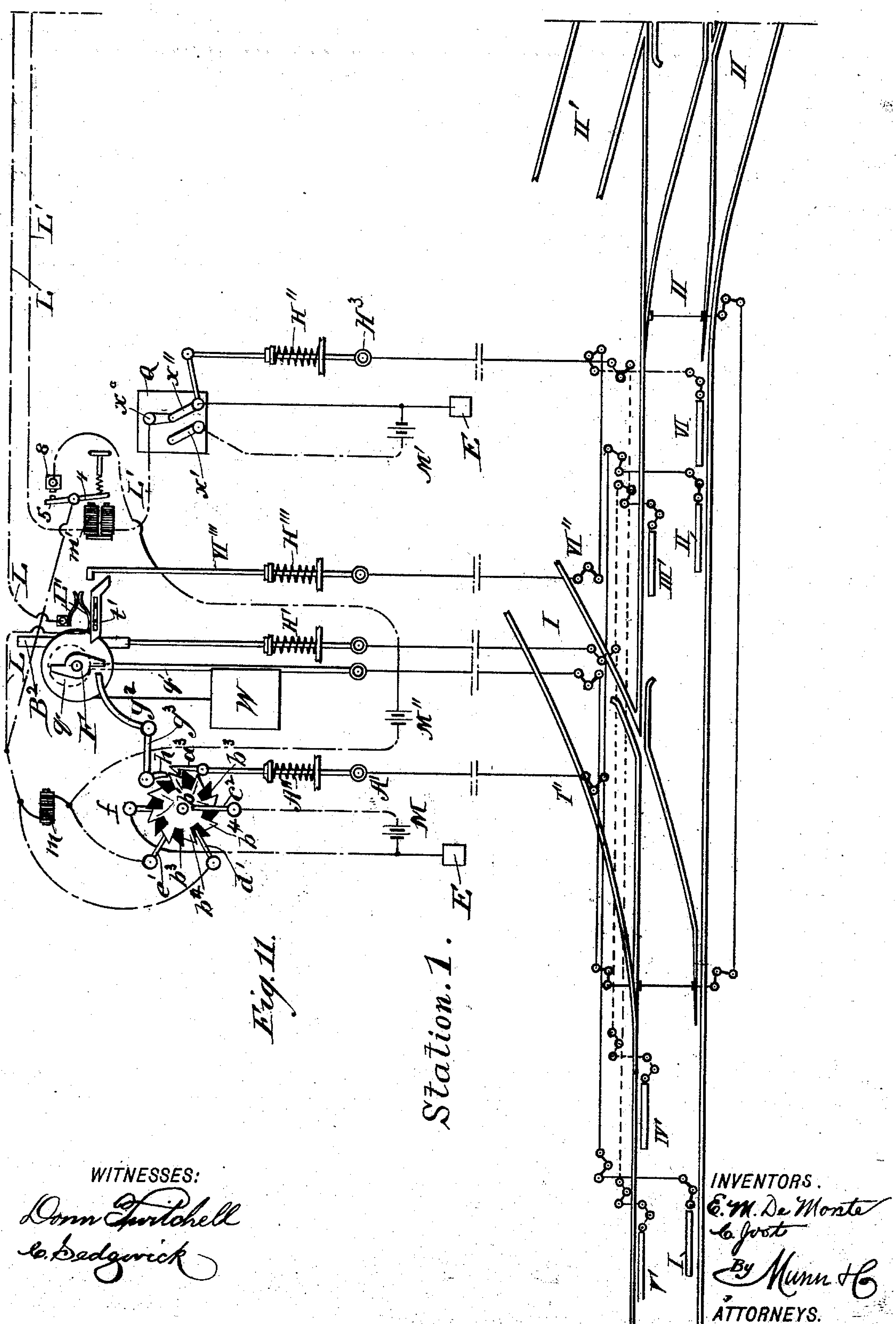

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MEANS FOR PREVENTING RAILROAD COLLISIONS.

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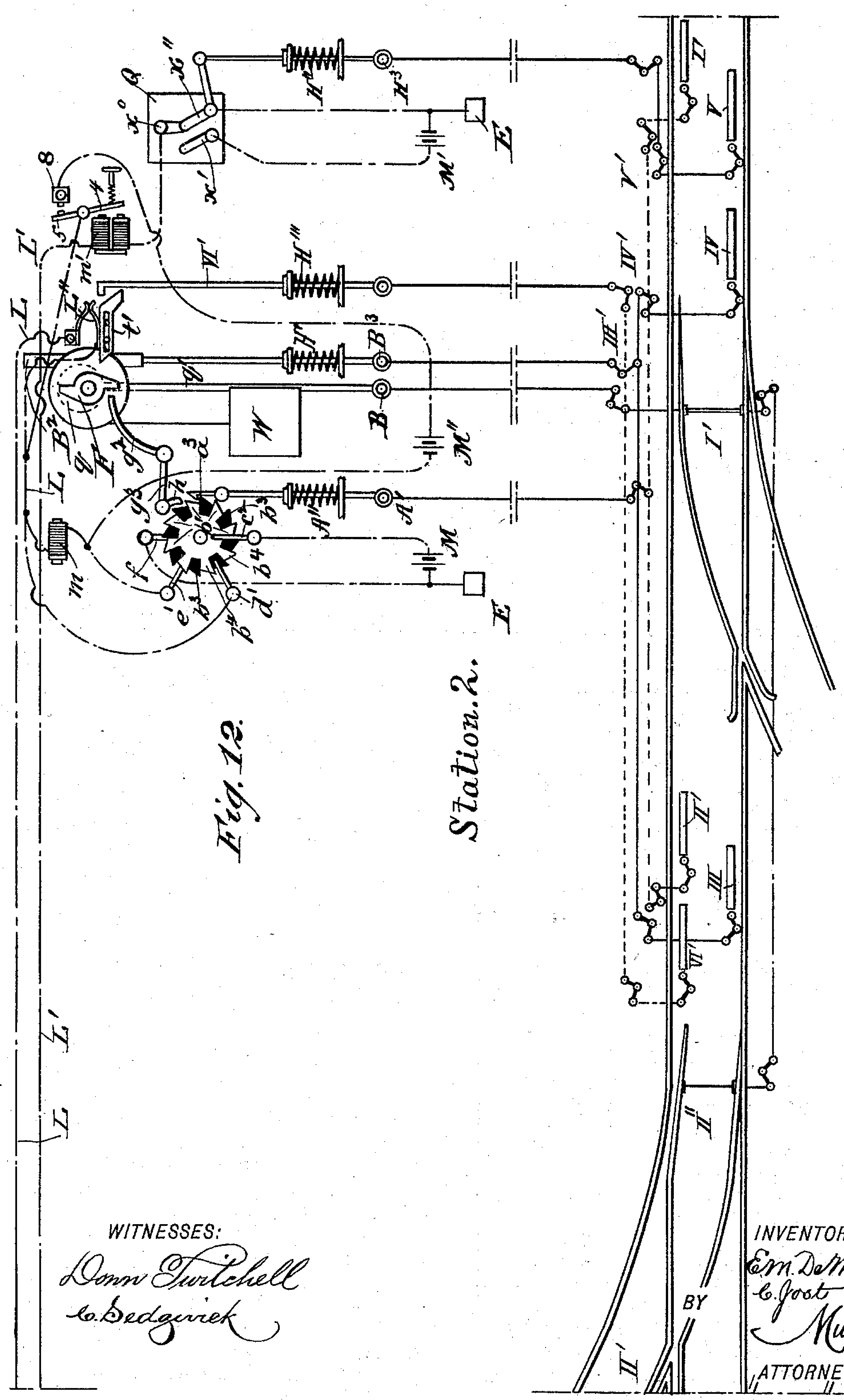

