No. 801,655. PATENTED OCT. 10, 1905.

T. DUCOUSSO & F. RODARY.

MEANS FOR OPERATING AND CONTROLLING RAILWAY POINTS.

APPLICATION FILED MAR. 12, 1901.

6 SHEETS—SHEET 1.

Fig. 1.

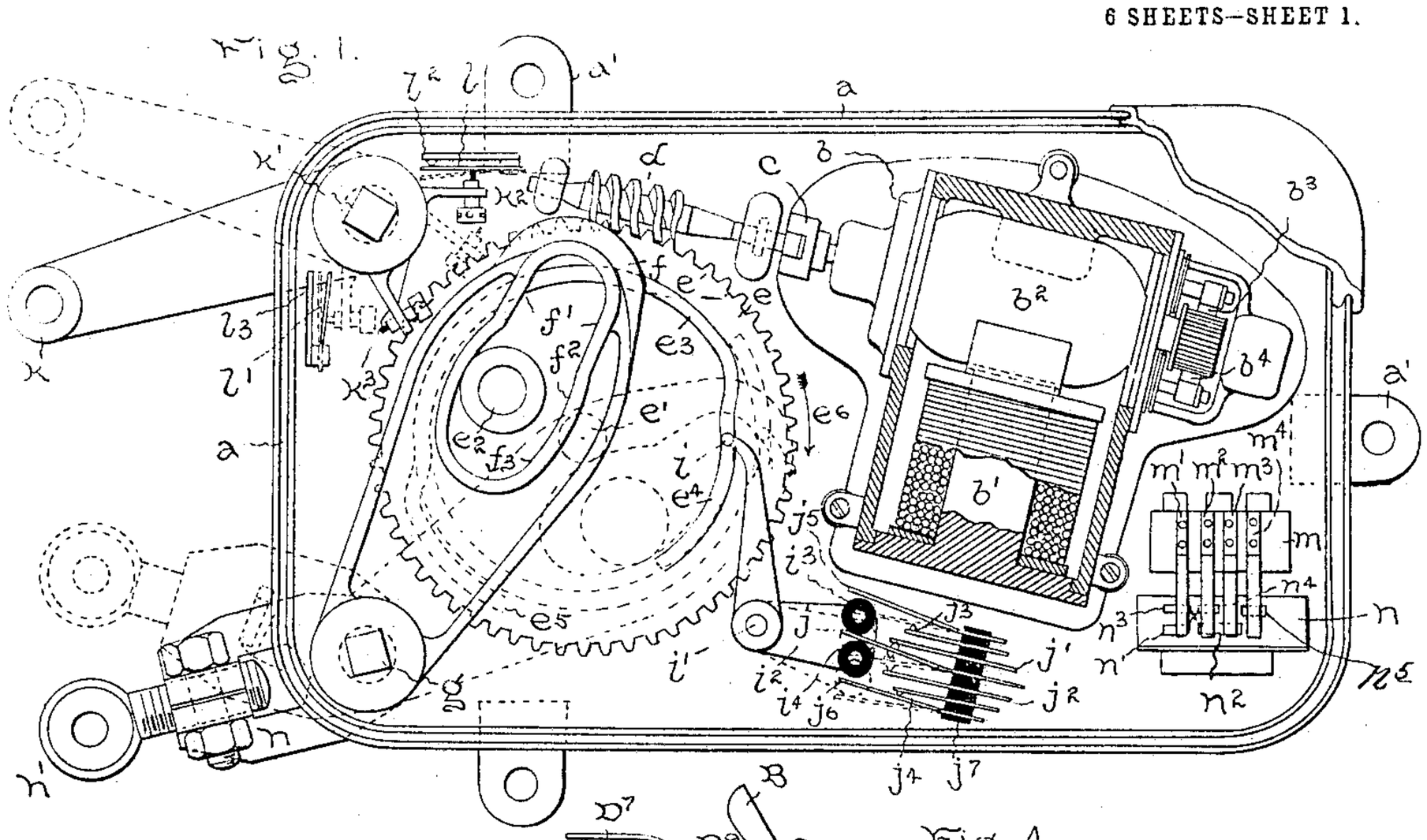

Fig. 2.

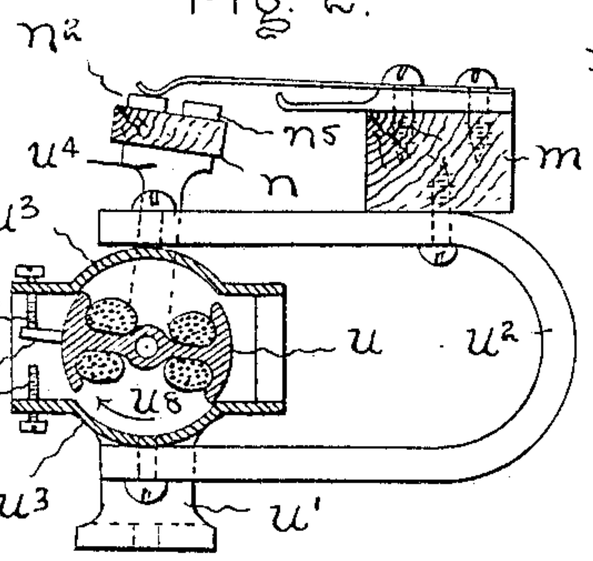

Fig. 3.

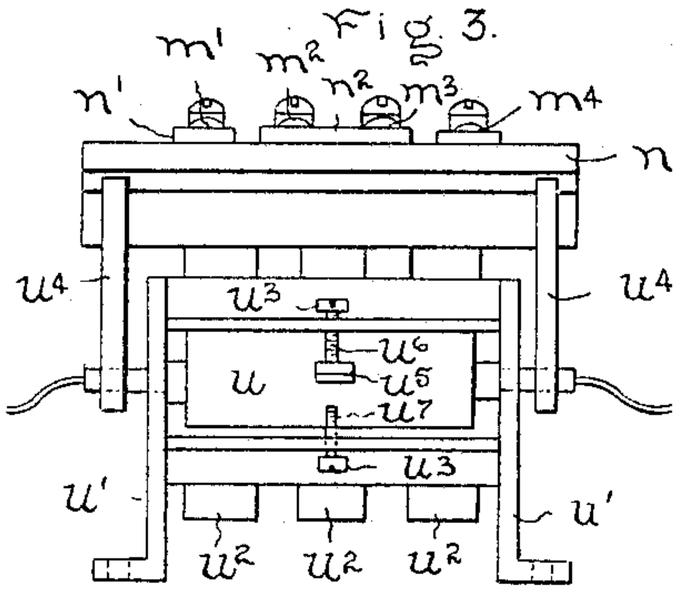

Fig. 4.

