(No Model.) 4 Sheets—Sheet 1.

W. C. CRANDELL, Jr.

APPARATUS FOR AUTOMATICALLY STOPPING RAILWAY TRAINS.

No. 275,599. Patented Apr. 10, 1883.

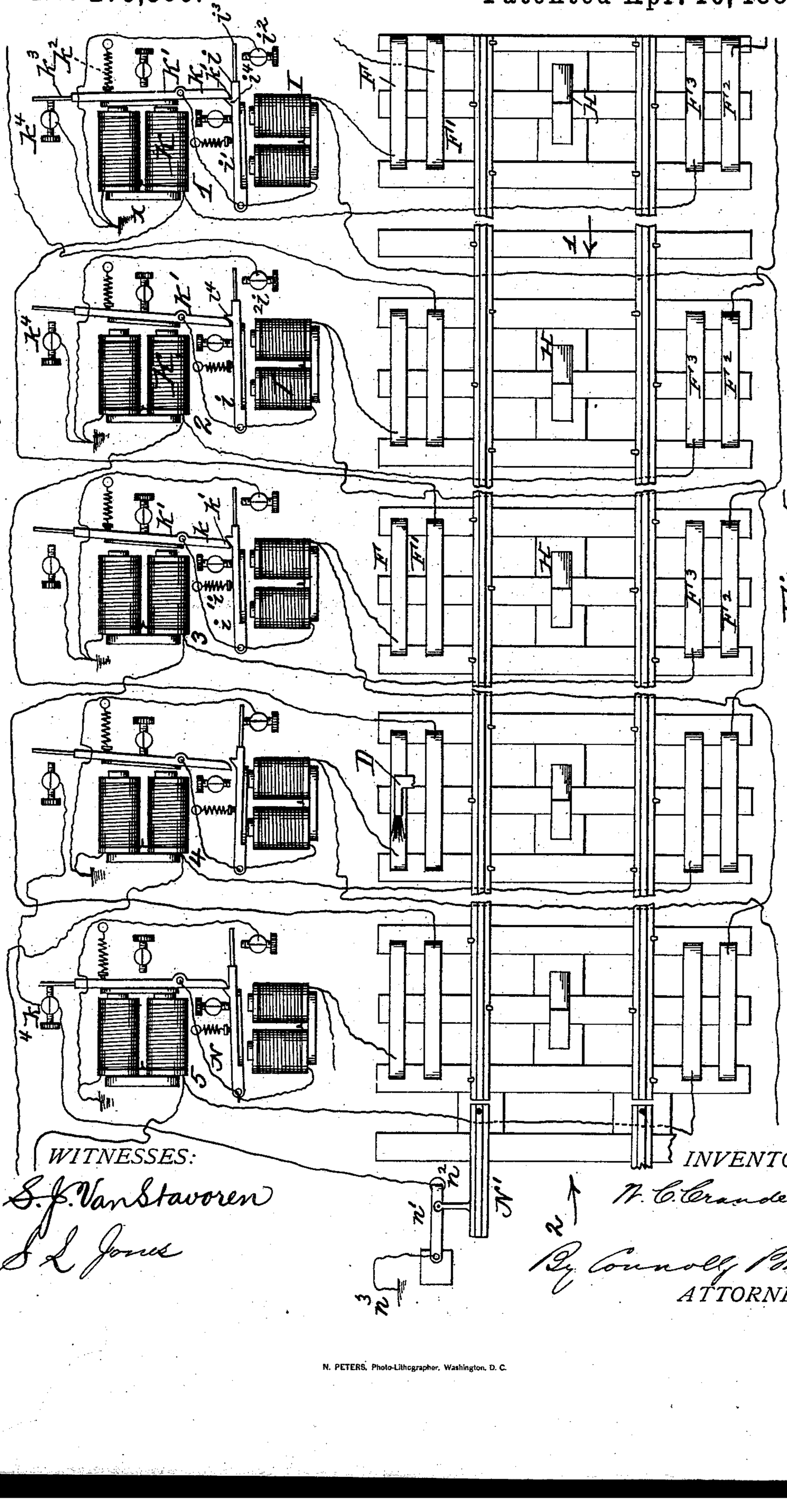

FIG. 1.