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UNITED STATES PATENT OFFICE.

EDUARDO M. DE MONTE AND CARL JOST, OF BOMBAY, INDIA.

MEANS FOR PREVENTING RAILROAD COLLISIONS.

SPECIFICATION forming part of Letters Patent No. 505,669, dated September 26, 1893.

Application filed October 28, 1892. Serial No. 450,231. (No model.)

To all whom it may concern:

Be it known that we, EDUARDO MIGUAL DE MONTE, a subject of the King of Spain, at present residing in Bombay, British India, and CARL JOST, a subject of the Emperor of Austria-Hungary, at present residing in Bombay, British India, have invented a new and Improved Means for Preventing Railroad Collisions, of which the following is a specification.

The object of the invention is to provide certain new and useful improvements in electro mechanical apparatus for automatically preventing railroad collisions, such as now frequently arise from negligence, oversight or error on the part of the railroad officials, the said means not being controlled by the officials, but entirely governed by the trains on the road.

The invention consists principally of a track comprising individual sections, each arranged to be automatically closed at the forward end by the train when the latter enters the respective section.

The invention also consists of certain parts and details, and combinations of the same, as will be hereinafter described, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters and numerals of reference indicate corresponding parts in all the figures.

Figure 1 is a face view of a car wheel employed for actuating the apparatus. Fig. 2 is an end elevation of the same. Fig. 3 is a side elevation of the compensating device with parts in section. Fig. 4 is a sectional side elevation of the transposing lever mechanism. Fig. 5 is a sectional plan view of the same. Fig. 6 is an end elevation of the electro mechanical controlling apparatus. Fig. 7 is a side elevation of the same. Fig. 8 is a sectional side view of the same on the line 8—8 of Fig. 6. Fig. 9 is a like view of the same on the line 9—9 of Fig. 6. Fig. 10 is a similar view of the same on the line 10—10 of Fig. 6. Fig. 11 is a plan view of the apparatus on one end of a section, and Fig. 12 is a like view of the apparatus on the other end of the section.

According to this invention, the fact of a train being upon any part of a given section of a line will render it impossible for any other train to enter upon that particular section from either direction. As soon, however, as the first train has passed from that section it will become possible for any train to enter upon that section from either direction, such train, in its turn, blocking that section against the entrance thereupon of any other train. As the line is divided into a series of sections of any desired length, but which would easily extend from one railway station or depot to the next, it will be seen that but one train can occupy one such section at a time and therefore two trains cannot possibly come into collision.

In order to carry out the invention, we prefer the mechanism shown in the drawings presently to be described in detail.

Figs. 1 and 2 show the special form of wheel employed to operate the mechanism to be hereinafter described. This wheel will herein be assumed to be a locomotive wheel, for convenience of description, but it may be placed instead under a tender, or any other convenient carriage of a train, so that the requisite pressure may be obtainable through it. This wheel is made wider in the rim than any of the ordinary wheels of a train, and this rim therefore projects beyond the rails to a greater extent than the other wheels. Such wheel will thus be the only one to come in contact with and pass down the tops of certain levers, called for distinction "transposing levers," to be hereinafter described, which will be placed, in suitable positions just alongside of the rails. This extra projection of the rim or flange of this special wheel, may be either toward the "inside" or toward the "outside," as may be desirable; and the location of the "transposing levers" will likewise be arranged to correspond, but in the drawings it is shown on the inside. This broadened rim or flange, will also be so made that this part will run a little higher than the tops of the rails, so that while capable of coming in contact with and passing down the "transposing levers," it will run clear of the tops of switches, &c. This construction is shown in the drawings, where *a* is the ordinary rim of the wheel and *b* the broadened part; see Figs. 1 and 2.

The "transposing levers" shown in Figs. 4

and 5, are placed at suitable places (as may be seen in Figs. 11 and 12); those which regulate the "up traffic" being placed along one side of the track, and those which regulate the "down traffic" being on the other side. In the plan of a single line track as shown in the drawings, these levers are so arranged that the specially broadened wheel will be on the right hand side, and will press them, in the progress of the train, in one direction, and when the locomotive at the end of the journey, is turned round on a turntable or on a triangle, it will on its return, press down the other levers on the other side of the track. In the case of double line tracks, these levers may be placed on either side of the track, and the locomotive for actuating them, if not required to run on single lines also, may have a broadened wheel on each side, or on one side only, and when so adapted, may be run backward or forward, without having to be turned.