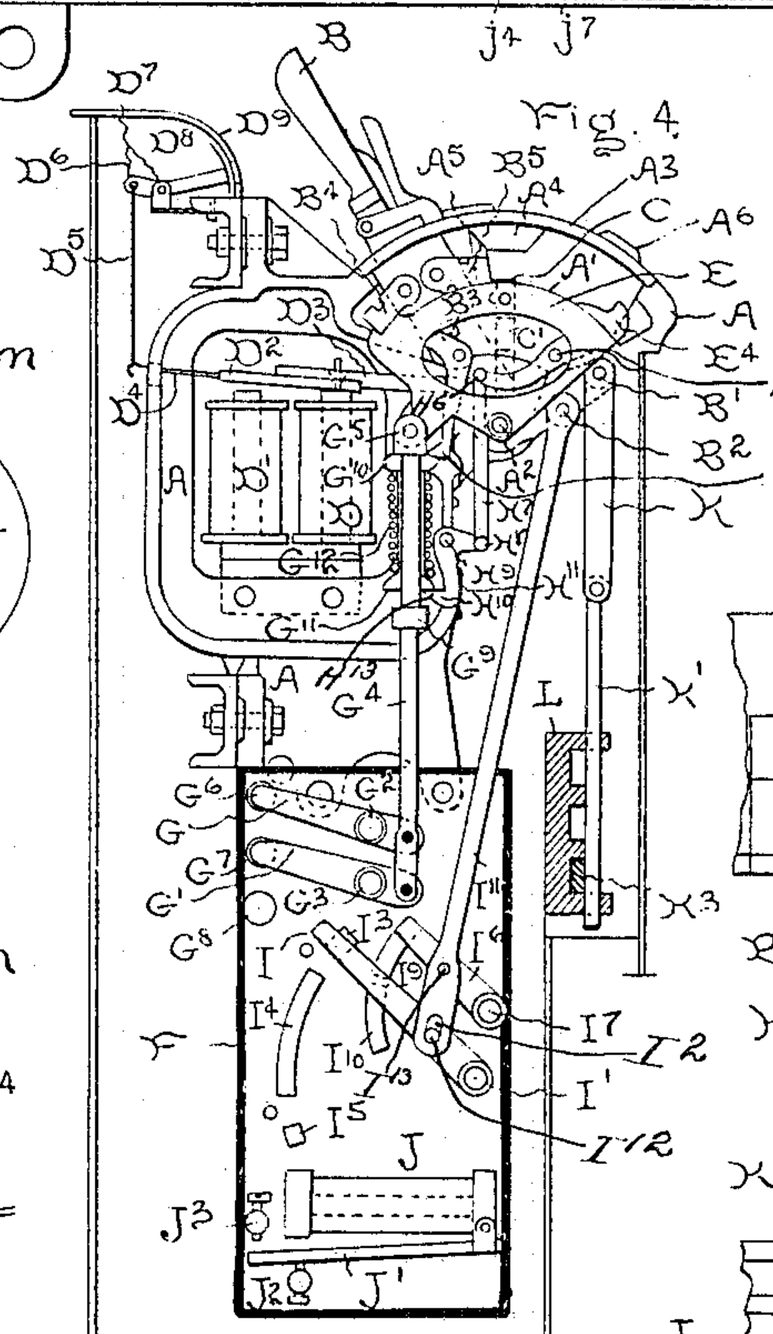

Fig. 5.

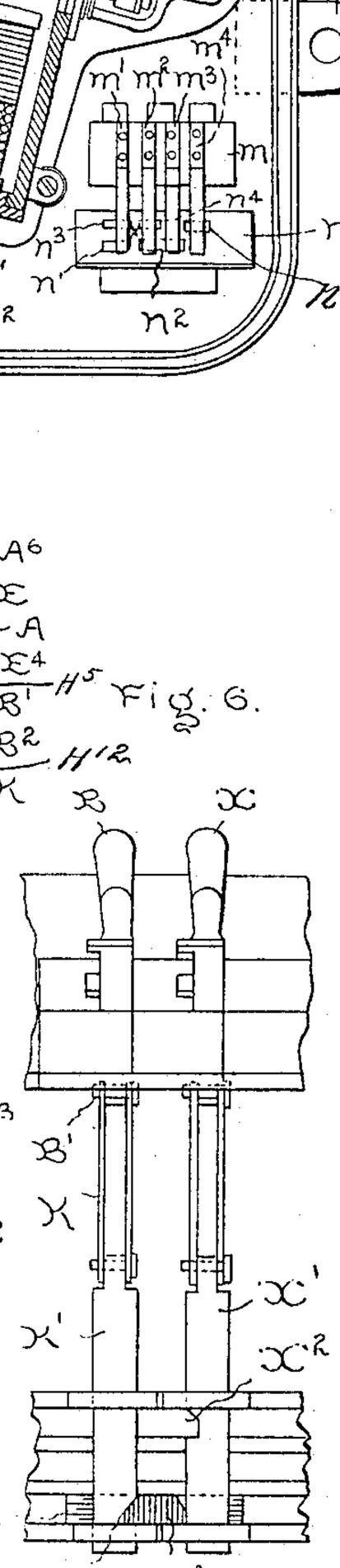

Fig. 6.

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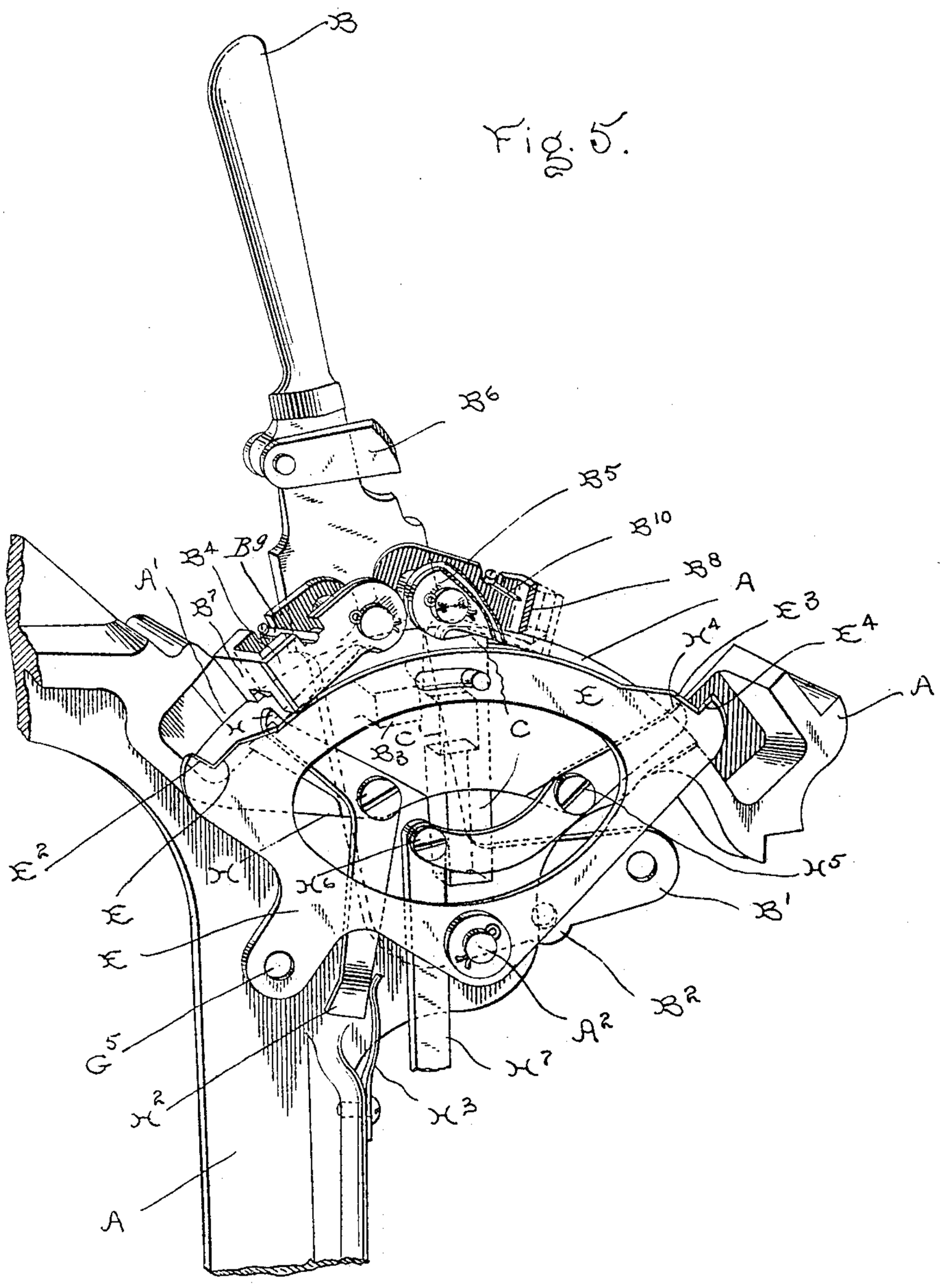
Fig. 5.