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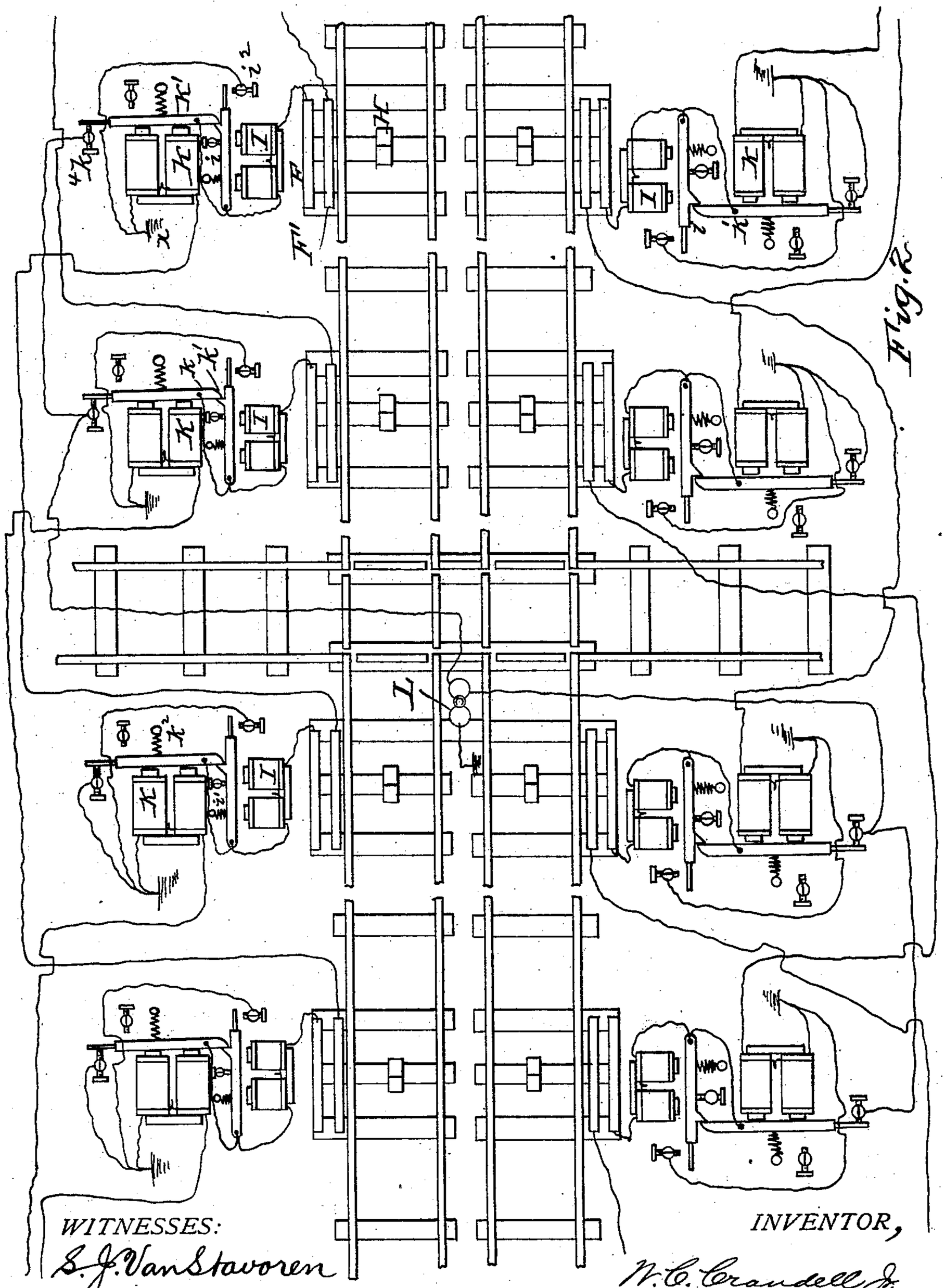

Fig. 2.

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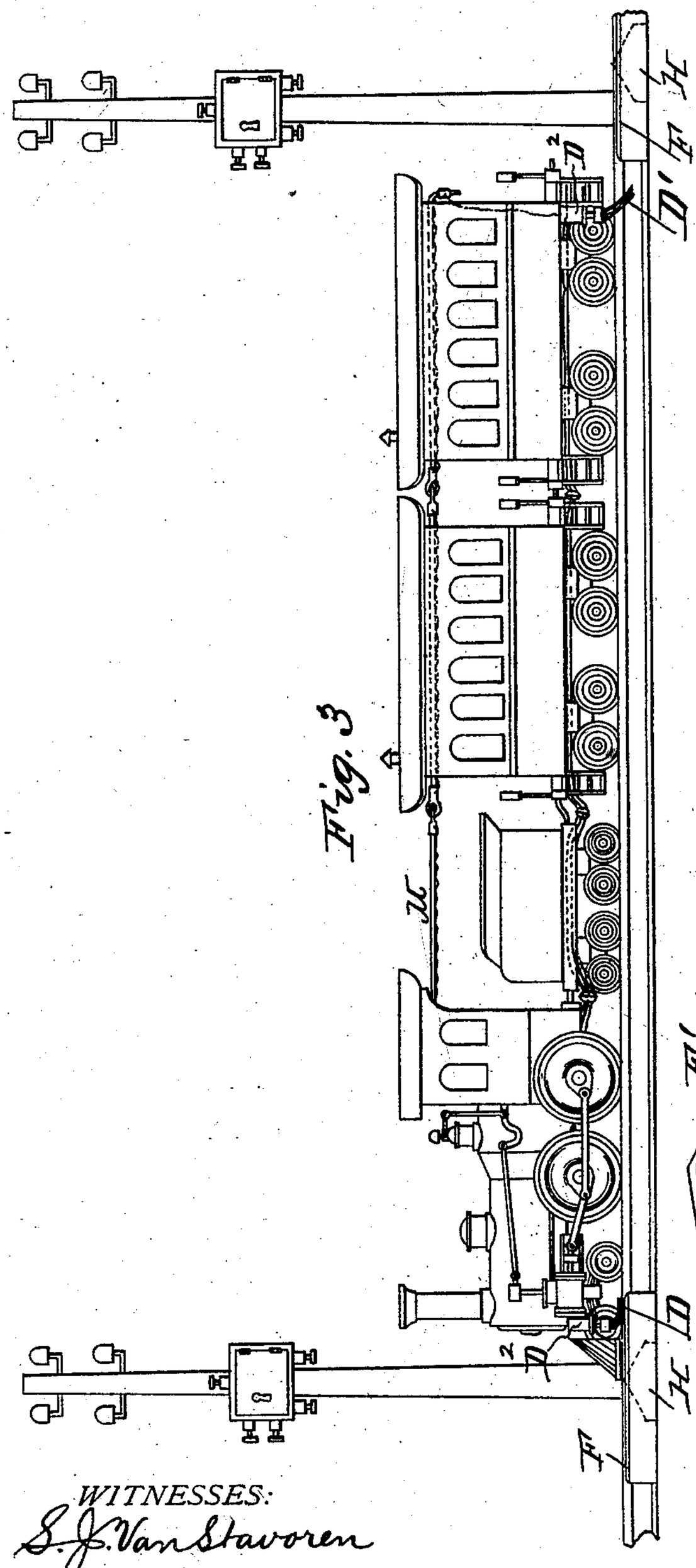