In Figs. 4 and 5, the lever A is pivoted at a', and works through a close fitting opening in the metal box B', so that it has just sufficient play to work up and down freely, yet fits so closely that no stones or rubbish can fall through this opening and so get under the lever A. This arrangement is further protected from such accidents by a cover, which is screwed down over it and has an opening at the top through which, as stated, the lever A can just work freely. C is a slide with one of its sides sloped in an inclined plane, against which the free end of the lever A works through the friction pulley d; this slide itself works freely, in the horizontal direction, on the friction pulley e, and is strengthened at its vertical face to receive the rod r which is screwed into it at one end while its other end c' is pivoted as shown in Figs. 4 and 5 to the bell crank or quadrant lever g g' pivoted on the stud n in the box B'. The whole of this arrangement, the slide C, the rod r, and the quadrant lever g g', is covered by the continuation of the same cover through which the lever A works up and down. The working dimensions and proportions of the various parts of this arrangement, are so adjusted that the lever A can only be pressed down, (when connected as hereinafter described) to actuate its connected arrangements when a pressure of a given number of tons is brought to bear upon it such as that from the specially broadened wheel of the locomotive which may have been adopted to control the traffic under this system. These quadrant levers g g' at their other ends are connected by means of rods and other quadrant levers to the electro-mechanical controlling apparatus to be hereinafter described, so that the motion imparted to the lever A, by the pressure from the specially broadened wheel, may be transmitted to the electro-mechanical controlling apparatus, and these produce other motions, through which the traffic along the line is controlled automatically. The bed plate B of these "transposing levers," is fixed to a strong foundation, in a suitable manner. These "transposing levers" may inclose section after section, so as to leave no gaps which are not under control of this system; and all station work may be done on separate lines adjacent to the main line, or they may commence at such a distance from railway stations or depots, that all station shunting or other work may be done between the first of these levers and the station, leaving gaps at stations or depots which are not under the control of this system. When arranged along a track, the top of the box B' will be about level with the top of the rails, and the top of the lever A will stand so much higher than the tops of the rails, as may be desirable to allow sufficient play to this lever under pressure. The bell crank or quadrant lever g g' may be so arranged that the arm g' may, if necessary, work lower than even the bottom of the rails or sleepers; and to prevent any "jumping" when the broadened wheel passes over the top of the lever A, this lever may be made of any desired length, so that the wheel may pass over it as gradually or as rapidly as may be requisite. The corners of the box B', as shown in the drawings, may also be rounded off, so as to allow space for oscillation of the wheel in passing these corners, and prevent any flange from striking against them, and under all circumstances of oscillation permit the flange to pass freely between the corners of the box and the rail. The foundations of these "transposing levers," will be out of the way of sleepers, switches, and other parts of the line. Longitudinal in place of transverse sleepers may be used where desirable, proper drainage arrangements preventing any water lodging in the box B'; and pits like ash pits may be provided for the location, protection, and inspection of these "transposing levers," with locking appliances if necessary. In referring hereinafter to these "transposing levers" in this specification, they will be, for brevity called "transposers."

The rods and quadrant levers connecting the bell crank lever g g' to the electro mechanical controlling apparatus, might run in pipes or in masonry or other ducts, so that no stones or other rubbish could get in among them and interfere with their free movement. To overcome and provide for the expansion and contraction of these rods, any well known device may be adopted; but that shown in Fig. 3, would perhaps be preferable. In that figure, the rod a^2 is divided into as many lengths as requisite, and the ends that meet, are provided for a short distance, with rack teeth b' b' which engage with the toothed pinion c on opposite sides; being kept in gear by means of springs or guides (not shown in the drawings), any longitudinal movements of these sections of this rod, causing these free ends to approach, or recede from, each other; and as the pinion c will at all times move freely in rotation, it will always accommodate itself to every new position. The other ends of these rods, connected to the electro-mechanical controlling apparatus, on the one side, and to the "transposers" on the other, will always be maintained in their true respective positions, by means of suitable springs shown in the diagram Figs. 11 and 12. This arrangement will always compensate for expansion and contraction of the rods, and keep them at all times of the same effective length, for transmitting thrust or pull from either direction.

Through the counter action of the spring on the rod r of the "transposers" (not shown in the drawings) of the springs A″, H′, H″ or H‴, and the other springs on the continuations of the rods actuated by these springs, shown in diagram Figs. 11 and 12, the lever A of the "transposer" will always revert back to its original position as soon as the broadened wheel has passed over it. (See Fig. 7.)

Figs. 6 and 7 show electro-mechanical controlling apparatus, which automatically controls the traffic under this system, and which for the sake of brevity will hereinafter be called and referred to as the "automaton," in this specification.

All the parts of the apparatus are contained within or attached to a metal frame, composed of metal plates Z′, Z′, properly connected together by means of suitable tie rods, as shown in Fig. 6.

