T. M. FREEBLE.

ELECTRIC RAILWAY SIGNAL SYSTEM.

APPLICATION FILED JUNE 7, 1907.

900,273.

Patented Oct. 6, 1908.

5 SHEETS—SHEET 1.

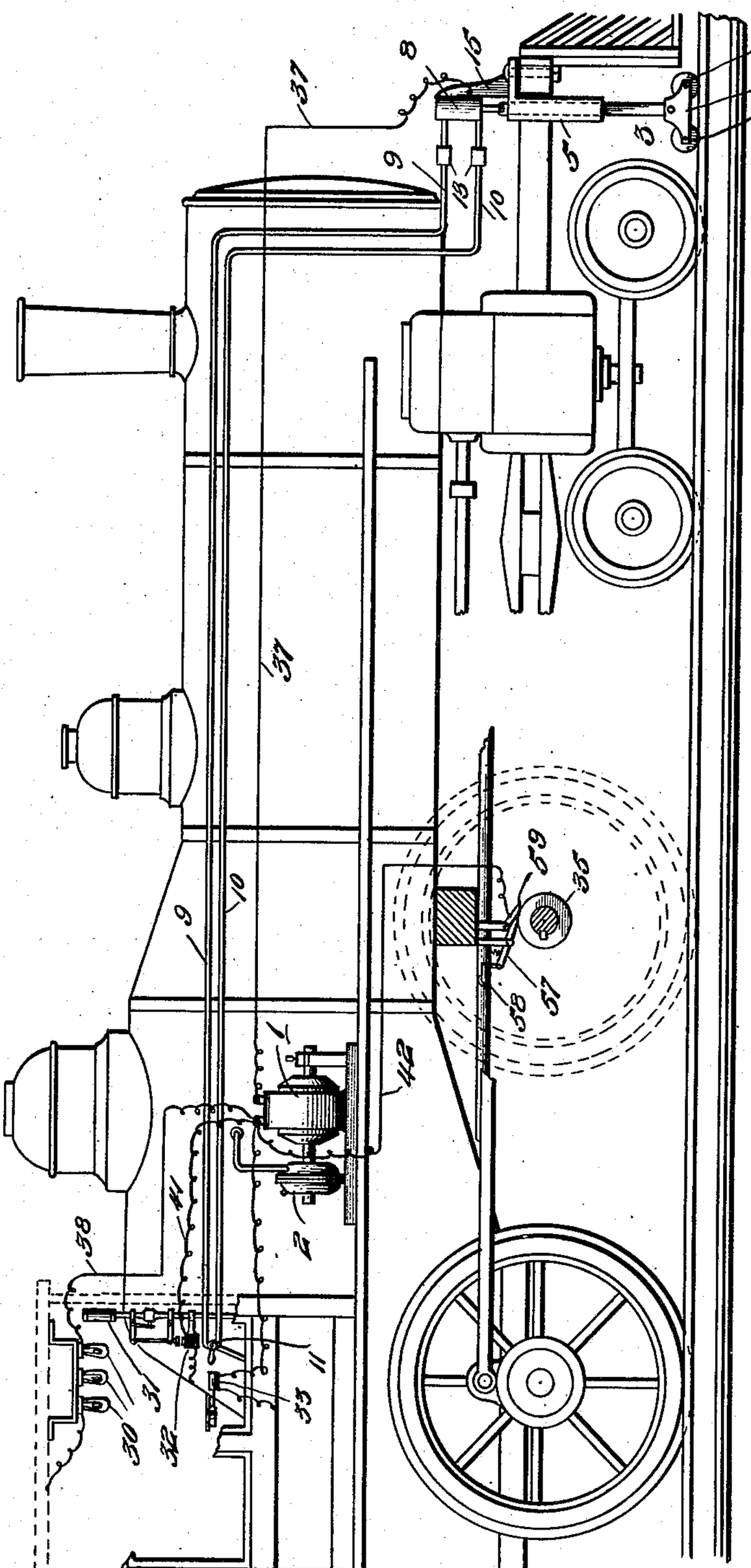

Fig. 1.