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6 SHEETS—SHEET 3.

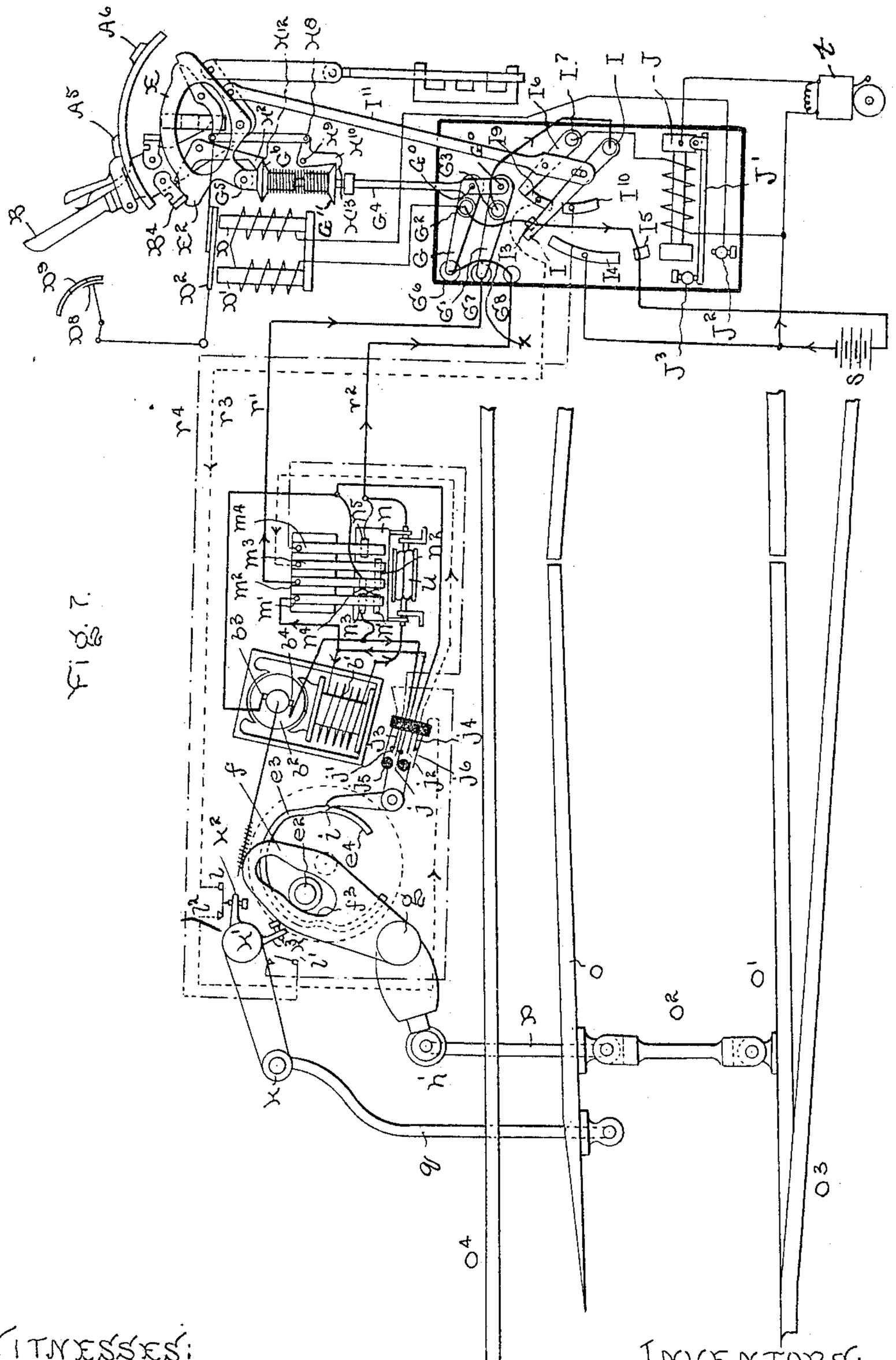

Fig. 2.

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6 SHEETS—SHEET 4.

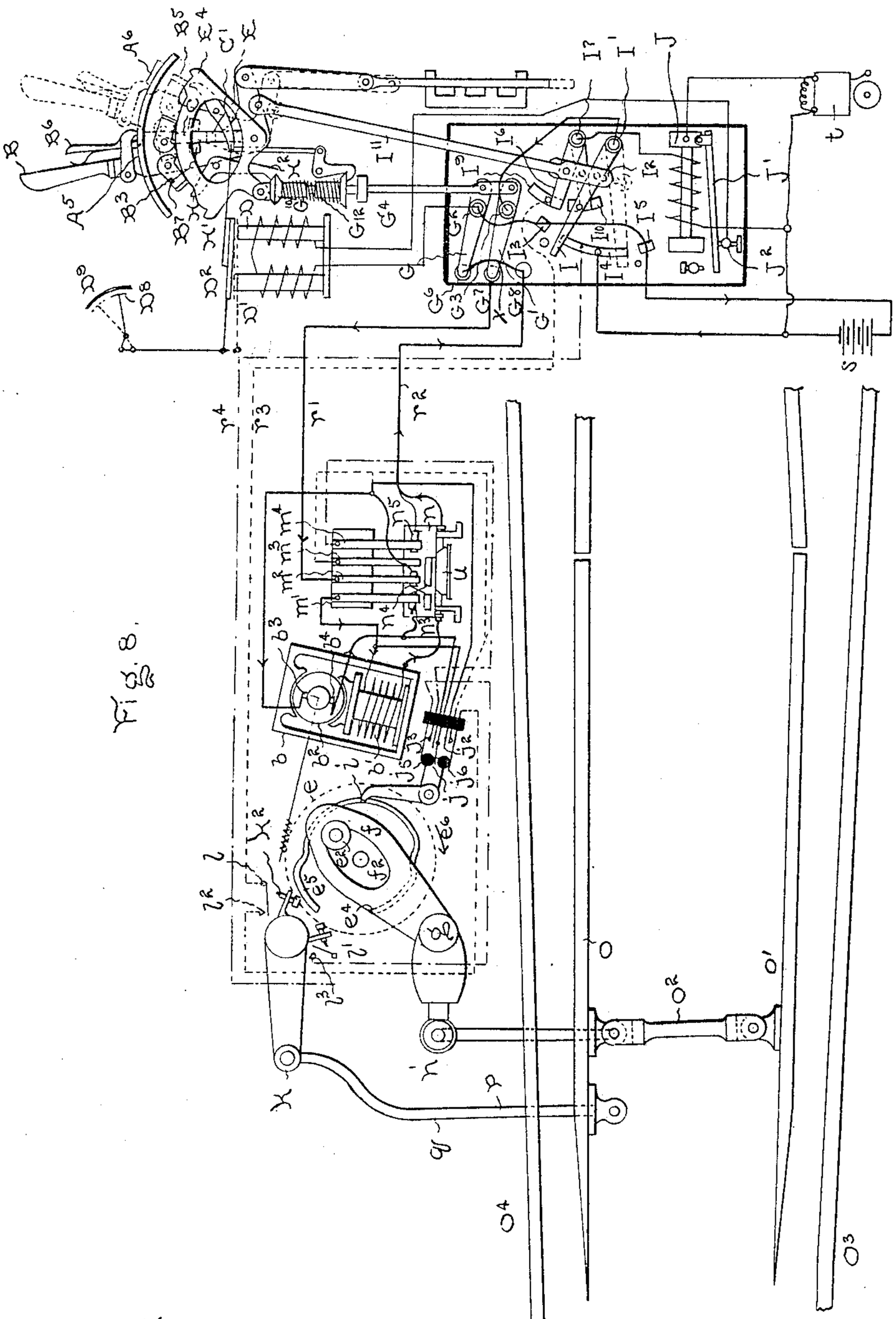

Fig. 8.