A′ is a vertical bar moving vertically through a hole in the foot plate (not shown in the drawings) and the guide O. It has a strong spring A″ placed on it, which is made of a strength corresponding to the number of tons that may have been arranged as the pressure under which the "transposer" is to actuate the mechanism. Thus, no pressure short of this would transmit any motion from the "transposer" to the "automaton" so as to actuate it, when they were connected together by means of the proper rods and quadrant levers for the transmission of this motion. The lower end of the bar A′ has a suitable eye hole by means of which it is connected through a set of rods and quadrants to a "transposer," while at its upper end, (better seen in front view) it has, fixed to it, a hook a^3 which is always kept in gear with the teeth of the contact wheel b^2. This contact wheel b^2 is made of ebonite or other insulating material, and is somewhat in the shape of a ratchet wheel, of sixteen teeth; two star-shaped metallic plates, b^3 b^3, are inlaid in this contact wheel, one on each side or face of it, so that the two metal plates remain permanently insulated from each other in all their parts; and the teeth or portions b^4 b^4, at the rim on both faces, are also insulated from each other, on each face, by the portions of the ebonite which interpose between every two teeth on each face of the wheel, and which are shown black in the drawings, (Fig. 7.) From the terminal c^2 a contact spring (best seen in front view) remains in permanent contact with all the metallic star-like portion of the contact wheel b^2 during all its revolutions; and as this terminal is connected to the carbon pole of the battery M, it follows that this battery, through the terminal c^2 is always connected with one face of the contact wheel b^2 on all its metallic parts. From the terminal f another contact spring remains, in like manner, in permanent connection with all the metallic star-like portions of the contact wheel b^2 on its other face or opposite side, during all its revolutions; and as this terminal is connected to the zinc of the battery M and to the earth, it follows that this opposite face of the contact wheel b^2 on all its metallic parts is, throughout all its revolutions, in permanent connection with the earth. Thus in all positions, and throughout all the revolutions of this contact wheel b^2 one of its metallic star-like faces is in permanent connection with the battery of its own "automaton," while its other metallic star-like face is in permanent connection with the earth. From the terminal d' which is always in permanent connection with the line wires L, L, a contact spring runs to that face of the contact wheel which through the terminal c^2 is connected to the battery M; but as this terminal spring does not extend over the contact wheel b^2 beyond that part where the ebonite and metallic teeth-like portions alternate with one another, it will be seen that as the contact wheel b^2 revolves this spring comes alternately on the metallic and the ebonite portions of this face of the contact wheel b^2. So that through this spring on the contact wheel, the line wires are brought into connection with the battery M, and this connection is broken when the spring goes on the ebonite, is again restored as the spring gets on the metal, to be broken again and again restored, each time the contact wheel makes one-sixteenth revolution or is moved one tooth. Thus, the line wires L L are alternately brought into connection with the battery M, then disconnected, again connected and disconnected again, at every one-sixteenth revolution of this contact wheel. From the terminal a' which is in permanent connection with the magnet coil m, another contact spring, not shown, runs to the other face of the contact wheel b^2, that one which through the terminal f is in permanent connection with the earth. Like the contact spring of the terminal d' this spring only extends to that part of the contact wheel b^2 where the ebonite and metallic tooth-like portions alternate with each other, so that this spring too, only makes contact with the metallic face of the contact wheel alternately, that is, it is in contact with and insulated from this metallic face as this spring through the revolution of the contact wheel comes on the metallic or gets on the ebonite teeth of the contact wheel. And as this face of the contact wheel is, through the terminal f, in permanent connection with the earth, it follows that the magnet coil m, through the contact wheel, is alternately connected with the earth, disconnected from it, reconnected, and again disconnected at every one-sixteenth revolution of the contact wheel b^2. The arrangement is however such, that when the line wires L L through the spring of terminal d' are in connection with the metallic face of the contact wheel, and through it with the battery, at the time the spring of the terminal c^2 is on the ebonite part of the contact wheel, on its opposite face, and thereby the magnet coil m is disconnected from the earth, so that no current from this battery can ever pass through the magnet coil of its own "automaton."

K is a key board, on which the terminals c^2, d', e', f, as well as the contact wheel b^2 are fixed, but all properly insulated from each other.

Fig. 7 shows a lever g^2 g^3 having a pawl h, which like the hook a^3 on the top of the rod or bar A′, also gears into the teeth of the contact wheel b^2; and both this pawl and the hook a^3 can either independently or together, work the contact wheel b^2 round.

m is a magnet coil, with its armature V′, which is kept apart from the magnet by the spring VI, or by any other suitable means. When, however an electric current passes through this magnet coil, the magnet gets excited, and overcoming the resistance of the spring VI, draws the lower end of the armature V to it, thereby deflecting the rod of this armature from its vertical position; and its upper point slips out from under the tapered end of the horizontal lever i i, which it supports when not attracted from its vertical position by the magnet m.

V^2, V^2, V^2, are three adjusting screws to regulate the resistance of the armature against the attraction of the magnet coil m; but this arrangement may be modified as desirable.

F is a two-armed or double-tappet wheel, fixed to the axle L°; each of these arms lifts the lever i i whenever it passes under that lever at y'; the same arm also pushes back the slide t', and restores the contact between the contact springs L″ L″ whenever it has been interrupted through the downward motion of the rod VI‴, as hereinafter described. The other arm of this wheel at the same time, in descending presses down the arm g° of the lever g^2 g^3 h, to bring the pawl h into gear with the next tooth of the contact wheel b^2; so that as soon as this arm g^2 is liberated by the arm of the tappet wheel F, the force of the spring z° pushes this pawl h down on the tooth of the contact wheel b^2 and causes it to move one tooth. This arrangement may be reversed if desirable.

L° is the axle, resting in its bearings set in the frame plates Z′ Z′.

D is a large toothed wheel, having sixty or any other number of teeth that may be a multiple of the number of teeth on the pinion VII (to be hereinafter described,) and which gears with the teeth of D. This wheel D is fixed to the axle L°, so that the wheel and axle revolve together in the axle bearings. Solidly combined with, or fixed to the wheel D within its inner rim is the ratchet or catch wheel v (Fig. 8) having two, four, or any even number of teeth. This ratchet is so fixed within the rim of the wheel D, as to leave sufficient space between the teeth of this ratchet wheel and the inner rim of the wheel for one or two ratchets or pawls r to gear into the teeth of the ratchet wheel v without having friction against the inner rim of the wheel D (Fig. 8). The drum P P′, has two flanges, between which the rope supporting the weight W is wound; and the pawls r r above described, are fixed on that face of the flange P′ of the drum which is toward the wheel D; so that the ratchet wheel v fixed to the wheel D, and the ratchets r r fixed to the flange P′, are contained between the face of this flange and that of D, within the hollow part of the latter, but so as to have no friction against any part of D or P′.