Fig. 3

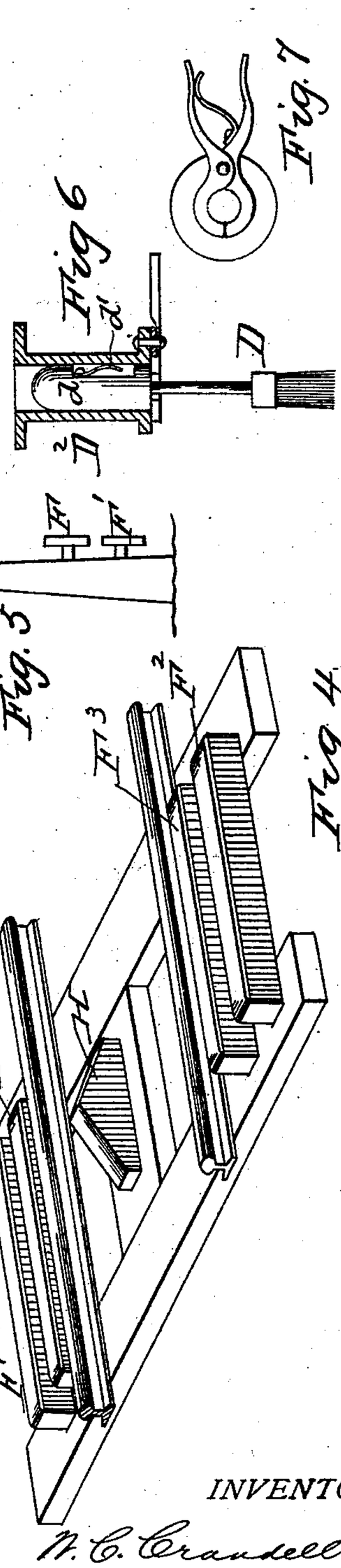

Fig. 6

Fig. 7

Fig. 5

Fig. 4

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Fig. 8

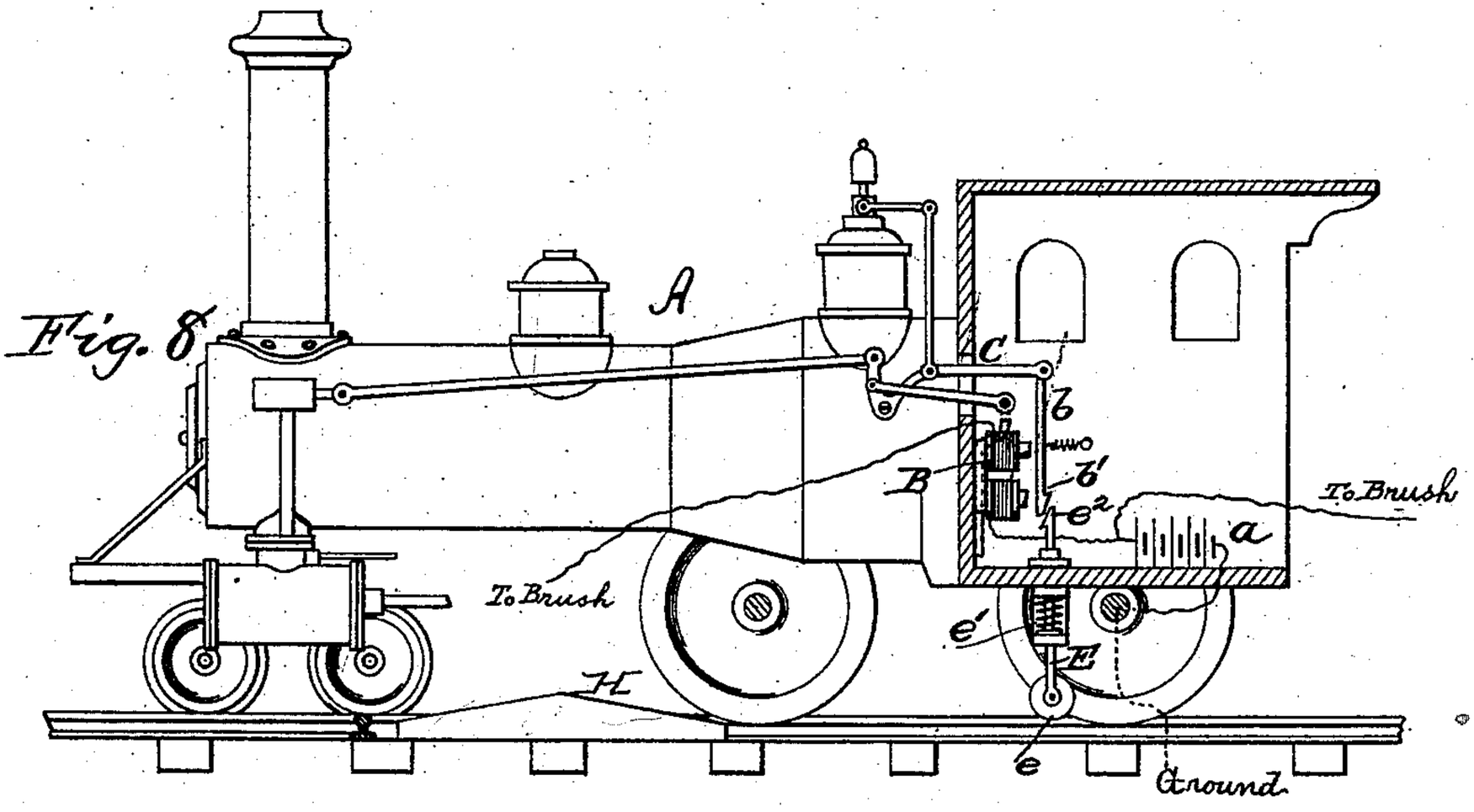