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6 SHEETS—SHEET 5.

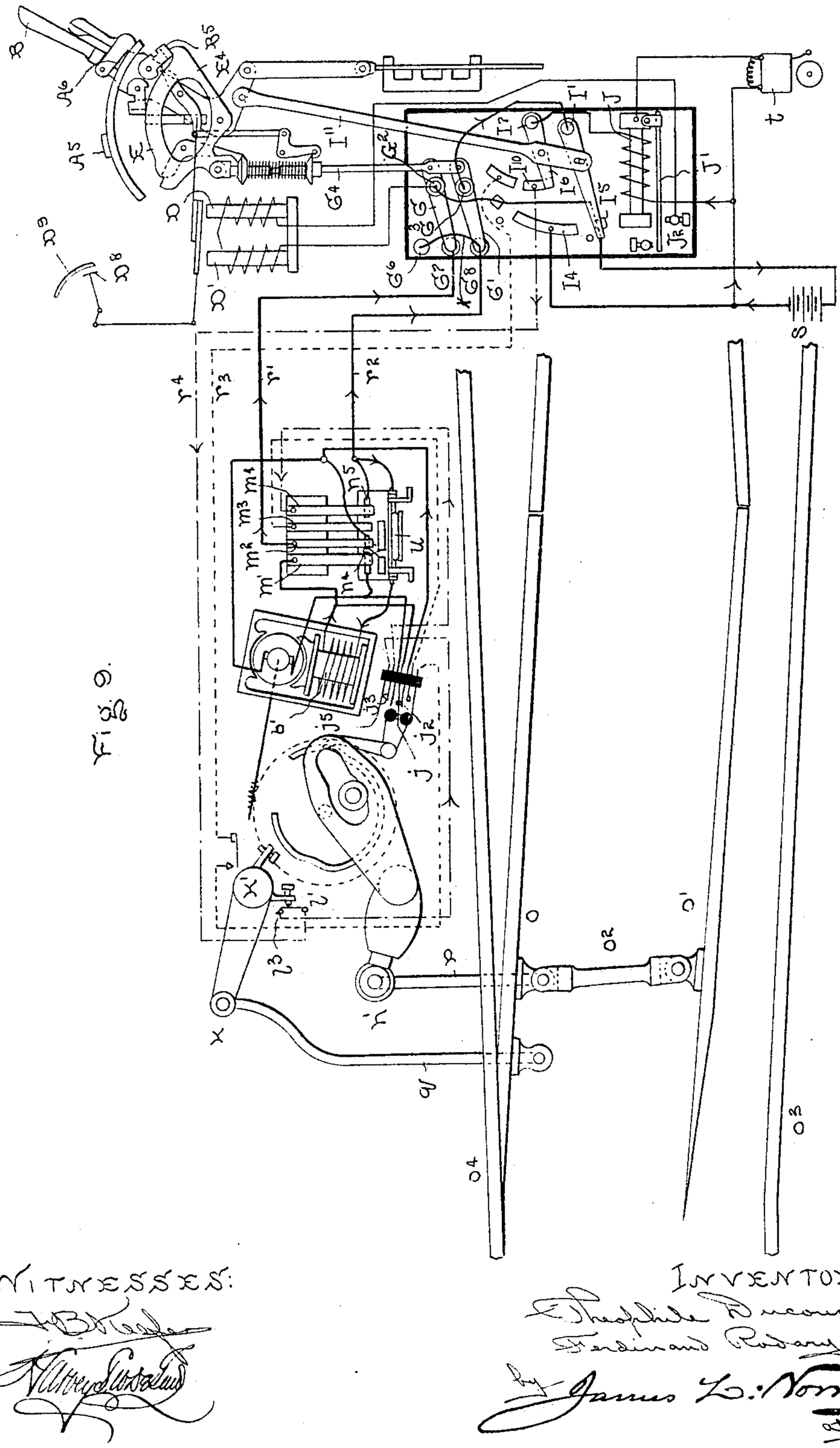

Fig. 6.

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6 SHEETS—SHEET 6.

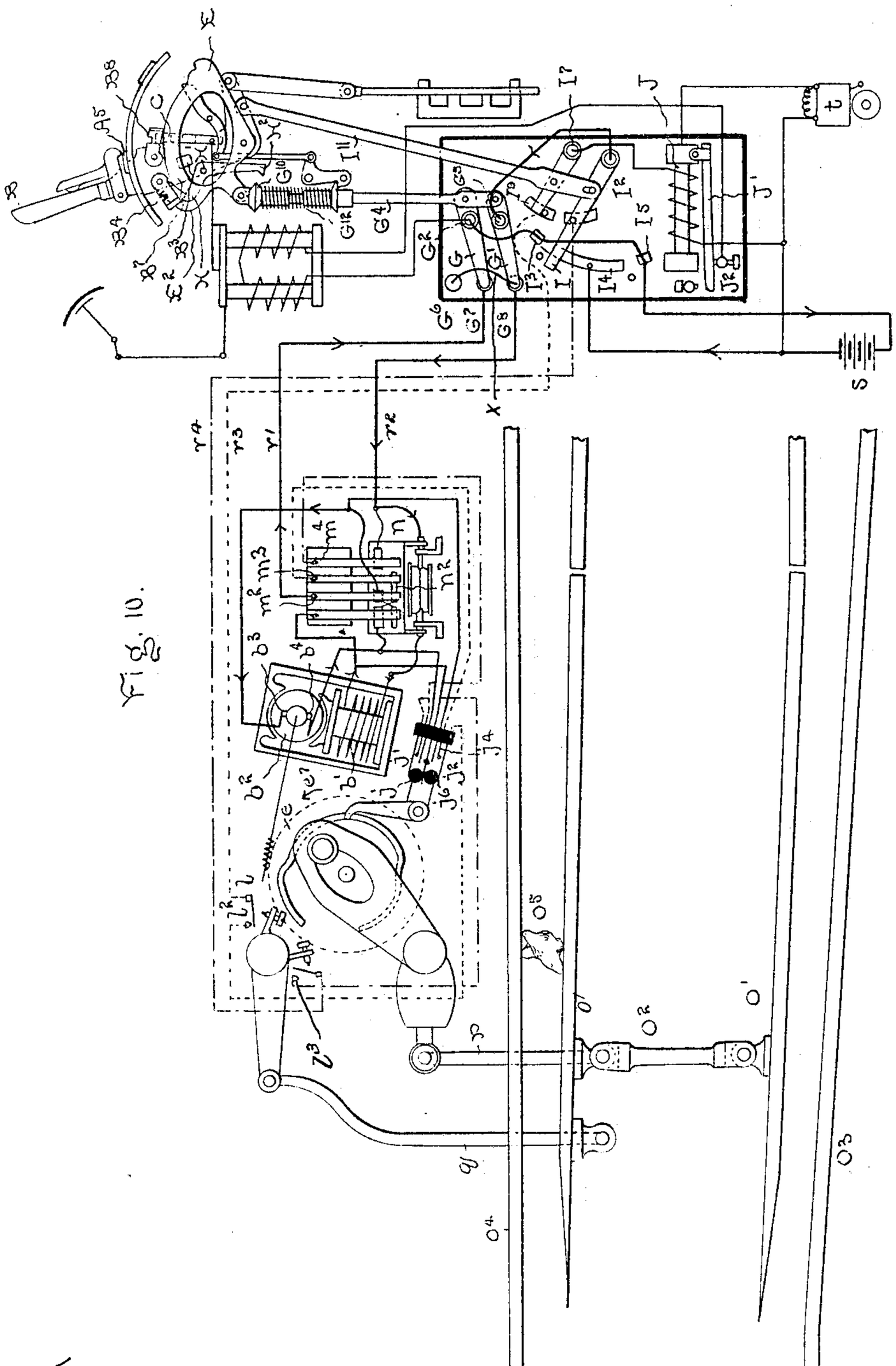

Fig. 10.