q q' is an eccentric with its strap and rod. w is another ratchet or catch wheel having only two teeth, into one or other of which the pawl u gears or clicks whenever the pinion S S′ is made to revolve by the downward movement of the rack B^2. The drum with its flanges P P′, the eccentric q q' and the ratchet wheel w are all made in one solid piece, or fixed together, and revolve loose on the axle L°, so that as the weight W descends and turns the drum, the eccentric q q' and the ratchet w go round with it; and as the pawls r r are fixed to the flange P′ of the drum, and gear into the teeth of the wheel v, and this is fixed to the wheel D, both the ratchet wheel v and the toothed wheel D are carried round with the revolution of the drum whenever the weight W descends; and as the tappet wheel F, as well as the wheel D are fixed to the axle, this tappet wheel F goes round with D as often as D is made to revolve by the descent of the weight W. When however, the drum revolves in the opposite direction to wind up the weight then, as the pawls r r do not gear into, but simply click over the teeth of the ratchet wheel v in the reverse direction, neither v nor D, nor F are moved.

S (Fig. 6) is a small toothed pinion, carrying a wide flange S′, on the face of which the pawl or ratchet u is fixed, and which gears into the teeth of the ratchet wheel w; this pinion with its flange S′ also works loose on the axle L°.

B^2 is a rack moving up and down in the guide j which keeps it in gear with the pinion S S′: the spring H′ (Fig. 10) always keeps the rack B^2 in its highest position, when no force pulls it downward. When this rack is pulled downward by the rod B^3 (Fig. 10) the pawl or ratchet u fixed to the flange S′ gears into the teeth of the ratchet wheel

w, and as the pinion revolves, it carries with it the ratchet wheel w, the eccentric $q\ q'$ and the drum P P', which being thus carried round in the direction opposite to that of the descent of the weight, this weight W is wound up; but as the pawls $r\ r$ fixed to the flange P' and gearing into the teeth of v are carried in the reverse direction they do not gear into but click over the teeth of the ratchet wheel v, and neither it, nor D, nor F are moved.

III (Fig. 9) is a fixed slide lever. When the rack B^2 is freed from the downward pull on it, and rises to its highest position through the counter force of the spring H', carrying with it the pinion S S', with the pawl u in the reverse direction, the pawl u is pressed up against this slide III and is at once lifted out of the tooth of w; being pivoted in the middle, one end in gear with the ratchet w, the other end t is pressed up against the slide bar III, whereby the opposite end is lifted out of gear.

VII is a small toothed pinion having fifteen or any other number of teeth that may have a like proportion to the number of teeth on the wheel D. This pinion is fixed to its axle near one end, so as to gear with the wheel D. The other extremity of this axle carries a fan VIII to regulate the speed of this pinion and through it the rate of the descent of the weight W. At the other extreme end of this axle, on the side where the pinion is fixed, is a pawl XI, which gears into a catch cavity in the horizontal lever $i\ i$ at y, and arrests the further movement of this axle, stopping the pinion VII and with it the wheel D to which this pinion is geared.

$i\ i$ is a horizontal bar lever pivoted at 2 (Fig. 7) having double vertical projections $y\ y'$, the upper one of which forms the catch cavity into which the pawl XI falls to stop the pinion VII. The other end of this lever is tapered, and rests on the top point of the armature rod V', of the magnet m, while this armature rod retains its vertical position. This end of the lever $i\ i$ may be weighted, if necessary to assist its fall when the top of the armature rod slips out from under it, upon deflection caused by the attraction of the magnet m for the armature. m' is another magnet coil, with its armature 4—5, and having a platinum point at 5. 8 is an insulated terminal from which a wire runs to the battery M''. The armature 4—5 is insulated from all other parts of the arrangement, and is connected by means of a wire with the magnet m. One end of the magnet coil m' is in permanent connection with the second line wires L' L', the other end of this magnet coil, through the springs on the switch board Q, being in permanent connection with the earth through the zinc pole of the battery M'.

Q is a switch board with three terminals $x^\circ\ x'\ x''$ with their contact springs, all insulated from each other. Terminal x° connects the magnet m', on this switch board, and the terminal x'', with the earth through the zinc pole of the battery M'; the third terminal x' being connected with the carbon of this same battery M' but insulated on the switch board from all other parts of the arrangement. The spring H'' keeps the contact spring of terminals x° and x'' in continued contact, and keeps the contact spring of terminal x' switched off, except when the rod H^3 is pulled down, when the contact between the terminals x'' and x° is switched off and x' is switched into contact with x° connecting the battery M' with the magnet coil m'. As soon however as the pull on H^3 ceases the spring H'' switches off x', and switches on x'', into contact with x°. The rod H^3 is connected to a "transposer" by means of rods and quadrant levers, so that the pressure on it is communicated to H^3 as a downward pull. For all the details of the above arrangements see Fig. 7.

The third battery M'' has its carbon pole, as stated above, in connection with the insulated terminal 8, its zinc pole being connected with the magnet coil m, from which a wire runs to the armature 4—5 of the magnet coil m'. This third battery only acts locally.

B^4, Figs. 9 and 10, is a lever pivoted at z, the other end z' being connected to the spring H' which always keeps the rack B^2, also connected to this lever, at its full height. At z'' this lever B^4 is connected by means of rods and quadrant levers to a "transposer" on the track; so that the pressure on this transposer draws this lever B^4 and with it the rack B^2 downward, which through this motion actuates the pinion S S'. Instead of drawing the rack downward directly, a slide bar, arranged to gear and ungear automatically at certain points of its traverse with the rack B^2, might be pushed upward, and it could, on its return, bring the rack B^2 down with it, with less jerk, the return movement of this slide bar being regulated by means of springs or weights. Or again the jerk in drawing the rack down might be reduced through pneumatic valves, or in other known ways.

The eccentric $q\ q'$, through the rod q', the lever C, and the rod C^2, and the rods and quadrant levers, is connected to the line switches, which regulate the opening and closing of the line, so that every time the eccentric makes a half turn, it actuates these switches, and these switches at the first and second points, are connected together and so arranged that when the one set is opened the other is closed, and vice versa.