Fig. 9

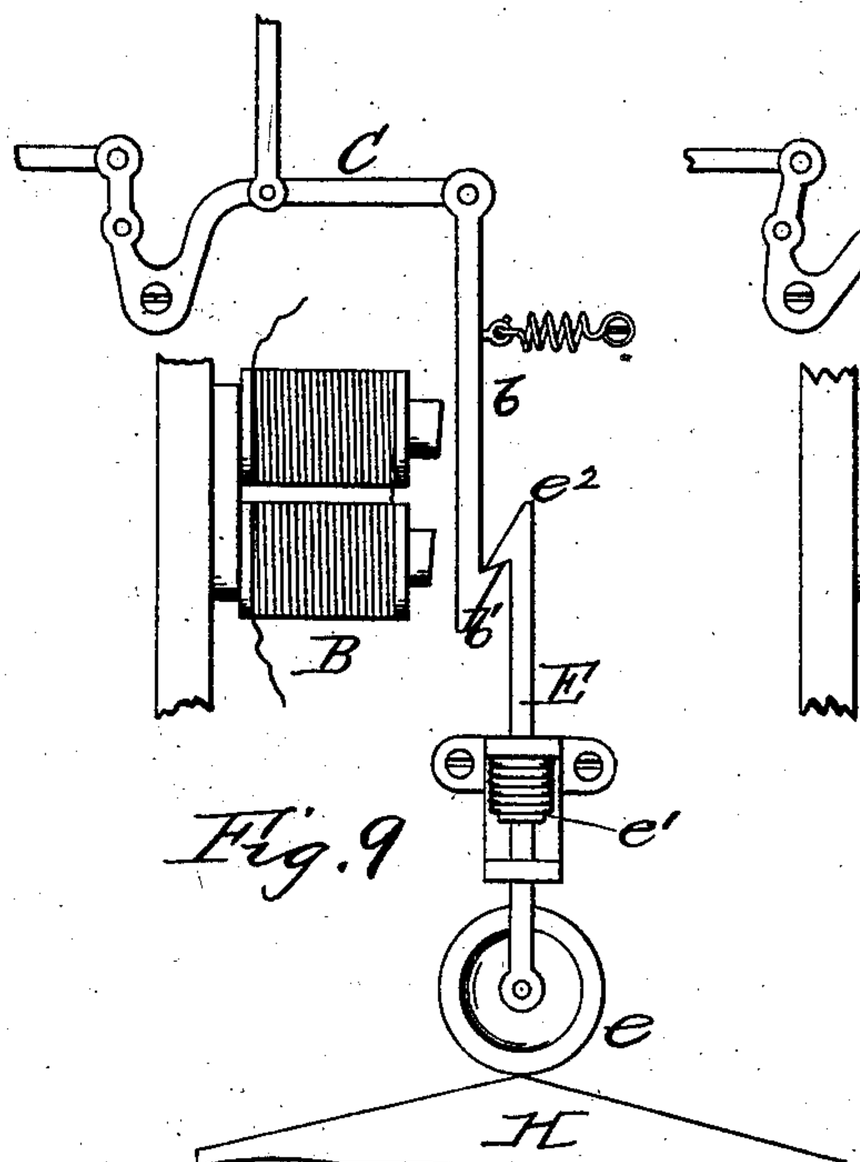


Fig. 10

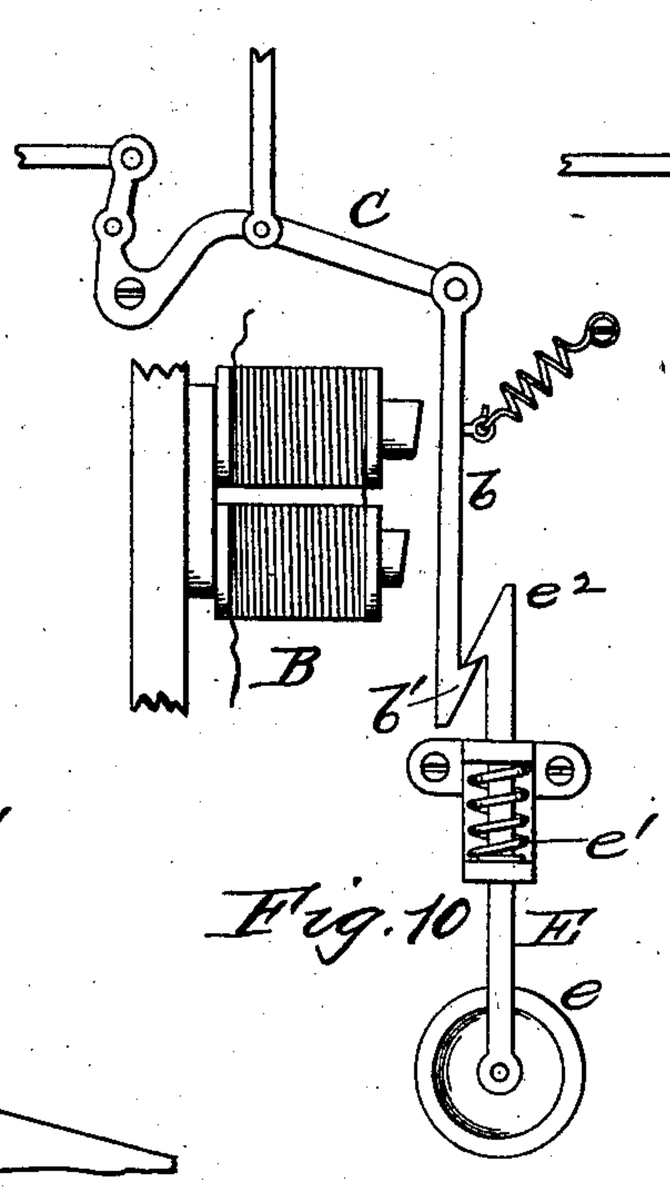
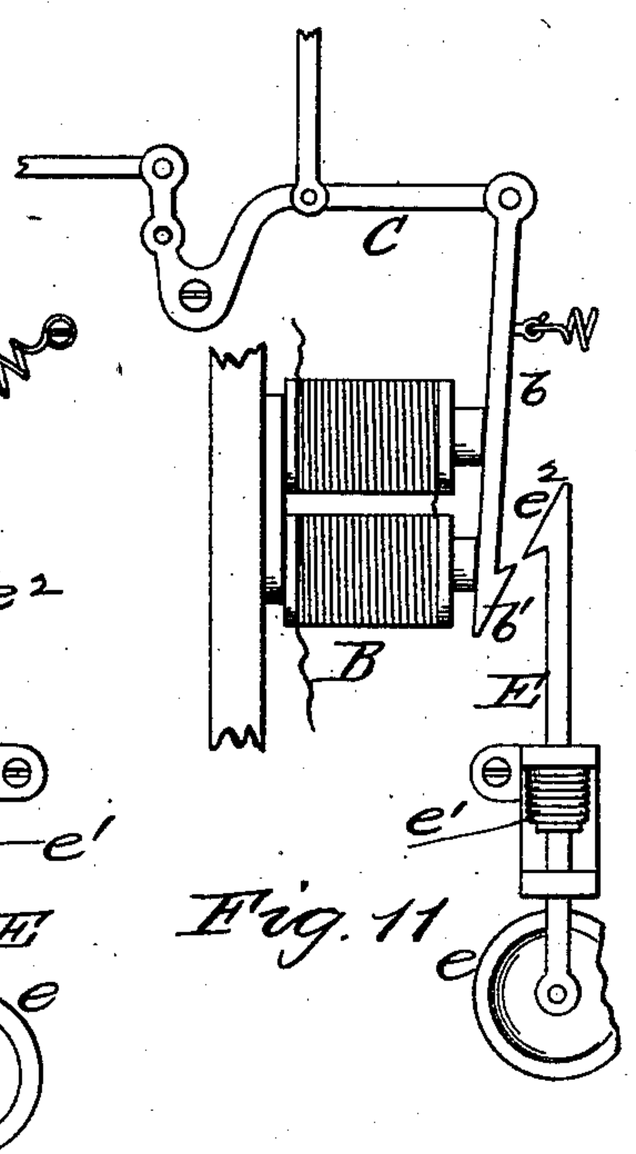