Witnesses

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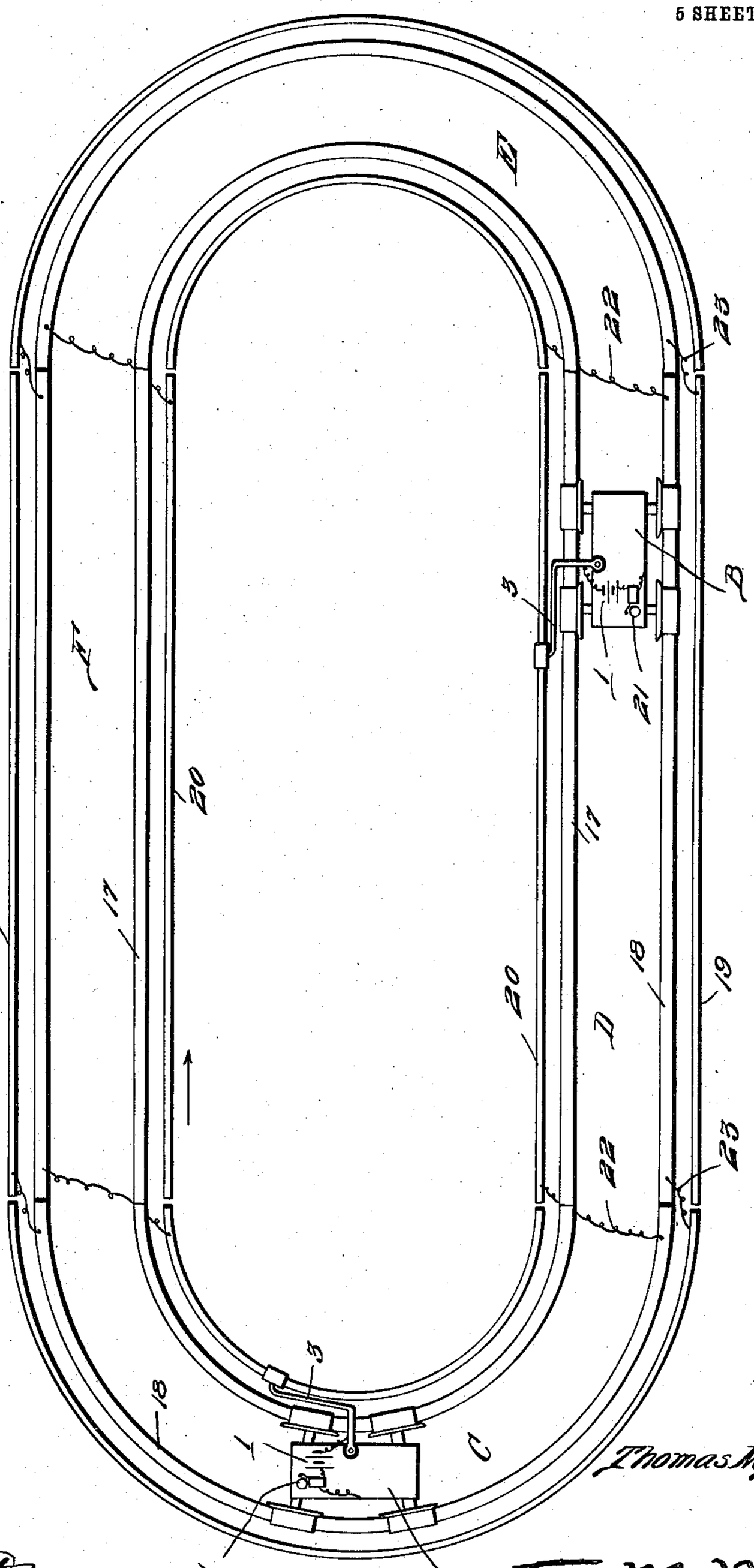
5 SHEETS—SHEET 2.

Fig. 2.



Witnesses

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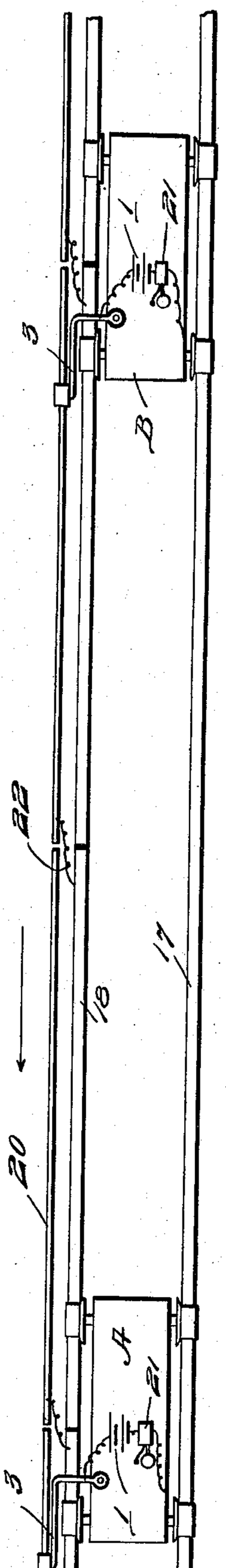

Fig. 3.

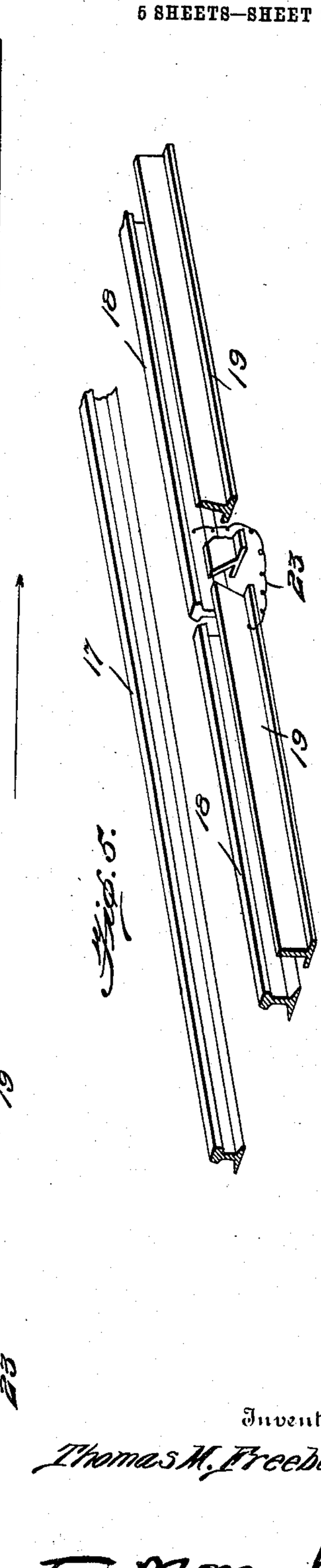

Fig. 5.