In place of switches and sidings, an arrangement, already patented (or some modification of it) havings arms or levers on a track, which could be depressed or raised, and so allow a locomotive to pass freely, or by coming in contact with tappets carried on the engine actuate steam regulators, reversing gear, or brakes, and so stop the progress of the train, or modifications of any of such devices may be used; and the opening and closing of the line regulated by this or other suitable means.

Where any arrangement already patented is adopted, all that would be claimed under this specification, in respect to any such arrangements would be the actuating of them automatically through the electro mechanical apparatus in the novel manner herein described whereby the ends of a section of any required length are electrically controlled in the way herein set forth and described; such arms or levers on the track being actuated through the eccentric on the "automaton" through rods and quadrant levers connecting the arms and levers on the track to it.

Any given state or condition of the switches or of the arms or levers on the track, so long as these continue connected to the "automaton," cannot possibly be altered manually, as they could not be actuated except by the pressure of several tons, such as that applied through the specially broadened wheel on the "transposer" and through it transmitted to the "automaton" whereby the opening and closing of the line are regulated.

VI‴ Fig. 7, is a slide rod connected to a "transposer" by means of rods and quadrant levers, so that the pressure of the broadened wheel is transmitted to this slide rod as a downward pull. The top of this rod which is bent at an angle works against the sloping face of the slide t' on which, through the contact springs L″ L″, the continued electrical connection between the two ends of a section is maintained so long as these springs L″ L″ are in contact. When the slide bar VI‴ is pulled downward its top pushes the slide t' from it, and thereby causes the lower spring L″ to slip out of cantact with the upper one, thus interrupting the electrical connection between the two ends of the section.

L L are line wires which electrically connect the "automaton" of one end of a section to that of the other end. This connection is however not made directly but through the slide t' and the contact springs L″ L″; so that whenever the contact between these two springs is broken, the electrical connection between the two automata is interrupted. These wires L L are for utilizing the electric currents from the batteries M of each automaton for working, through the magnet coil m of the other automaton, the mechanism of that automaton. The line wires L′ L′ are a second or supplementary arrangement for transmitting the electric current from the battery M′ of one automaton to the other automaton through the magnet coils m' of both automata, so as to complete the circuits of the local batteries M″ of both automata and set the mechanism of both in motion simultaneously. These wires are used for restoring the interrupted connection of the line wires L L after it has been interrupted.

The principle of the above invention is that the weight on the specially broadened wheel is stored up as potential energy in the weight W, always ready to be used as active force for automatically controlling the traffic on the line, through the excitation of certain magnets, by electric currents set in motion automatically by the progress of a train whereby certain machinery is set in motion regulating and controlling the traffic.

The manner in which the arrangement works will be best understood by illustrating the progress of a train over a section of the line fitted up with the afore-described apparatus for the control of traffic. Figs. 11 and 12 show the two ends of a section of a line worked under the system. All details have been omitted from these figures, which are diagrams rather than drawings, showing only such parts of the "automata" as are necessary to show how the traffic is controlled; for details of the movements of the parts, to which references may be made, the prior named figures of the drawings, and the description herein must be consulted.

The automata will all be located in suitable buildings protected by lock and key from unauthorized interference. The "transposers" will be located along the track, as before described, and placed as shown in these diagrams, Figs. 11 and 12, for a single line track, along both sides of the line. The stations or depots are not shown in these diagrams but may be supposed to be at each end. Between those points marked II and II″, that is, between the points of the second switches at both ends of the section is supposed to be an open track of railroad with its usual crossings, &c. The arrangement of "transposers" along a track will, at each end of a section, not extend much more than about a train's length. The sidings wherever such may be used, may be made with old rails and sleepers for they will be very rarely used, and if made with sufficient gradients need not be longer than about one and a half train's length at the outside. Fig. 11 represents that end of the section from which, according to the following description, the train is supposed to start, and Fig. 12 that at which it has to arrive. The point I, on the line, Fig. 11 is the first switch from station 1 and the corresponding point I′ on Fig. 12 the first switch at station 2. Similarly the points II and II′ represent the second switches at the two stations, see Figs. 11 and 12. It will be observed that the first switches at both ends are open to admit a train on to the main line, but that the line at the second switches, at both ends of the section, is closed; and that until these switches are moved, a train from either side, would get shunted off onto the sidings. This is the normal state of the line at the end of every section. It will be remembered that every "transposer" on the track is connected by means of rods and quadrants to some special part of the "automaton," and that all switches are similarly connected to the eccentric; and that while so connected they can be moved only through the action of the "automaton;" and lastly that the whole of the arrangements are properly protected from accidents and unauthorized interference.

When the line is in the normal condition before described, the arrangements of the various parts of the automata at the two ends of a section are such that the batteries M, at both stations, are disconnected from the line wires L L, the contact springs of the terminals d' of both automata being on the ebonite portions of their respective contact wheels b^2. The magnets m, at both stations, are in connection with the earth, each through the zinc pole of its own battery M of its own automaton, the contact spring of the terminal e' being on the metallic portion of its own contact wheel b^2, and the magnet coil m at one station being also connected to the corresponding end of the magnet coil m of the other station, through the line wires L L; the contact springs L'' L'' on the slides t', at both stations, are in contact on their own respective slides. The one end of the other magnet coil m' of one station is also connected to the corresponding end of the similar magnet coil m' of the other station, through the second line wires L' L'; the other ends of each of these magnet coils being in connection with the earth through the terminals x° x'' on its own respective switch board Q. Thus the circuit of the battery M', is at each station, interrupted on the switch board at its own terminal x', and the circuit of the local battery M'' is at each station, interrupted at its own insulated terminal 8.