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THÉOPHILE DUCOUSSO AND FERDINAND RODARY, OF PARIS, FRANCE.

MEANS FOR OPERATING AND CONTROLLING RAILWAY-POINTS.

No. 801,655. Specification of Letters Patent. Patented Oct. 10, 1905.

Application filed March 12, 1901. Serial No. 50,858.

To all whom it may concern:

Be it known that we, THÉOPHILE DUCOUSSO, a resident of 219 Rue de Vaugirard, and FERDINAND RODARY, a resident of No. 53 Rue de Vaugirard, Paris, France, citizens of the Republic of France, have invented certain new and useful Improved Means for Operating and Controlling Railway-Points, of which the following is a specification.

Our invention relates to improvements in means for operating railway-switches electrically.

Our invention includes the combination of a transmitting apparatus and an operating mechanism electrically connected by wires and any desirable distance apart, in which the transmitting apparatus automatically checks the movements of the operating mechanism and in which the operating mechanism checks the movements of the transmitting apparatus, thus insuring the locking of the switches that are not visible to the operator at the transmitting apparatus.

Our invention, furthermore, includes the novel mechanisms by which these means are carried into effect.

The object of our invention is to provide the means by which railway switches or points may be operated electrically in such a manner that the operator may only make one operation at a time, and has automatic and visible checks by which he may know that such an operation has been completed; furthermore, the means for giving various alarms should the operating mechanism or the tracks connected with the instrument in his charge be tampered with or obstructed.

Accompanying this specification are the illustrations of the mechanisms by which these objects are carried out, in which—

Figure 1 is a plan view of the operating mechanism. Fig. 2 is a section of the distributing-switch u on a line formed by the inside of support u' of Fig. 3. Fig. 3 is a front elevation of the distributing-switch u, a part of the operating mechanism. Fig. 4 is a side elevation of the transmitting apparatus. Fig. 5 is a perspective side view of lever B and mechanism controlling its movement, a part of the transmitting apparatus, detents B^5 and B^8 broken, section-lined, and dotted in full to show their relation. Fig. 6 is a detail front elevation showing a plurality of transmitting-levers for controlling the operation of duplicate sets of mechanism. Figs. 7, 8, 9, and 10 are plans to show the general arrangement, the relative positions of mechanisms, and wiring diagrams indicating the direction of current in conductors at four possible positions of the levers and switches.

Referring to Fig. 1, our improved apparatus comprises a table or framing a, provided with supports a' and carrying at b a series electric motor, of which b' is the field-magnet, b^2 the armature, and b^3 b^4 the brushes. The motor-shaft is connected with the worm d through a coupling c, and the said worm gears with the wheel e. Said wheel is adapted to turn freely on its spindle e'. This wheel e carries at an eccentric point a roller e^2, which engages in the cam-like slot f' f^2 f^3 of a lever f, keyed upon a shaft g, upon which is likewise keyed a lever h, terminating in a threaded head h', which allows the length g h' of the lever to be adjusted. This combination of parts constitutes the apparatus for moving and locking the point.

The wheel e carries a concentric groove e^3, which is of medium radius, united at its extremities to other grooves e^4 e^5 of smaller and larger radius. This groove e^3 engages with a finger i of a lever i i^2, movable about a fixed axis i'. This lever carries two insulating-rollers i^3 i^4, situated between the springs j j^5 j^6, which are fitted in a suitable fixed insulating-support j^7, with respective contacts j' j^2 j^3 j^4. The springs j^5 j^6 are set in such manner as to make contact with their respective contact-bearings j^3 and j^4 if no obstacle is opposed thereto. This part constitutes a switch controlling the position of the roller-pin e^2, and thereby controlling the locking of the railway-switches and producing also the stoppage of the motor at the desired moment by short-circuiting the armature.

The apparatus also carries a lever k, keyed on a shaft k', carrying two arms with regulating-screws k^2 k^3. The extremities of these screws are fitted with insulated ends, and they are situated in the same plane as the springs l l' and their respective contacts or bearings l^2 l^3. These springs have an initial tension sufficient to keep them freely away from the contacts or bearings. This part constitutes the switch which controls the position of the switch-rails.

n is the distributing device, which is also shown in detail in Figs. 2 and 3. This distributer is moved by a polarized electromagnetic device formed, for example, of a double T-iron bobbin u, the spindle of which is adapted to turn freely in supports u', this bobbin

being placed in the fixed magnetic field of the magnets u^2 with their expanded pole-pieces u^3. The spindle of the bobbin is hollow and gives passage to the two insulated wires or extremities of the bobbin-winding. This spindle is rigidly connected to two arms u^4, upon which is fixed a piece n of wood or other insulating material provided with two series of metallic contacts n' n^2 and n^3 n^4 n^5. The contacts n' n^4 are electrically connected together, as are also n^2 and n^3. Further, flexible wires lead from these contacts, the connections of which wires will be described hereinafter. Upon these contacts rubbing springs m' m^2 m^3 m^4, fixed to an insulating-support m, are adapted to make contact. The bobbin u carries a finger u^5, which limits the angular travel by coming against the screws u^6 u^7. In combination with the short-circuiting switch for the armature the distributer n serves to make the required connections for determining the direction of rotation of the motor and providing for the stoppage of same. It therefore forms part of the means of control, as will be explained later.

The operation of the apparatus is as follows: Referring first to the distributer, in Fig. 2 the bobbin is maintained in the position shown by the constant action of the fixed magnetic field upon the bobbin u, which action operates in the direction of the arrow u^8. If a sufficiently strong electric current be sent into the said bobbin, the resultant action will depend upon the direction of this current. If the current passes in such direction as to turn the bobbin in the direction of the arrow u^8, the bobbin does not move, but is held securely in its position against the stop u^6. With a current of reverse direction the action is in the opposite direction to the arrow u^8 and the bobbin turns on its axis until it comes against the screw u^7. In its movement the bobbin carries with it the arms u^4 and the piece n, carrying the contacts. The result is that the springs m' m^2 m^3 m^4 are opposite the one or the other of the series of contacts n' n^2 or n^3 n^4 n^5, according to the direction of the current last sent through the bobbin u.

Referring now to the motor, the motor b (which is mechanically in rigid or driving connection with the worm d) is susceptible of three different states or conditions—namely, a state of rest, rotation to the right, and rotation to the left. In the first case the wheel e is locked by the worm. In the second case the wheel is driven by the worm and turns in the direction of the arrow e^6. In this movement the roller e^2, working in the slot f', moves the lever f from the position shown in full lines to that shown in dotted lines, the consequence of which is to produce a similar movement of the lever g h h' and, further, the operation of the lever i i'' i^2 in such manner that when the roller e^2 leaves the concentric portion f^3 and enters the straight portion f' of the lever f the finger i is at the commencement of the part e^3 of medium radius of the groove e^4 e^3 e^5, and consequently the three switch-springs j' j'^5 j'^6 are put by the rollers i^3 i^4 into an intermediate position, such that they do not touch their contacts. Matters remain in this state so long as the roller e^2 continues its movement in the straight slot f'. Then as soon as this roller enters the curved portion f^2 the motion of the finger i is deviated by reason of the deviation of the groove from e^3 to e^5, this bringing the rollers i^3 i^4 into the position shown in dotted lines, such that j' makes contact with j'^2 and j'^5 with j'^3. The part played by these sets of contacts will be explained later. The third state or condition of the motor—viz., rotation to the left—produces in an inverse direction all the effects just described—that is to say, the movement of all the parts from the position shown in dotted lines to that shown in full lines.

The action of the lever k k' will be further explained in describing the general operation.