Witnesses

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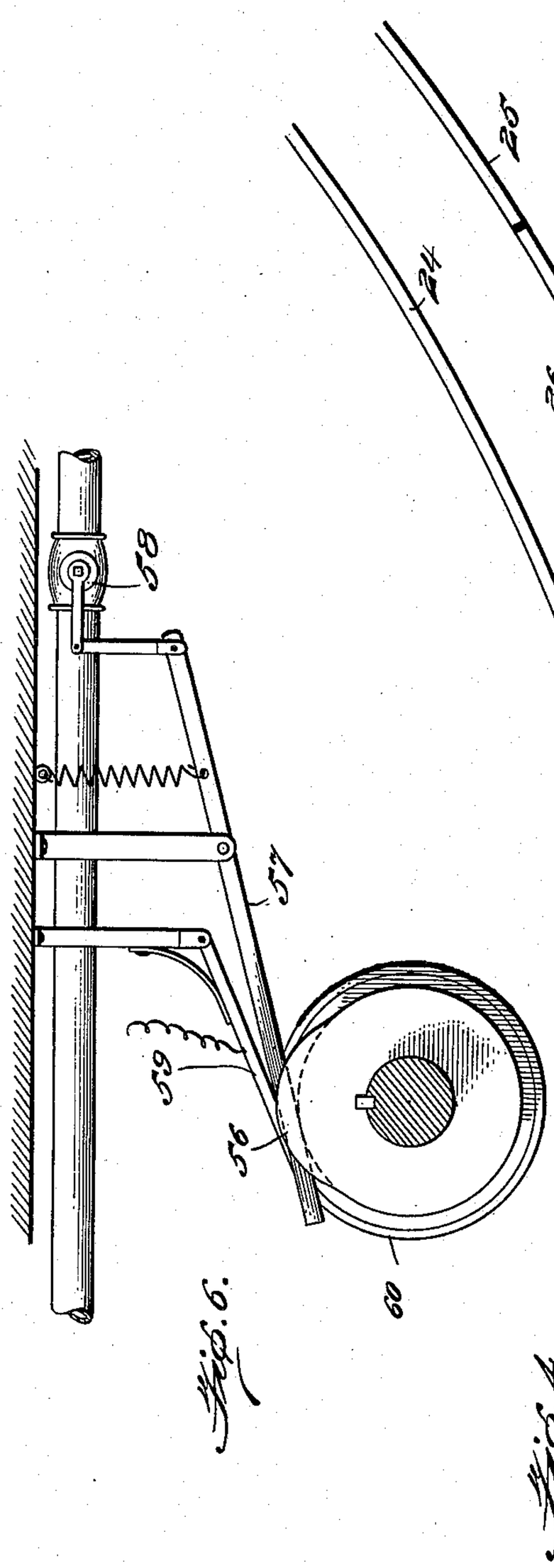

Fig. 6.

Fig. 4.

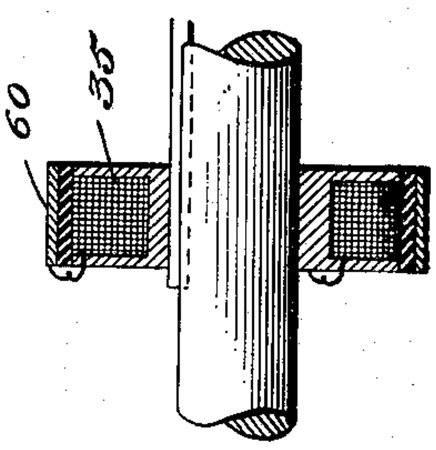

Fig. 8.

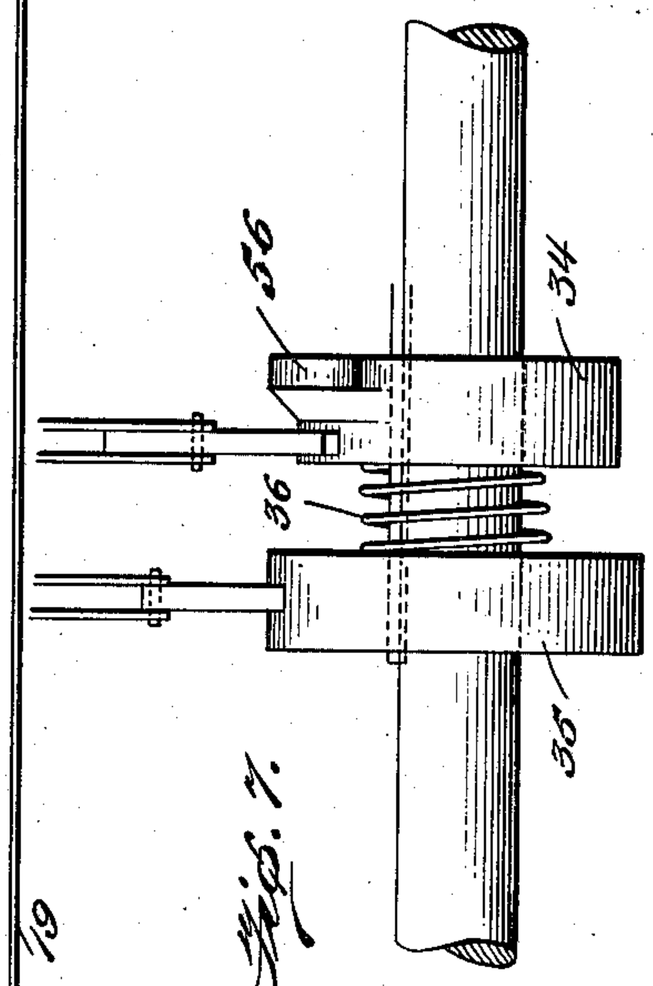

Fig. 7.