It will be seen from Fig. 7, that the mechanism of the automata is ready to be moved, by the descent of the weight W, and that it is kept from being turned round, through the pawl XI being held locked in the nick or catch cavity in the horizontal lever i i, so that as soon as this lever shall fall, (through the slipping out of the armature rod V' from under its tapered end) the pawl XI, will become liberated, and the mechanism would be turned round by the descent of the weight W. This will as explained hereinbefore, give motion to the wheel D, and the double tappet wheel F, and this motion might go on so long as the weight could descend; but as the tappet wheel F revolves a half turn its lower arm, Fig. 7, passing under the horizontal lever i i at y', lifts it, and the pawl XI is arrested in its nick at y, and as this pawl is fixed on the same axle as the pinion VII which gears in the teeth of the wheel D, the whole of the machinery is stopped at every half revolution, that is the eccentric can only make a half turn at one time; at the same time, as before described the lever g^2 g^3 h, moves the contact wheel b^2 one tooth, and switching off the contact on the contact wheel b^2, stops the electric current which had caused the mechanism to move by the deflection of the armature V' as hereinbefore described: it will be remembered that the pinion S S' and the rack B^2 are not moved when the weight descends, as u is out of gear with the wheel w.

The "transposers" I, II, VI, III, IV and V (Figs. 11 and 12) control the traffic from station 1 to station 2 and transposers I', II', VI', III', IV' and V' that from station 2 to station 1. Those on one side are successively pressed down by the broadened wheel as the train proceeds from station 1 to station 2 and the others similarly on the return journey.