Fig. 11



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UNITED STATES PATENT OFFICE.

WILLIAM C. CRANDELL, JR., OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO SAMUEL D. STROHM, OF SAME PLACE.

APPARATUS FOR AUTOMATICALLY STOPPING RAILWAY-TRAINS.

SPECIFICATION forming part of Letters Patent No. 275,599, dated April 10, 1883.

Application filed February 25, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. CRANDELL, Jr., a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Method and Apparatus for Automatically Stopping Railroad-Trains; and I do hereby declare the following to be a full, clear, and exact description of the invention, reference being had to the accompanying drawings, which form part of this specification, in which—

Figure 1 is a plan illustrating a single track equipped with my improvements. Fig. 2 is a similar view of a double track. Fig. 3 is an elevation of train and track. Fig. 4 is a detail perspective. Fig. 5 is a broken elevation, showing the contact-plates secured to poles. Fig. 6 is a detail section of brush and brush-holder. Fig. 7 is an inverted plan of brush-holder. Fig. 8 is a section of a locomotive, illustrating the mechanism designed to be applied thereto; and Figs. 9, 10, and 11 are elevations of such mechanism in different positions, drawn to an enlarged scale.

My invention has for its object to provide means for automatically stopping railway-trains in cases of danger from open draw-bridges or switches, and to prevent collisions.

In carrying my invention into effect I place upon each locomotive-engine a battery or equivalent generator, an electro-magnet, and armature. I also provide a lever, which is in connection with the whistle, the steam-inlet to the cylinders, and the air-brake lever. One pole of the battery or generator makes ground through the wheels of the engine and track. The other pole leads to a brush on the engine, which is designed to make ground through a contact-plate beside the track. If such ground be made, the circuit is closed on the electro-magnet mentioned, and its armature is attracted. If ground be not made, the armature is unattracted when the engine passes the contact-plate mentioned. There is also on the engine a vertically-moving bar or spindle, carrying at its lower end a shoe or wheel designed to ride upon an incline or elevation located inside the track. When this shoe or wheel mounts the incline the bar rises, and as the shoe or wheel leaves the incline the bar descends. This movement of the bar is effected at the same time that the engine-brush is in contact with the plate already mentioned. The bar and the armature have latch-heads opposed to each other, so that they may be engaged or clutched together, and the armature is connected with the lever which controls the whistle, steam-port, and air-brakes. If ground be made through the engine-brush and its contact-plate, the armature is attracted while the vertical bar ascends and descends, and is out of the path of the latter, so that no engagement of the latch-heads is effected. If ground be not made at the time specified, the armature is unattracted, and an engagement of the latch-heads takes place, the result being that steam is cut off from the cylinders, the whistle blown, and the brakes put on. Now, ground will be made if the track ahead be clear, and switches, &c., are closed, but it will not be made if the track for a certain distance ahead be not clear, or if within that distance there be an open switch or draw-bridge. The pole of the battery on the engine which connects with the brush thereon also has connection with another brush on the rear car of the train, which latter brush gets contact with another plate beside the track, so as to restore ground for the engine brush-plate of a following train, as hereinafter specified. The opening and closing of circuit through the contact-plate on which the engine-brush rubs is accomplished in the following manner: Along the track at each station or at either end of every block of division are located magnets having connection with contact-plates upon which the brushes of the engine and rear car rub in passing. Circuit for the engine-battery is made by way of the contact-plates, line-magnets, and armatures of the latter. In certain positions of the armatures of these line-magnets such armatures make circuit to ground. In another position of said armatures such circuit is broken. In passing a station, if the block ahead be clear, the engine-battery finds a return-circuit by way of the ground-circuit, which is broken the moment the engine passes, or just after it has passed. Such ground remains broken until the same train has pro-

ceeded two blocks; but just as it passes the third station it restores ground for the first station by closing the battery-circuit through the rear brush on one of the line-magnets of the first station. When there is a switch or draw-bridge on a block, ground for the engine-battery by way of the contact-plate is made through or by such switch or draw-bridge in such manner that ground is broken if the switch or draw-bridge be opened, so that no train can enter upon such block without being stopped until such switch or draw-bridge be closed or in its proper position.