Witnesses

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5 SHEETS—SHEET 5.

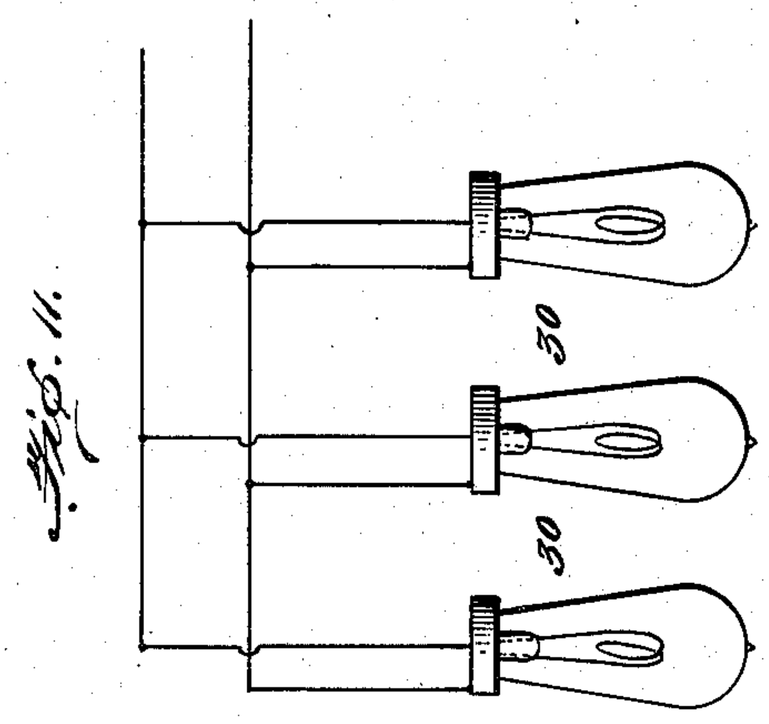

Fig. 11.

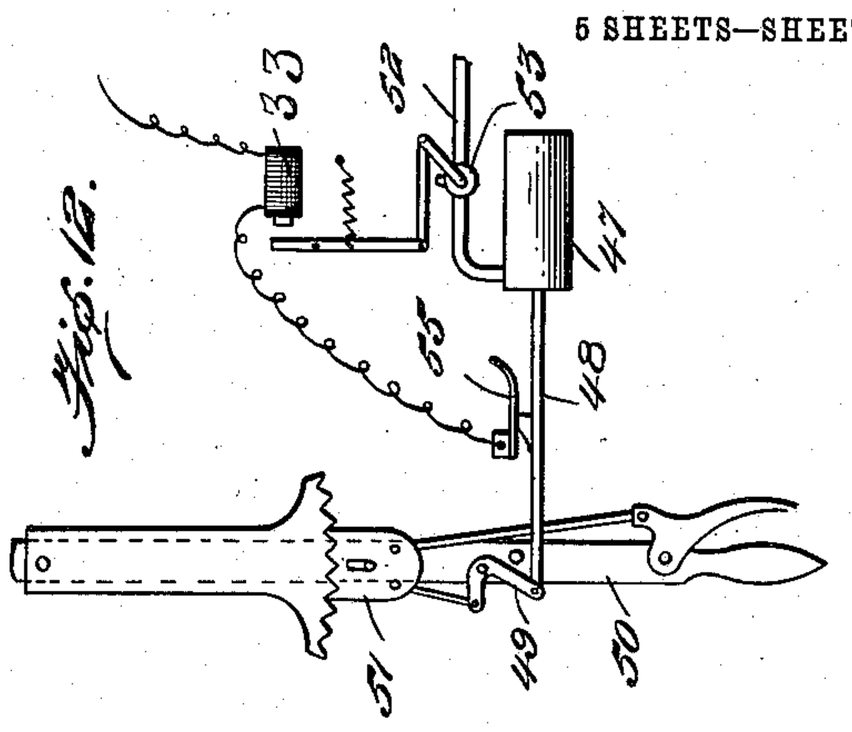

Fig. 12.