Referring now to the transmitting apparatus, Figs. 4, 5, and 6, the transmitting apparatus placed in the signal-box or central station comprises a framing A with a table in the form of a segment of a circle A,′ at the center of which is a fixed spindle A^2 and covered by a piece A^3 with projections A^4 A^5 A^6. Pivoted upon the spindle A^2 on the back side of table A′ is the transmitting-lever B B′ B^2, with a lug B^3 toward the table A′ and hereinafter referred to, also two symmetrical sets of detents or catches. One set B^7 and B^8 are link-shaped, right and left handed, and pivoted on pins next to lever B, so as to slide along the surface of table A′. Detents B^7 and B^8 are provided with springs B^9 and B^{10}, the end of each of which bears on another detent B^4 and B^5 of similar outline, but flat and independently movable on the same pin. These slide along the top of and are adapted to engage with a plate E, hereinafter referred to. It is evident that though the detents are movable independently the detents B^4 and B^5 will raise detents B^7 and B^8 by means of the springs if not obstructed. A bolt C, movable vertically in the framing A, normally presents its upper end at the level of the table A′ and in the path of the grooved detents B^7 and B^8. This bolt is cut away at C′ at such a height that the lug B^3 of the transmitting-lever shall not be able to pass if the bolt is not raised, and, on the other hand, when the bolt is raised the lug B^3 can pass; but the detents B^7 and B^8, according to the direction of the movement, will be arrested by the projection of the bolt above the table A′. An electromagnet D D′, fixed to the framing A, has an armature D^2, which is supported upon one of the poles D, and this armature is prolonged by the lever D^3, which engages with the lower portion of the bolt and actuates same. When the electromagnet D D′ is excited, the bolt is raised.

When this electromagnet is not excited, the weight of the bolt causes it to descend and draws the armature away from the pole D′. Thus the electromagnet D D′ controls the lever B by allowing or preventing its movements. The armature D^2 is also prolonged by a rod D^4, connected by the rod D^5 to a small lever D^6 D^8, pivoted at D^7 and carrying at D^8 an indicator which is adapted to appear opposite a window D^9 when the electromagnet is excited. A plate E is applied against the framing A and is adapted to move about the spindle A^2. This plate has the same circular form as the table A′; but it carries at its extremities projections E′ E^3 and teeth E^2 E^4. The framing A carries an insulating-plate F, which supports a reversing-switch formed of two metal arms G G′, movable about the spindles pivoted at G^2 and G^3, fixed on the plate F and actuated by the connecting-rod G^4 by means of electrically-insulated pins G^0. This connecting-rod is pivoted at G^5 to the plate E. The arms G G′ are arranged to make contact with the contact studs or bosses G^6 G^7 G^8, according to their position. To the connecting-rod G^4 is fixed a ring G^9, and, further, two collars G^{10} and G^{11} are mounted freely upon this connecting-rod between the ring G^9 and the pivoted joint G^5. Between these collars is a strongly-compressed helical spring G^{12}, which tends to force the said collars apart; but they are retained by catches H^{12} H^{13}. The catch H^{12} is formed by the end of a lever H H′ H^2, Fig. 5, pivoted at H′ and pressed by the spring H^3, so as to hold the collar G^{10} in place, while the lever H^4 H^6 is pivoted at H^5 to a fixed point of the framing A and at H^6 to a connecting-rod H^7, itself jointed at H^8 to a detent H^8 H^9 H^{10}, pivoted at H^9 and pressed by the spring H^{11}, holding the collar G^{11} in place by the catch H^{13}, formed by the end of the part H^{10}. The extremities H and H^4 of the said levers project above the circular table A′ to a less extent than the projection E′ E^3 of the plate E. These said extremities, moreover, pass behind the plate E and into the path of the detents B^7 B^8 while the plate E is itself in the path of the detents B^4 B^5. The movement of the reversing-switch G G′ is in one with that of the plate E, which is actuated directly by the detents B^4 B^5 during the movement of the lever B, while the switch G G′ may be independently operated by the action of the spring G^{12} when one of the levers H or H^4 is actuated by the detents B^7 or B^8. The insulating-plate F carries also a switch I, pivoted at I′ to the said plate and jointed at I^2 to a connecting-rod I^{11} by a suitably-insulated pin I^{12}. This switch has three contact surfaces or bearings I^3 I^4 I^5. Another switch I^6 is pivoted to the fixed point I^7 and is jointed to the connecting-rod I^{11} by a suitably-insulated pin I^{13}. It has two contact surfaces or bearings I^9 I^{10}. The connecting-rod I^{11} is jointed at B^2 to the transmitting-lever.

The plate F also carries a relay J of very great resistance, the armature J′ of which is adapted to return by its own weight against the stop J^2, while the relay when excited brings the armature against the stop J^3.

The transmitting-lever is jointed at B′ by a rod K to a bar K′, passing into the locking-table L. The object of the locking-table is to prevent the possibility of moving the lever B to the position occupied by another analogous lever, such as X, Fig. 6, commanding another switch. Thus in Fig. 6 the bar K′ has a groove or slot K^2, into which enters the block K^4 of a bar K^3, sliding at right angles to the first-mentioned bar, the said block bearing against the bar X′ of the other lever, which bar X′ has a corresponding groove or slot at X^2—that is to say, at a position such that it would be necessary to first completely move this lever X to bring the groove X^2 opposite the block K^4 and permit the movement of the lever B. Now it will be hereinafter seen in the course of this description that in consequence of the arrangements of our system the lever B can never occupy a position which is not in accordance with the actual position of the corresponding point or switch and that in particular this lever B cannot be put over to the full extent unless the point or switch itself has entirely assumed the desired position.

The complete installation of an apparatus coupled up with a switch is shown diagrammatically in Fig. 7, as well as that of the corresponding transmitting-lever. The two switch-rails are at *o* and *o′* connected by the tie o^2. The rails are at o^3 and o^4. A connecting-bar *p* or operating-bar connects the lever *g h′* with the joint of the tie. This is the mode of rigid connection; but in certain cases where it is required that the switch-rail should be able to yield and where an intermediate spring device is employed the bar *p* is connected to the said spring apparatus. In all cases one of the switch-rails *o* is connected to the lever *k k′* by a connecting-bar or controlling-bar *q*. The transmitting-lever is connected by four insulated conductors with the switch apparatus. Two of these conductors *r′* r^2 (indicated in heavy lines) constitute the electric transmission-circuit acting upon the motor. The two other conductors r^3 r^4 (shown in dotted lines) each form in combination with the first-named a circuit for controlling the operation of the switch-rails and of various other parts of the apparatus.

At the transmitting-station the electricity is furnished by a battery of accumulators *s* or other source of continuous current, one pole being connected to the contact-surface I^4 and to the coil of the relay J, the other end of said coil being connected to the contact I^7. The same pole is also connected, through a shunted tremulous bell *t*, to the body of the relay J, and consequently to its armature J′. The second pole of the battery *s* is connected to the con-

tact-surfaces $I^5 I^3$, to the center G^2, and through the electromagnet D D′ to the stop or bearing J^2. The centers G^3 and I′ are connected together. The line-wires $r' r^2$ are connected, respectively, with the contacts G^7 and G^8. The contacts G^6 and G^8 are electrically connected together by the wire x. The controlling-wires $r^3 r^4$ are connected, respectively, to I^9 and I^{10}. In the switch apparatus the line-wire r' is connected to the rubbing contact m^2, the line-wire r^2 to the contact n^5 and through the bobbin u of the distributer to the field-magnet b' of the motor. The other end of the field-magnet coils is connected to the spring j and with the contact m'. The brush b^3 is connected to the contacts $n^4 n'$ and with the contact-bearing j^2. The other brush b^4 is connected to the contact-bearing j' and with the contacts $n^3 n^2$. The controlling-wire r^3 is connected to the spring l, the contact-bearing l^2 to the spring j^6, and the contact-bearing j^4 to the rubbing contact m^3. The controlling-wire r^4 is connected to the spring l', the contact-bearing l^3 to the spring j^5, and the contact-bearing j^3 to the rubbing contact m^4.