Referring to the accompanying drawings, A designates a locomotive-engine carrying a galvanic battery or other electric generator, *a*, and an electro-magnet, B, with armature *b*, having hooked end or latch-head *b'*. Said armature is pivoted at its upper end to a lever, C, having connection, as shown, with the whistle, the cylinder steam-port, and also with the brake appliances, whereby when the armature end of said lever is drawn down the whistle will be blown, steam cut off from the cylinders, and the brakes applied. The battery makes ground from one side or pole through the engine-wheels and railway-track, and from the other pole or side through a brush, D, on the engine. From the latter pole of battery a wire leads to a brush, D', on the rear car of the train.

E represents a vertical rod or bar, adapted to be moved up and down in bearings on the engine. Said rod carries at its lower end a shoe or wheel, *e*, and is encircled by a spiral spring, *e'*, which tends constantly to hold it down, yet yields to permit its upward movement, as hereinafter described. The upper end of rod E has a latch-head, e^2, which is in line with the latch-head *b'* of the armature *b* when the latter is unattracted by the magnet.

F represents a contact-plate or other conducting-surface on the side of the track, on which the brush D rubs in passing, and F' is another plate, on which the rear-car brush D' makes like contact. From plate F circuit is made to ground, as hereinafter described.

H represents an incline located between the railway-tracks and upon which the wheel or shoe *e* rides in passing, causing the vertical rod E to ascend. The wheel or shoe rides on this incline at the same time that the brush D is in contact with the plate F. If the engine-battery has ground by way of said plate, said battery is thrown on the magnet B, attracting the armature *b* and holding it out of the path of the latch-head on rod E as latter ascends and descends. It follows that if the engine-battery get a ground through its brush passing a plate, F, the engine is not stopped. If, however, said battery does not secure such ground through said brush, the armature *b* is not attracted and remains in the path of the latch-head of the vertical rod, being engaged thereby when the latter descends, thus drawing down the lever C, causing the whistle to be blown, steam cut off from the cylinders, and the air-brakes applied. On the line of way, and adjacent to the plates F F', are the electro-magnets and appliances whereby ground is made and broken, as shall be now described.

I represents an electro-magnet, having an armature, *i*, with retracting-spring *i'* and adjustable front stop, i^2. The free end of the armature has a projecting spring, i^3, which makes connection with the stop i^2, and it has also a back rib, i^4, one side of which is at right angles to the armature, the other side being beveled or inclined, as shown.

K represents another electro-magnet, arranged transversely with respect to the magnet I, so that its armature K' is normally perpendicular to or at right angles with the armature *i*. The armature K' is pivoted centrally or formed with an extension, *k*, having a beveled end, *k'*, which meets and rests against the rib i^4 on armature *i*. Said armature K' has a retracting-spring, k^2, and makes contact at its free end when attracted to or held against its magnet through spring-extension k^3 with a stop, k^4.

From the plate F there is a circuit to and through magnet I, thence to armature *i*, thence to armature K', and thence, when the latter is in its attracted position, by way of stop k^4, to ground *x* or the rails. There is also a direct connection between stop i^2 and ground. The line of railway to which my improvements are applied is divided into blocks, and at the end of every block a pair of the magnets I K is located. From the plate F' adjacent to each pair of magnets a connection leads, as shown, to the second magnet K therefrom, and from said magnet to ground. The series of magnets shown are numbered in groups or pairs 1, 2, 3, 4, and 5. From the plate F', adjacent to the group 3, a connection leads to the magnet K of group 1. From plate F' of group 4 there is a like connection to magnet K of group 2, and from plate F' of group 5 a similar connection is made with magnet K of group 3. This arrangement is for an interlocking system; but if the interlocking arrangement be not adopted the connection may be from the plate F' of one group to the magnet of the next group preceding it—for example, from the plate of group 2 to the magnet of group 1.

The operation is as follows: When the engine of a train reaches the end of a block or commences its entrance thereto, its brush makes contact with plate F. The parts being arranged as shown in group 1, the engine-battery obtains a circuit to ground from said plate by way of magnet I, armatures *i* K', and stop k^4. Having a ground, said battery energizes magnet I and attracts armature *i*, thus releasing armature K' from engagement with the rib or shoulder i^4 on the back of said armature. The retracting-spring k^2 now draws back armature K', breaking circuit at post k^4; but before the circuit is broken, armature *i* has made contact with stop i^2 and obtained a circuit to ground that way. Consequently the engine-battery has a ground so long as its brush D is

in contact with plate F and no stoppage of the train results. As soon as engine-brush leaves plate F the magnet I becomes demagnetized and releases armature *i*, which is then drawn back by its retracting-spring, breaking contact at stop i^2. The parts are now in the position shown in group 2, contact being broken at stops i^2 and k^4, and plate F having its ground cut, so that an engine following while the parts are in this condition would be stopped. The first engine, proceeding to group 2, finds its parts as it found those of group 1, and the operations just described for breaking the ground-connection are there repeated. It then proceeds to group 3, finds the same arrangement of parts as was found at group 1, and breaks the ground-connections for plate F and leaves the same broken. As the rear brush of the train in passing group 3 makes contact with plate F′, and as the latter has connection with magnet K of group 1, said magnet is energized and its armature K′ attracted until it meets stop k^4, thus restoring the parts of group 1 to their normal position, or to that shown for said group in the drawings, making the ground-connection for following trains. This operation is continued as the engine proceeds, so that the engine restores ground for the second block back of each block it enters upon. When an armature K′ is attracted, as just described, by the energization of its magnet, it latches behind the rib i^4 of the armature of the companion magnet I and maintains ground-circuit through stop k^4 after such magnet K is demagnetized and until the magnet I is again energized.