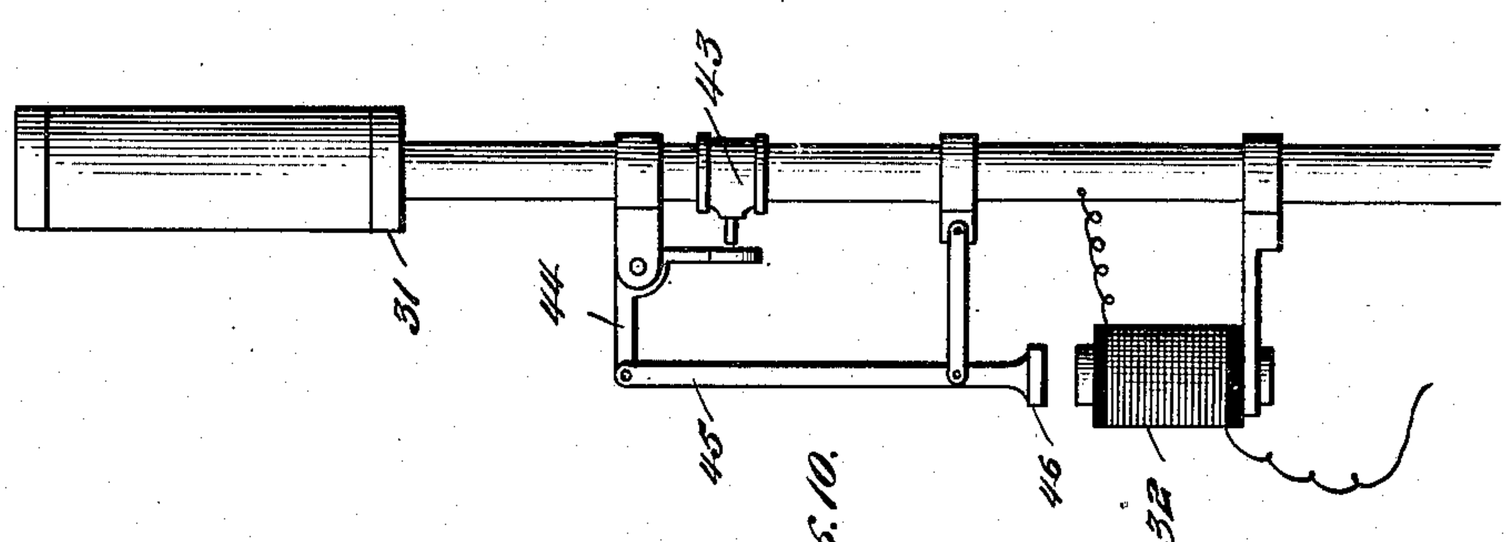

Fig. 10.

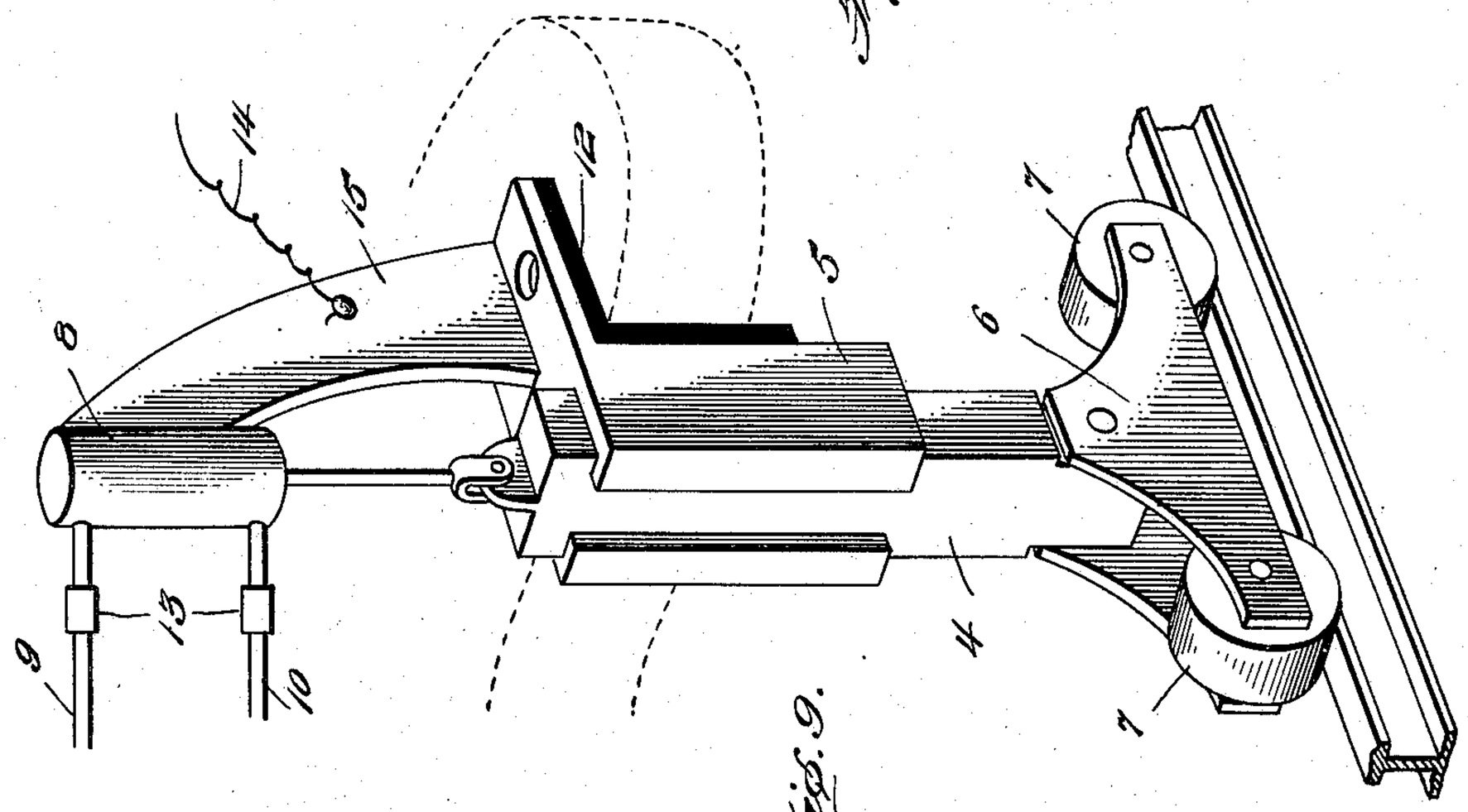

Fig. 9.