Figs. 7, 8, 9, 10 will serve for illustrating the operation. Fig. 7 shows the whole apparatus in its normal position with the switch-rail o' applied against the rail o^3 for, say, trains to pass on the main line. Fig. 8 shows the position of the parts during the movement of the point-rail o from its normal position. Fig. 9 shows the switch-rail o set for the passage of trains to the branch line. Fig. 10 shows the case where an obstacle prevents the entire movement of the switch-rail.

We will first follow Fig. 7. In this condition a current (indicated by the arrows) passes from the battery s through the relay J, the switch $I^7 I^9$, the line r^3, the contact $l l^2$, governed by the point-rail o, the contact $j^6 j^4$, governed by the position of the roller e^2, the rubbing contact m^3, the contact n^2, and here the current divides into two portions, the one going through the rubbing contact m^2, the line r', the switches $G^7 G^3 I' I^3$ to the other pole of the battery, the other portion from the contact n^2 to n^3, through the contact $j'' j$, the motor-magnet b', the bobbin u, the wire r^2, and by $g^8 g^6 g^2$ to the other pole. The relay J is excited, and its armature is moved away from the bearing J^2. The switch-rail o' is kept locked in this position by the presence of the roller e^2 in the curved portion f^3 of the lever f. If during this condition of things an external force capable of distorting the bar p (or of overcoming the spring device if the switch is provided therewith) is applied to the point-rail o' and causes same to move away from the corresponding rail o^3, the mechanical combination of $o' o^2 o$ with the bar g and the lever $k k'$ transmits the movement to the interrupter $l l^2$, the contact of $l l^2$ is broken, and the current no longer passing in the relay J the armature J′ falls back by its own weight upon the bearing J^2. At this moment the current of the battery passes through the bell t to the body of the relay J and by J′ J^2 through the electromagnet D D′ and returns to the other pole of the battery. The bell t operates, and at the same time the electromagnet D D′ being attracted causes the indicator D^8 to appear in the window D^9. The person in charge of the signal-box or central station is thus warned when the switch is half-open.

To move the switch-rails so as to close the main-line track and to open the branch track, the lever B is put over from the position Fig. 7 to the position shown in full lines, Fig. 8, in front of the projection A^5. In this movement the said lever B brings the switch I from I^3 upon I^4, the switch I^6 resting on I^9. At the first moment the lever B cannot be put farther forward, because the lug B^3 bears against the bolt C; but as soon as it is in the said position the current of the battery s passes through the switches I^4 I I′ G^3 G^7, the line r', and then (the switch apparatus being still in the position shown in Fig. 7) by the rubbing contact m^2, the contacts $n^2 n^3$, the contact $j' j$, the field-magnet coils b', the bobbin u of the distributer, and returns by the wire r^2, the contact bosses or studs $g^8 g^6$, the switch g^2 to the other pole of the battery. Then the current passing through the bobbin u causes it to move the distributer n into the position indicated, Fig. 8. In this condition the current (indicated by the arrows, Fig. 8) passes from the rubbing contact m^2 by the contact n^4 to the brush b^3, through the armature, the brush b^4, the contact n^3, and the rubber m', the exciting coil or inductor b', the bobbin u, and, as before, to the battery, and causes the motor b to turn to the right, this causing the turning of the wheel e in the direction of the arrow e^6. The roller e^2 in its turn communicates motion to the lever f, which through the medium of the lever $g h'$ and the bar p moves the switch toward the rail o^4. It must be remarked that at the commencement of the rotation of the wheel e, starting from the position Fig. 7, the finger i is guided by the small radius-groove e^4 into the part e^3 of medium radius. The insulating-rollers thus put the springs j, j^5, and j^6 into an intermediate position, where they are out of contact. On the other hand, as soon as the movement of the switch commences the bar q, acting upon the lever $k k'$, moves the screw k^2 from the spring l, and this latter interrupts the contact $l l^2$. The distributer n itself in passing from the position Fig. 7 to the position Fig. 8 has insulated the rubbing contacts m^3. Consequently from this moment the controlling-current, which we have indicated by arrows, Fig. 7, has ceased to pass through the relay J. The armature J′ has fallen upon the contact J^2, thus closing the battery-current through the tremulous bell t, which operates the electromagnet D D′. The

armature D^2 of this electromagnet is attracted and the bolt C is raised and presents the slot or groove C′ for the passage of the lug B^3. The lever B can then be pushed farther forward, as far as the position shown in dotted lines, Fig. 8, where its catch B^7 is arrested by the bolt C, projecting above the table A′. In passing from the position shown in full lines to that shown in dotted lines, Fig. 8, the only change produced by the lever B has been to carry the switch I^6 from I^9 on to I^{10}. The handle B^6, with which the lever B is provided, in striking the stops or projections A^5 A^6, limits the stopping-points corresponding to these two positions in a manner which is felt by the hand of the operator. The lever B cannot be put over farther than the position shown in dotted lines so long as the bolt C remains raised; but as soon as the complete movement of the switch has taken place, the contact l' l^3 is first established, and then the contact j^5 j^3 as soon as the finger i enters the curve e^5, this corresponding to the entrance of the roller e^2 into the concentric portion f^2 of the lever f. At this moment the controlling-current passes from the battery s through the relay J, the switch I^7 I^{10}, the wire r^4, the contacts l' and l^3, j^5 and j^3, the rubbing contact m^4, the contact n^5, and the wire r^2, the contact boxes or studs G^8 G^6, and returns by G^2 to the other pole. The controlling-circuit is thus completed and the relay J is excited, breaking the contact J′ J^2 and stopping the bell t; but a very short time after the closing of the contact j^5 j^3 the contact j j^2 closes also, placing in short circuit the armature of the motor by way of the brush b^3 to the spring j^2, through j to the rubbing contact m', and by the contact n^3 to the brush b^4. The brake is thus applied to the motor, which stops before the roller e^2 arrives at the bottom of the slot f^2. As soon as the relay J is excited, as we have seen above, the electromagnets D D′ are cut out of circuit and demagnetized. The bolt C then falls by reason of its weight until it is level with the table A′ and no longer presents an obstacle to the passage of the detent B^7, but would present an obstacle to the lug B^3 if it were desired to move back the lever B. The lever B can therefore only be put over to the end of its throw from the dotted position Fig. 8 to the position shown in Fig. 9. Simultaneously with this final movement the switch I and the reversing-switch G G′ are moved. In fact, the first-named is moved by the connecting-rod I^{11} from I^4 onto I^5, while the arm or plate G passes from the contact G^6 to the stud G^7, and the arm or plate G′ passes from the contact-stud G^7 to the contact-stud G^8, because the plate E is moved, by reason of the detent B^5 striking against the tooth E^4 and carrying with it the connecting-rod G^4. The switch I^6 remains upon the contact I^{10}. We would remark that this final movement of the lever B to the position Fig. 9 can only be accomplished when all the contacts of the controlling-circuit have been closed in consequence of the complete movement and locking of the switch itself. The positions being as shown in Fig. 9—that is to say, the switch set and locked for the branch or siding track and the lever B in the corresponding position—the controlling-circuit is as follows: from the battery s, through the relay J, which is excited, by I^7 I^{10} to the wire r^4, to the contact l' l^3, thence to j^5 j^3 to the rubbing contact m^4, to the contact n^5, and from here in two portions, the one passing by the wire r^2 to the contact G^8 into G^3 and by I′ I^5 to the other pole, the other portion passing from the contact n^5 through the bobbin u, the exciting-coil b' j j^2, the contact n^4, the rubbing contact m^2, and the wire r' to the other pole. Any rupture of one of the contacts mentioned which may be caused by an external action acting to displace the switch-rail will, as we have already explained with reference to the normal position, cause the ringing of the bell t and the appearance of the indicator D^8.