Starting from station 1 the broadened wheel first presses down the "transposer" I, (which it will be seen is located just before the first switch gives admission to the main line) and this motion transmitted to the automaton at station 1 draws the rod A' downward; and the hook a^3 moves the contact wheel b^2 one tooth. This movement causes the contact spring of the terminal d' to pass from the ebonite to the metallic part, and the contact spring of the terminal e' to pass from the metallic to the ebonite part of the contact wheel b^2: so that the magnet coil m at station 1 becomes disconnected from the earth, and at the same time the line wires L L become connected with the battery M, at this station. It will be remembered that the arrangement at both stations had originally been the same, so that at station 2 the position remains similar to that of station 1 before the change just described had been effected, viz: that the magnet coil m is connected to the earth, and the line wires disconnected from the battery, therefore the result of the change at station 1 will be that an electric current will pass from the battery M of station 1 through the line wires L L, through the magnet coil of station 2, and thence through the terminals e' and f on the contact wheel of that station to the earth. This will excite the magnet m of station 2, the armature V' will be deflected from its vertical position, the point of the horizontal lever i i, losing its support, will fall, this will liberate the pawl XI, the pinion VII will be free to be carried round, the eccentric will go round a half turn, the switches on the line track will be moved, the upper arm of F will lift the ratchet h into gear with the next tooth of the contact wheel b^2, and as it leaves the lever g^3, the spring z° will force the pawl h down and cause the contact wheel b^2 to move one tooth and interrupt the electric current which had excited the magnet m at this station, the armature V' will revert to its vertical position, the other arm of F in its upward movement will pass under the lever i i at y' and as this lever lifts it will arrest the pawl XI, and its tapered point descending will rest on the top point of the armature V' which has returned to its vertical position; the arresting of the pawl XI will stop the pinion VII, and with it the wheel D, the drum P P', the eccentric and the wheel w, all the mechanism will thus stop after making half a revolution. The half turn of the eccentric having actuated the line switches those at the point I′ will be closed while those at point II′ will be opened. Thus even before a train has entered upon a section of railroad under this system, it first closes the entrance to that section at the forward end, so that no train can come on that section from that direction. Advancing about a train's length farther, the broadened wheel next presses the "transposer" I I and this pressure transmitted through the same set of rods and quadrant levers to the "automaton" again draws the rod A′ downward, and its hooked end a^3 again moves the contact wheel b^2 one tooth. The spring of the terminal e' is switched onto the metallic from the ebonite part of the contact wheel b^2, bringing the magnet coil m at this station into connection with the earth; while the spring of the terminal d' is at the same time switched off from the metallic to the ebonite portion of the contact wheel b^2, disconnecting the battery M at this station from the line wires. It will be remembered that at station 2, just before the mechanism had stopped, the pawl h had moved the contact wheel b^2 one tooth, whereby the battery M at that station had become connected with the line wires, and the magnet coil there had been disconnected from the earth, so that as soon as the contacts, above described, are effected at station 1 an electric current from the battery M at station 2 passes along the line wires L L through the magnet coil m of station 1 to the earth. This magnet m is excited, the armature V′ at this station becomes deflected from its vertical position, the lever i i falls, and the mechanism being set in motion, the action that has just been described as having resulted similarly at station 2 is now repeated in the "automaton" of station 1. The motion of the eccentric, actuating the switches, closes those at point I and opens those at point II of station 1; as the corresponding switches had just before been closed and opened at station 2 at the same time, just before the mechanism stops, the pawl h moves the contact wheel b^2 one tooth, interrupting the electric current that had set the mechanism in motion. It will now be observed that the line wires at both stations are connected to the batteries M which are through them connected with each other, and that the magnet coils m at both stations are disconnected from the earth; the contact springs of the terminals d' at both stations being on the metallic parts of their respective contact wheels b^2, and the contact springs e', at both stations being on the ebonite portions of these wheels. Having thus closed the line behind it, as well as in front at the forward end of the section, the broadened wheel immediately presses the next "transposer" marked VI in Fig. 11, and this motion transmitted through a set of rods and quadrant levers to the "automaton" draws the rod VI‴ downward; and the top of this rod which is bent at an angle, works against the sloping face of the slide plate t' pushing this plate from it, whereby the lower contact spring L″ slips out of contact with the upper one, immediately interrupting the continuity of the electric connection between the two ends of this section through the line wires L L, at this point. This arrangement may however be varied by other modifications answering the same end, which is to interrupt the electric connection between the two ends of a section, as soon as the train, after having closed the line at the forward end of a section, enters upon that section and closes the line behind it. All the different modifications for effecting this cannot of course be described in a specification like this, which is therefore not limited to this or any other special arrangement, but another means of accomplishing the same object may be briefly described thus. The slide plate t' with its contact springs L″ L″ may be located near the vertical bar A′; another ratchet wheel may be placed in the same vicinity, having also sixteen teeth with pins at every second tooth; the rod A′ on its return upward movement could move this second ratchet wheel by means of another hook placed upon it to act on the upward direction of the movement of A′, and at every second movement of this second ratchet wheel, the pins placed on it could actuate, either directly or indirectly, the slide plate t', making the interruption at the contact springs L″ L″, the contact being restored through the movement of the armature 4, 5 when the magnet m' was excited, of course both these, with the insulated terminals, being suitably located. For the sake of convenience of description however the arrangement as illustrated in the drawings has been adopted. Returning to the point where the train has automatically interrupted the electric connection between the two ends of the section, it will now be seen that the train is now on a section both ends of which are closed to the intrusion on that section of another train; and that as the electric connection between the two "automata" at the two ends, is interrupted, and as the switches cannot be actuated except electrically through the "automata," as before explained, the train can travel with absolute guarantee against a collision over the open track between the two ends of this section; which may be of any desired length from a hundred yards to a hundred miles or even more or less. Having passed over this open track and arriving just near the station of destination, the broadened wheel presses the "transposer" III, and this motion transmitted to the "automaton" through a set of rods and quadrant levers pulls the lever B^4 downward, and through the downward movement of this lever, the rack B^2 which is connected with it is also pulled downward. This actuates the pinion S S′, the pawl u, on the flange S′ of the pinion engages with the wheel w, and it, with the eccentric and the drum, all go round in a direction opposite to the descent of the weight W, and wind this weight up a half revolution of the drum. For the sake of simplicity of illustration, the position of the eccentric in the diagrams is shown reversed, its true position may be seen in Fig. 9. The lever B^4 which is omitted from the diagrams produces the same result or motion in Fig. 9 through the ascent of the lever as its descent would give in the diagrams. This movement of the train actuates the switches, closing those at II′ and opening those at I′, thus automatically opening these points for its own onward progress which it had closed on passing over the first "transposer" when it was entering upon this section. Having passed these switches and almost arrived at the end of this section the broadened wheel presses the "transposer" IV and this like "transposer" III, being also connected with the rod B^4 and through it with the eccentric, this is again pulled downward, and the motions just before described on the pressing of "transposer" III, are repeated, but as the throw of the eccentric will now be in the reverse direction, the switches will now be actuated in the reverse way, closing the points at I′, and opening those at II′, and at the same time winding the weight W again another half revolution of the drum. Having passed the last switches the train is now supposed to be quite near the station, and the broadened wheel now presses the last "transposer" V, and this motion transmitted to the "automaton" through the rods and quadrant levers pulls the rod H^3 downward, whereby the contact spring of the terminal x'' is switched from off and that of x' switched on into contact with the spring of terminal x° on the switch board Q, Fig. 12, and an electric current immediately passes from the battery M′ at station 2 through the terminals x', x°, through the magnet coils m' at this station, through the line wires L′ L′, and passes, at station 1, through the magnet coil m' and the terminals x° x'' to the earth at this station No. 1. The magnet coils m', at both stations, are excited and deflect their respective armatures 4—5, making contacts between these and the insulated terminals 8, at each station. This completes at each station the circuit of its own local battery M″, whereby the magnet m, at each station, becoming excited, deflects its own armature V′, and the horizontal lever i i, at each station, falls and sets in motion the mechanism of its own automaton. The result is that the same motions are simultaneously produced at each station that have been hereinbefore described when the "transposer" I was pressed, setting the "automaton" of station 2 in motion. The throw of the eccentric, at each station reverses the position of the line switches, closing those at the points II, and II′, and opening those at I, and I′, respectively, at each end of the section, at the same time the lower arm of the double tappet wheel F at station 1, in its ascent, coming in contact with the slide plate t', in the new position into which it had been moved when it was pushed aside by the rod VI‴, pushes it back again into its former position, restoring the interrupted connection of the line wires L L by bringing the contact springs L″ L″ again into contact. The other arm of this tappet wheel F, through the pawl h of the lever g^2 g^3 h, moves the contact wheels b^2, at both stations, one tooth, disconnecting the line wires L L at each station from the batteries M, and bringing the magnets m at each station into connection with the earth through the zinc poles of their respective batteries M, so that the line is again restored to its normal condition, in which it was before the train had arrived at transposer I at the first station. It will also have been observed that as soon as the pressure on transposer V at station 2 had passed off the spring on the rod H^3 immediately switches off the connection that had produced the results just described, and the contact springs of the three terminals on the switch board Q at station 2 are restored to their previous positions interrupting the connection between the battery M′ and the magnet coil m', and restoring the connection between this magnet coil and the earth at this station. On its return journey from station 2 to station 1, the broadened wheel presses the corresponding "transposers" on the other side of the track shown in Figs. 11 and 12, from I to V in the same order as those just described, and the control of the traffic would be in precisely the same way.

When the rack B^2 actuates the mechanism, the wheels v, D and F, are not moved. When the weight descends and moves v, D and F, then the pinion S S′ and the rack B^2 are not moved, as already explained.

As each "automaton" can only be actuated by the excitation of magnets through an electric current from the "automaton" at the other end of a section, it will be evident that if through any cause, such as the breaking of the line wires L L or any derangement at either or both stations, the switches at the forward station are not closed when the transposer I is pressed at station No. 1, then when the train arrives at "transposer" II and this is pressed, the same cause will prevent the opening of the switches at station II at this end of the section and the train will not be able to proceed on the main line but will get shunted off at these sidings. The fact therefore that on the pressure of "transposer" II the line at these switches is opened and the train enabled to proceed, is thus a certain proof that the "automata" at each end of the section are working satisfactorily and that connection through the line wires is free from interruption.

In the possible, but altogether improbable event of two trains starting from opposite ends of a section so that the broadened wheel of each train shall arrive at and press the