Witnesses

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UNITED STATES PATENT OFFICE.

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ELECTRIC RAILWAY SIGNAL SYSTEM.

No. 900,273. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed June 7, 1907. Serial No. 377,730.

To all whom it may concern:

Be it known that I, THOMAS M. FREEBLE, citizen of the United States, residing at Latrobe, in the county of Westmoreland and State of Pennsylvania, have invented certain new and useful Improvements in Electric Railway Signal Systems, of which the following is a specification.

My invention relates to electric railway signal systems, and particularly to that class thereof, known as cab signal systems, wherein signals are operated in the locomotive or car the movements of which are to be controlled and regulated.

In the system herein described the current for the operation of the signals and other safety devices of the system is supplied by generators located on the locomotives, cars or trains themselves. Track-circuits are used, as hereinafter described, and the system comprises means whereby not only are proper signals displayed automatically, upon occasion, but also the brakes are set and power turned off automatically.

The objects of my invention are to improve and simplify automatic railway signal systems, to avoid normally-energized track circuits with consequent multiplication of low-voltage generators (usually primary batteries), to economize current by energizing those circuits only which are in the immediate vicinity of the train or trains to be protected, to display the signals where they may be seen to best advantage, to avoid accident in case of neglect to observe signal indications by automatically cutting off power and applying the brakes, to make the system relatively simple, easily understood, and easily applied, to render the mechanism required simple and efficient, and generally to make the system simple, reliable, inexpensive in operation and maintenance, and adaptable to modern conditions of railway operation.

I will now proceed to describe my invention with reference to the accompanying drawings, in which certain forms of apparatus and certain circuits embodying my invention are illustrated, and will then point out the novel features in claims.

In the said drawings: Figure 1 shows in diagrammatic elevation the parts of my system designed to be mounted upon a car or the like, the said parts being in this instance shown mounted upon and arranged to control a steam locomotive; though they may obviously be mounted upon an electric locomotive, a motor car, or any car of a train. Fig. 2 is a diagram showing the track circuits and other circuits which may be employed in the case of a single-track railway. Fig. 3 is a diagram showing the track circuits and other circuits which may be employed in the case of a double-track railway. Fig. 4 is another diagrammatic view illustrating the circuits which may be employed at a switch of a single-track railway. Fig. 5 is a perspective view showing the track rails and signal rails of a single-track system and the electrical connection of the track and signal rails of a block. Fig. 6 is a detail sectional elevation showing the contact device for operating the brakes automatically, and Fig. 7 is a detail side view of the same. Fig. 8 shows a detail section through the magnet of the brake-setting device. Fig. 9 shows a detail perspective elevation of the rail-contact device carried by the locomotive or car to be controlled by the signal system, and of the means for holding said contact device against the corresponding rails. Fig. 10 is a detail elevation of the alarm-whistle operating device. Fig. 11 is a diagram showing the connections of the signal lamps hereinafter mentioned. Fig. 12 is a diagrammatic plan view showing means for operating the throttle-lever or controller-handle automatically.

Referring now to the drawings, and at first to Figs. 1, 2 and 3, numeral 1 designates an electric generator (in this instance shown as a dynamo driven by a steam turbine 2, the generating set corresponding generally to generating sets used for operating electric headlights, though arranged to produce current of voltage suitable for railway signal work) mounted upon a steam locomotive and arranged to supply current to the signal circuits, as hereinafter described.

3 designates a rail-contact device likewise carried by said locomotive and arranged to make contact with suitable rails laid alongside the track rails and constituting special conductors for the signal-circuits. As shown particularly in Fig. 9, said rail-contact device comprises a vertical slide 4 mounted in a suitable guide 5 carried by the pilot or other convenient part of the locomotive or car, and having secured to it a suitable truck 6 provided with one or more contact-wheels 7. A fluid-pressure-actuated device 8 is arranged to press said rail-contact device down upon the corresponding rails, or to raise it there-

from, at will, being provided with pipes 9 and 10 leading to a suitable source of fluid under pressure (for example the engine boiler or the tank of the air-brake equipment); said pipes controlled by a suitable valve 11, whereby either of said pipes may be connected to supply at will and the other connected to exhaust, so raising or lowering the contact device 3, as desired. When said device is down, it is held down elastically, owing to the elastic nature of the fluid holding it down, and hence the device accommodates itself automatically to inequalities of the line of rails with which it contacts.

For convenience in properly insulating the electric circuits, I prefer to insulate the guide 5 and fluid-pressure-actuated device 8 from the frame of the locomotive, and to this end provide insulation 12 between guide 5 and the part of the locomotive to which same is secured, and insulating couplings 13 in pipes 9 and 10. This enables me to lead a conductor 14 direct from one pole of the generator to the bracket 15 forming a part of guide 5, whence the current passes directly to the slide 4, wheels 7, and the rails upon which said wheels run.

On single-track roads I commonly provide each locomotive or car to which my invention is applied with two contact devices 3, one for each of the two signal-conductor rails provided in such case, one such contact device being raised out of contact with the rail and the other depressed into such contact.

At some convenient point, preferably the engine cab in the case of a steam or electric locomotive, I provide a visual signal, an alarm whistle and means for actuating it, and means for closing the throttle valve or operating in an equivalent manner any other controller with which the locomotive or car may be equipped; and I further provide means for applying the power brakes with which trains are now usually equipped.