When my improvements are applied to a double-track railroad, the arrangements described are duplicated for each track, so that on each such track the blocks will be locked behind a train to prevent one train from overtaking another and colliding with its rear.

The improvements are also applicable to single tracks, and without duplication of the magnets will, by the connections which I shall now describe, operate to lock blocks in advance of a moving train, so as to prevent two trains moving in opposite directions on one track from meeting upon the same block and track. To effect this, duplicates of the plates F F′, which are indicated by the letters F^2 F^3, are placed on the side of the track opposite to said plates F F′. The plates F^2 have connection, as shown, with the magnets I of the second group farther on, while the plates F^3 have connections with the magnet K of their own groups. Now, a train moving in the direction of arrow 1 in passing a group of magnets and breaking ground therefor, as described, breaks the ground which another train two blocks off, moving in the direction of arrow 2, must needs have in order to proceed. In like manner a train moving in the direction of arrow 2, upon entering a block, breaks ground by energizing the magnet I two blocks ahead, so that a train approaching in a contrary direction and seeking ground at such station cannot find it, and will be stopped there. Said train (moving in direction of arrow 2) restores ground for the block it passes by reason of its rear brush completing circuit through plate F^3 and on the magnet of the group pertaining thereto.

The connection between the battery or generator on the engine and the rear brush may be made by way of the train bell-cord or signaling-rope M, or by way of the air-brake pipes. To provide for moving the rear brushes to the different sides of a tender or car, or from one car to another, said brushes may be made with cylindrical heads *d*, having springs *d*′, said heads *d* entering and said springs bearing against the sides of sockets D^2, provided at either side and end of car, and in contact with the battery-connections. Below these sockets are clamping-jaws, which grip the brush-stems as shown, and which may be readily opened when said brushes are to be removed.

From the foregoing it will be seen that a train entering a block or passing a station automatically arranges matters so that another train following cannot get onto said block until all of the first one has left such block and passed into the second one ahead; also, that when a train passes into a third block, it restores the original condition of things at the first block, so that a train can enter and proceed upon said first block. This arrangement is repeated on each successive block along the line, so that one train following another can never overtake it, but must always remain at least one block behind the first. All possibility of collision between two trains running in the same direction on the same track is thus avoided.

To prevent a train from running onto an open switch or draw-bridge ahead of it, the circuit from plate F may be to ground by a line, N, stop k^4 to a spring, *n*′, and contact n^2, and thence to ground n^3.

The switch N′ (or draw-bridge) is connected, as shown, to spring *n*′, and, when open, pushes said spring away from contact n^2, breaking ground. When said switch or draw-bridge is closed, circuit is also closed by way of spring *n*′ and contact n^2. Hence a train entering a block cannot obtain ground if a switch or draw-bridge on the said block is open, and so cannot proceed on said block until such switch or draw-bridge is closed. Danger from open switches is thus avoided.

To prevent collisions on crossing lines, the ground *x* of the lock adjacent to the crossing may be made through a plug, L, which can be removed by a switchman before the train crosses, so that another train reaching such block or station will find its ground cut or broken, and must wait until the same is restored, such restoration not being effected until the train on the crossing track has passed.

In making a return-circuit for the battery or generator on a moving train I do not confine myself to the use of the ground for such circuit, as the rails may not always make good ground-contact. A metallic circuit may be

formed to the rails direct by a wire leading from the magnets to the rails, and thence to said battery by way of the wheels, axles, &c., without changing my invention. By this means ground-connections for the magnets and for the rails are dispensed with, the circuit being metallic from the former to the latter without grounding.

What I claim as my invention is—

1. A railway provided with two or more magnets and with contacting devices located beside the track at each station or block thereof, adapted and designed to be operated by a battery or generator on a passing train, whereby mechanism, substantially as set forth, is automatically operated to control the movement of said train as it passes said stations or blocks, substantially as shown and described.

2. The combination, with two or more magnets at each station or block along the line of way of a railroad, of plates located at each such station or block, adapted and designed to contact with brushes on a passing train, to operate mechanism, substantially as set forth, thereon, and thereby to control the movements of said train at such stations, substantially as shown and described.

3. A railway provided with magnets at each station or block thereof, having interlocking armatures, and with plates or contact-surfaces located beside the track at such stations or blocks, designed and adapted to contact with brushes on a passing train, whereby a current from a battery or generator on said train passes to said magnets to operate the latter and to make and break circuit for said current, substantially as shown and described.

4. A railway having contact-plates located beside the track at each and every station along the line of way, and two magnets at each such station, provided with interlocking armatures, said magnets being in normally-open circuits, which are closed successively by a passing train by way of said contact-plates, substantially as set forth.

5. A railway having two or more magnets located at each and every station or block, and provided with interlocking armatures, said magnets having electrical connections with one or more contact-surfaces located beside the track along the line of way, said magnets and surfaces at each station being in an open circuit, designed and adapted to be closed by a passing train, and said magnet or magnets energized by a battery located on said train, substantially as set forth.

6. The combination, on a railway-line, of two series of magnets (one of each series) at each and every station or block thereof, one series being designed and adapted to form circuit successively with a battery on a passing train by way of a brush located on the engine or front of said train, and the other series being correspondingly energized by said battery by way of circuit from a brush on the rear end of the train, substantially as set forth.