Returning to Fig. 8, which shows the position of parts when the motor is turning and moving the switch, we will suppose that an obstacle placed between the point o and the rail o^4 prevents the complete movement. Under these circumstances the motor stops if it is not powerful enough to crush the said obstacle and the contact l' l^3 is not made. The operator cannot therefore put the lever B over to the full extent of its throw, and this tells him that the point is not entirely set. He can then put back the switch to its initial position by reversing the direction of the motor. This we have indicated in Fig. 10, where there is shown the obstacle o^5, which prevents the closing of the switch. It is only necessary to put back the lever B as far as the top of the projection A^5—that is to say, toward its initial position. In this movement the detent B^7 comes against the end H of the lever H H′ H^2 and pushes same, this freeing the collar G^{10} from H^2. The spring G^{12} at once expands, pushing back this collar, which suddenly moves the connecting-rod G^4 and with it the reversing-switch G G′. The lever B is moreover arrested in the position shown, Fig. 10, by the bolt C, which locks the detent B^8. The connecting-rod G^4 has in its upward movement moved the plate E, and the projection E′ of this plate has raised the detent B^4, while the detent B^7 remains supported by the thrust of the lever H H′ H^2. The lever B is then bent slightly back to the bottom of the projection A^5, and at this movement the detent B^7 is raised by the spring B^9. In these short movements the connecting-rod I^{11} does not move the switch I, this being due to the play which is provided at its joint at I^2 by means of a slot giving a suitable delay in the transmission at the moment when this changes in direction. The arms or plates

G G′ of the reversing-switch upon coming onto the contacts G^7 and G^8 reverse the direction of the current in the transmission-circuit. The distributer *n* moves, and assuming the position shown, Fig. 10, modifies the communications in such manner that the current traverses the exciting-coil *b′* in the reverse direction and the armature b^2 in the same direction as previously; also, the motor begins to turn to the left, driving the wheel *e* in the direction of the arrow e^7. Further, the distributer insulates the rubber m^4 and puts the contact n^2 in contact with the rubber m^3. Consequently as soon as the switch-rail *o′* is entirely applied against the rail o^3 then, and only then, the contact $l\ l^2$ is made, and then the contact $j^6 j^4$, both in the controlling-circuit, and, finally, the contact $j\ j'$, which puts the armature in short circuit to brake and stop the motor. At this moment the controlling-circuit is complete, the current passes from the battery *s* through the relay J, which it excites, the switch $I^7\ I^9$, the wire r^3, the contacts $l\ l^2$ and $j^6 j^4$, the rubbing contact m^3, the contact n^2, the rubbing contact m^2, the wire *r′*, and by $G^7\ G^2$ to the other pole. The relay J being excited, the electromagnet D D′ is no longer excited and allows the bolt C to fall. This allows the lever B to be pushed to the end of its throw into its normal position behind the projection A^5, but not in the other direction, the lug B^3 and the bolt C presenting an obstacle to this movement, all things being now as they were described in referring to Fig. 7. In the movement—that is to say, in moving the lever B from the position Fig. 10 to that of Fig. 7—the detent B^4 acts against the tooth E^2 of the plate E to bring the reverser G G′ back upon the contacts $G^6\ G^7$ by means of the connecting-rod G^4. By the same operation the collar G^{10} is again brought into engagement under the end H^2 of the lever H H′ H^2. Simultaneously the connecting-rod I^{11} moves the switch I and I^6 to the end of their throw or travel.

In consequence of the symmetry of the different parts and sets of contacts the movement of the switch-rails from branch or siding track to the main-line track—that is to say, from the position Fig. 9 to the position Fig. 7—is effected in an entirely analogous manner to that which we have described for moving the switch-rails from the main-line track to the branch or siding track.

We would remark that the controlling-circuit comprising the relay J always comprises a contact $I^7\ I^9$ or $I^7\ I^{10}$, depending on the position of the transmitting-lever, a corresponding line-wire r^3 or r^4, according to the position, and in the switch apparatus a series of three contacts—viz., $l\ l^2$ or $l'\ l^3$, governed by the position of the switch; $j^6\ j^4$ or $j^5\ j^3$, governed by the presence of the roller e^2 in the concentric locking-curve f^2 or f^3; $m^3\ m^2$ or $m^4\ n^5$, governed by the distributer. Consequently the operation of the controlling-circuit is governed by the fact of the position of the operating-handle agreeing or being in harmony with the position of the switch-rails and its being locked in this position and also with the position or adjustment of the distributer, all being conditions which tend to insure safety.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In electrically-controlled operating mechanism for railway-switches, the combination with the switch-rails and a reversible electric motor operatively connected therewith, of an electric generator, transmitting mechanism, comprising a current-reversing electric switch for reversing the current through the transmitting mechanism and a transmitting-lever for actuating said switch, a circuit from said generator including said switch and said motor, a distributing-switch included in said circuit and controlled by the current-flow in said circuit, and a switch also included in said circuit actuated by said motor and acting to short-circuit the motor-armature and thereby throw said motor out of operation.

2. In electrically-controlled operating mechanism for railway-switches, the combination with the switch-rails and a reversible electric motor operatively connected therewith, of an electric generator, transmitting mechanism comprising a current-reversing electric switch for reversing the current through the transmitting mechanism, a transmitting-lever for operating said switch, a relay and a signaling device, a circuit from said generator including said switch and said motor, a shunt including said signaling device and controlled by the armature of said relay, a distributing-switch included in the main circuit and controlled by the current-flow therein, and a switch also included in said circuit, actuated by said motor and acting to short-circuit the motor-armature and thereby throw said motor out of operation.

3. In electrically-controlled operating mechanism for railway-switches, the combination of transmitting mechanism and a distributing-switch, an electric motor operatively connected to the switch-rails, the said motor being controlled by said switch and hand-operated transmitting apparatus electrically connected to said motor through said switch, the said apparatus comprising a lever B, having a lug B^3 thereon, a bolt C locking with said lug, an electromagnet for actuating said bolt, and detents B^4, B^5, $B^7\ B^8$ carried by said lever, and also locking with said bolt, substantially as described.

4. In electrically-controlled operating mechanism for railway-switches, the combination of a distributing-switch, an electric motor controlled by said switch and operatively connected to the switch-rails, and hand-operated transmitting apparatus electrically connected

with said motor through said switch, the same comprising a lever B having detents B^4 B^5 B^7 and b^8 thereon, a switch I, a locking device K, and an arm B^2 B′ connected to said lever and to both said switch I and said locking device, substantially as described.

5. In electrically-controlled operating mechanism for railway-switches, the combination of a distributing-switch, an electric motor operatively connected to the switch-rails, and hand-operated transmitting apparatus electrically connected with said motor through said switch, the same comprising a lever B having detents B^4 B^5 B^7 B^8, a bolt C for locking said lever, catch-levers H^{12} and H^{13} for the purpose set forth, a plate E and a switch G, the said detents coöperating with said catch-levers to release them, substantially as described.

6. In electrically-controlled operating mechanism for railway-switches, the combination with switch-rails, and a reversible electric motor operatively connected with said switch-rails; of an electric generator, transmitting mechanism comprising a current-reversing electric switch for controlling the passage of the current through said transmitting mechanism, means for operating said switch, a relay and a signaling device, a circuit from said generator, including said switch and said motor, a shunt including said signaling device and controlled by the armature of said relay, a distributing-switch included in the main circuit and controlled by the direction of current-flow therein, and a switch also included in said circuit actuated by said motor and serving to short-circuit the motor-armature and thereby throw said motor out of operation.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

THÉOPHILE DUCOUSSO.
FERDINAND RODARY.

Witnesses:
EMILE MOTTU,
WERNER HILDEBRAND.