Referring now to Fig. 2, I show in said figure two trains, A and B, each supposed to have a signal-equipment substantially like that already described with reference to Fig. 1. 17 and 18 designate the track rails, one of which, 17, is electrically continuous, extending unbroken electrically from block to block, while the other, 18, is divided into blocks of convenient length. This figure showing a single-track system, that is, a system over which trains move in both directions, I provide, in addition to said track rails, two other track conductors, 19 and 20, which preferably are rails of suitable size and section supported upon the ties and located parallel with the track rails. These signal-rails, 19 and 20, are divided into blocks corresponding to the blocks of rail 18. In Fig. 2 I have shown the track divided, as described, into four blocks, which I have designated respectively, C, D, E and F.

For convenience of illustration I have designated the current generators on trains A and B by the conventional designation of an electric battery, and have employed the conventional illustration of an electric bell to represent the various signal, power-controlling and brake-applying devices of such trains. The drawing shows trains A and B on adjacent blocks. It is assumed that both trains are moving in the same direction, viz., clockwise, for which reason the contact devices 3 of both trains are in contact with the inner signal conductor, 20. If either train were to move in the opposite direction, its track-circuit contact device would be in contact with the signal conductor 19 instead of signal conductor 20.

Considering the circuit from train A first, said circuit passes from the generator 1 of that train through contact device 3 of that train to signal conductor 20 of block C, where the circuit ends. Starting from the other pole of the generator, the circuit passes through the signal and controlling devices of the train (represented in the diagram by the electric bell 21) and through the wheels of the train to the track rail 18; but since the circuit is incomplete on the other side of the battery, it is unnecessary to trace the circuits from the battery of train A further. There being no complete circuit from battery 1 of train A, or through controlling devices 21, train A is free to move from block C to block D.

Considering now the circuit from train B, the circuit passes from the generator 1 of that train through contact device 3 to the signal conductor 20 of block D, thence by conductor 22 at the end of block D to the rail 18 of block C, thence through the wheels and axles of train A to the continuous rail 17, thence back through said rail 17 to block D and through the wheels and axles of train B signal and controlling devices, 21, of train B, and to the opposite pole of generator 1 of that train. This circuit being complete, signal and controlling devices 21 are operated, and continue to be operated so long as trains A and B remain on adjacent track blocks, train B being thereby held in block D, while train A is free to proceed. As soon as train A passes from block C into block F the circuit through the signal and controlling devices of train B is broken, and said train may proceed into block C, only to be held there in the same manner if the train A has not yet cleared block F. Should train B seek to go from block D to block E while a train is in block C, the contact device 3 of train B being shifted to contact with signal conductor 19, there is no circuit through its signal and controlling devices 21 so long as block E is clear, and hence train B, though blocked as to movement into block C, is free to move into block E. If train A were to seek to

move into block D, as soon as its contact device 3 was shifted into contact with conductor 19 a circuit would be completed through continuous track rail 17 to block D, the wheels and axles of train B, the track rail 18 of block D, conductor 23, and signal conductor 19 of block C and contact device 3 and signal and safety device 21, back to the generator 1 of train A. It will be seen that each signal conductor, 19 or 20, of each block, is connected to track rail 18 of the block next beyond in the direction of motion to which such signal rail corresponds.

Fig. 3 shows the circuits for the two tracks of a double-track system; one track rail of each track being continuous, as shown, the other being divided into blocks corresponding to the blocks in which the signal rail is divided, each signal rail being connected to the track rail of the block next beyond. The circuits are the same as described above except that each track has only one signal conductor, since trains normally move on each track in one direction only.

At switches I provide means whereby unless all cars on the switch are well beyond the clearance line the signals and controlling devices of an approaching train are operated the same as if such car projecting within the clearance line were on the main track. This is illustrated in Fig. 4, which shows, for the main track blocks G, H and I, the same circuits as shown in Fig. 2, viz., single-track circuits. Numerals 24 and 25 designate the switch rails, in one of which is an insulated section 26, connected to main track rail 18 and at such distance from the main track that the wheels of any car on the side track or switch which is so near the main track as to project within the clearance line, will be on such insulated section; said section 26 being insulated from the movable switch-point, 27, which is connected to main track rail 17, as shown. Other short insulated track sections, 28 and 29, are provided where the switch rails intersect the signal-conductor 20, so that wheels passing on or off the switch may not affect the circuit passing through said signal conductor. Switch rail 24 is connected to main line continuous rail 17. It will be seen that when wheels are on rail 24 and insulated section 26 the electrical effect is precisely the same as if said wheels were on the main track block H. Furthermore, if the switch is set to direct trains on the main track on to said switch, contact of switch point 27 with main track rail 18 produces the same electrical effect as if there were a train on block H.

The signal devices which, in the arrangement shown in the drawings, are provided in the cab or other suitable part of the locomotive or car, are a series of signal lights, 30, and an alarm whistle 31 operated by a magnet 32. In addition I provide mechanism shown in Fig. 12, and controlled by a magnet 33, for closing the throttle or other power-controller, and I further provide means shown particularly in Figs. 7 and 8, and comprising an electric clutch consisting of an armature 34 and magnet 35 and spring 36, for operating brake-applying mechanism. The controlling magnets of all of these parts, and the signal lamps, are represented in Figs. 2 and 3 by the diagrammatic representation of an electric bell, 21. The circuits shown in Fig. 1 are as follows: from track contact device 3, through conductor 37, generator 1, and branch conductor 38 to signal lamps 30, which are grounded through the metal of the locomotive. Also, through conductor 37, generator 1, and branch conductor 41 to magnet 32 of alarm whistle 31, and thence to the metal of the locomotive. Also through conductor 37, generator 1, and branch conductor 42 to the magnet 35 of the brake-controlling electric clutch and thence to the metal of the locomotive.