7. The combination, with a railroad switch or draw-bridge, of an electric switch in circuit with plate F, having a ground-connection, said parts being arranged substantially as set forth, whereby when the railroad-switch is misplaced from the main track the electric switch is open and the ground-connection for said plate F is broken, substantially as shown and described.

8. A locomotive or train provided with a battery or equivalent generator, a front and rear metallic brush, and connections, substantially as described, between said battery or generator and the last-car brush, substantially as set forth.

9. The combination, with the brush D, of sockets having clamping-jaws constructed as shown, and designed and adapted to receive and hold said brush, substantially as shown and described.

10. In an apparatus for automatically stopping railway-trains in cases of danger, the combination of the following elements: electro-magnetic devices placed at the stations or blocks along the railway, a series of contacting-surfaces placed along the road and connected with said electro-magnetic devices, a series of inclines or elevations adjacent to said surfaces, a train provided with an electric generator, metallic brushes at front and rear in electrical communication with said generator, an electro-magnet with an armature connected by intermediate mechanism with the whistle, cylinders and brake-operating devices of said train or locomotive, and depending mechanism in line with said armature, whereby when said depending mechanism is raised by said inclines at the stations or blocks it engages with said armature, if the latter be not moved out of the path of said depending mechanism, thereby causing it to move said lever to shut off steam to the cylinders, sound the whistle, and put on the brakes, and if said armature be not in the path of said depending mechanism it is not engaged by the latter, and the lever is unaffected by the movement of the depending mechanism.

11. The combination, with a locomotive or train, of an electro-magnet and armature therefor, a battery or generator, a lever having connection with the steam-cylinders of the locomotive, steam-whistle, and the brakes, and which is also connected to said armature, and designed and adapted to be reciprocated or operated by depending mechanism on the engine, which is moved by elevations or inclines placed along the roadway, so that said depending mechanism will rise to and engage with said armature and descend, depressing the latter and moving said lever to operate the whistle, shut off the steam, and put on the brakes, if said armature be not moved out of the path of such depending mechanism when the locomotive or train arrives at each block or station along the road, substantially as set forth.

12. In combination with a sliding bar carried by a moving train, and mechanism connected to said bar to stop the train, an elec-

tro-magnet having an armature normally aligned with said bar, and an incline or elevating device on the line of way adapted and designed to move said sliding bar, substantially as shown and described.

13. In combination with a locomotive, an electro-magnet, a generator therefor, an armature connected to a lever designed to operate the whistle, steam cut-off, and brakes, and a sliding bar designed and adapted to be lifted by inclines or elevations along the roadway and to descend and clear said armature or engage therewith accordingly as the latter is in or out of the path of said sliding bar, substantially as set forth.

14. In an apparatus for automatically stopping railway-trains at stations or blocks along the line, two or more magnets at each such block or station connected with plates located beside the track and adapted to make contact with brushes in circuit with a battery or generator on a moving train carrying mechanism for stopping the same, substantially as shown and described.

15. The combination, on a railway-line, of two series of magnets designed and adapted to have circuit successively with a battery on a moving train, the two series of magnets being arranged in pairs with interlocking armatures, and having connections, substantially as described, whereby when the circuit of the moving battery is closed on one of the magnets ground is made for the remaining magnet, substantially as set forth.

16. The combination, with a railway-line having inclines or elevations at different points thereon, of an engine carrying a shoe or wheel attached to a bar, which is adapted to move vertically, said engine carrying also an electric battery or generator, an electro-magnet in circuit therewith, and an armature attached to a lever which controls the steam-whistle, cylinder inlet-ports, and brake appliances, said battery having one of its poles connected with the wheels of the engine, the other pole being connected with brushes, and said bar and armature having latch-heads or equivalent devices whereby they are adapted to engage when the bar is moved vertically, if the armature be not synchronously moved out of the path of said bar, as set forth.

17. The combination, with a railway having at different points contact-plates, which have circuit to ground or track by way of the magnetic devices along the track, of an engine carrying a battery, one of the poles thereof being connected with rear and front metallic brushes, which make contact successively at each station or block with their respective plates in passing the same, so as to secure complete circuit for such battery in passing, and to leave said circuit incomplete for a following engine or train, substantially as set forth.

18. In combination with a single-track railway, electro-magnetic devices located at either end of every block or section along the line of way, and designed and adapted to be operated by a moving train to open circuit, and thereby lock both ends of a block entered for the battery of a following or approaching train, to prevent other trains from entering said block or section at either end thereof until the train on such block or section vacates the same, substantially as set forth.

19. The combination, with plates F and F′, of magnets I K, having armatures *i* K′, stops i^2 and k^4, and connections therefor, substantially as set forth.

20. The combination of two electro-magnets, I K, having armatures *i* K′, with stops i^2 and k^4 for said armatures, respectively, and independent ground-circuits from said stops, with intermediate connections, substantially as set forth, whereby circuit may be made to ground through armatures *i* K′ and stop k^4, or, alternately, when magnet I is energized, through armature *i* and stop i^2, substantially as set forth.

21. The combination, with a single-track railway having electro-magnets and interlocking armatures on the line of way, of two series of contact-plates on either side of said track, adapted to complete circuit with a battery on a moving train, said plates having electrical connections, substantially as described, with said magnets, whereby a train moving in either direction on said track will operate such magnets to make and break ground through such magnets and armatures to automatically control the movement of another train, substantially as set forth.

22. The combination, with plate F and its ground or return connection, of a plug or manual switch at the intersection of two lines, whereby such ground-connection may be broken to prevent collisions at crossings, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 24th day of February, 1882.

WILLIAM C. CRANDELL, JR.

Witnesses:

S. J. VAN STAVOREN,

CHAS. F. VAN HORN.