The mechanism for operating the alarm whistle 31 is simple, and is illustrated in detail in Fig. 10. The action of the whistle is controlled, as usual, by a valve, 43, against the stem of which one arm of a bell-crank 44 is arranged to press, the other arm of said bell-crank being connected to a link 45, suitably guided, to an armature 46 of the whistle magnet, 32.

As shown in Fig. 11, the signal lights 30 are connected in multiple circuit. As so connected, each lamp is the equivalent of all the others, and such others might be omitted; but I prefer to provide a plurality of signal lamps, so that in case one be broken or burn out the others may continue to operate.

The mechanism for turning off the power, *i. e.*, in a steam locomotive, closing the throttle, is shown in detail in Fig. 12, and comprises a fluid-pressure-operated actuating device, (pressure cylinder), 47, the piston of which is connected by a rod 48 to a bell-crank 49 pivoted to the throttle-arm or controller-lever 50; said bell-crank being also connected to the latch-piece 51 of said throttle arm or controlling lever. A pipe 52, controlled by a valve 53, is provided for admitting fluid under pressure to the front end of said cylinder, so as to withdraw the latch-piece 51 and then draw the throttle-lever toward said cylinder. Said valve 53 is arranged to be operated by the armature of the magnet 33.

The fluid under pressure for operating the whistle, for raising or lowering and pressing down the track contact devices 3, and for operating the throttle-closing cylinder 47 may be drawn from the locomotive boiler, from the air-brake tank, or from any other convenient source. In general compressed air is preferable for operating these devices, as it is not hot, is not subject to condensa-

tion, creates no cloud of vapor when it escapes, and is as available as steam on practically all present-day railway equipments.

In order that the throttle or other controller may not be held closed, but the power may be merely cut off so that positive action on the part of the operator is required to continue the running of the train, the circuit from throttle-control magnet 54 passes through a contact device 55, whereby the circuit through said magnet is broken as soon as the throttle is completely closed. The operator may then open the throttle again, holding the contact device 55 open or otherwise preventing the automatic closing of the throttle; which permits him to proceed with caution through the block, or to back out of the block.

Those who have observed the way a skilled engine runner applies the air brakes are aware that never, except in case of an emergency, are the brakes applied fully and held on hard from the very beginning; but instead the brake valve is opened momentarily and then closed, opened again and then again closed; and this operation is often repeated a number of times. In general it is not desirable that the automatic brake-operating device herein described shall produce an "emergency" application of the brakes; and therefore I provide means for simulating the actions of the skilled engine-runner in applying the brakes for an ordinary stop. The armature, 34, of the brake-clutch carries a cam 56, adapted to actuate the follower-lever 57, which in turn is adapted to actuate the controlling valve 58 of the brake apparatus. The side of the cam 56 is beveled, so that the follower will rise when the cam is pulled over by the magnet 35 while said follower is along side said cam. The brake clutch is mounted upon one driver-axle of the locomotive, current being transmitted to it through a brush 59 riding on a collector-ring 60 on the outside of the clutch; the other end of the clutch coil being connected to the axle itself and so to ground.

It will be seen that when a circuit is completed through the clutch magnet while the locomotive is moving, the brake valve 58 will be alternately opened and closed, in practically the manner commonly followed when making "service stops" in normal operation of trains.

It will be apparent that an iron bar or like conducting object laid across the rails of a block will have the same effect on the signals and other safety devices of a train approaching that block as if another train were in that block; consequently it is easy for track inspectors or train men to hold trains from entering a block in case of necessity. Furthermore, since it is practically certain that in case of a derailment of a train some metal part of the train will continue to short-circuit the track circuit of that block, the system affords efficient protection in case of derailment.

What I claim is:—

1. A railway block signaling system comprising in combination track rails, one electrically continuous through a plurality of blocks, the other divided into block sections insulated from each other, a signal conductor divided into blocks insulated from each other and each connected to the insulated rail block section of the block next in advance and train-controlling means mounted on a railway vehicle on said track, and comprising a contact device adapted to make contact with such signal conductor, and electrically-operated signaling means, power-controlling means and brake-applying means and a generator therefor on said vehicle, and a permanently closed circuit extending from said contact device through said generator and controlling means to a part of said vehicle adapted to contact with the track rails, said circuit being normally open as a whole and arranged to be completed through the wheels and axles of any railway vehicle which may occupy the block in advance.

2. In a railway signaling system, means for automatically applying train brakes comprising a brake-applying valve, means for opening and closing same intermittently comprising a driving member arranged to be driven automatically by means connected to an axle of the train while the train is in motion, and electrically-controlled means controlling the driving of said member, and automatic block-signaling means controlling the operation thereof.

3. In a railway signaling system, means for automatically applying train brakes comprising a brake-applying valve, a cam on one of the train axles for opening and closing said valve intermittently, an electric clutch controlling said cam, and automatic block-signaling means comprising a circuit for energizing said clutch.

In testimony whereof I affix my signature, in presence of two witnesses.

THOMAS M. FREEBLE.

Witnesses:
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JOHN F. MURRAY.