W. GRUNOW, JR.

RAILWAY BLOCK SIGNALING SYSTEM.

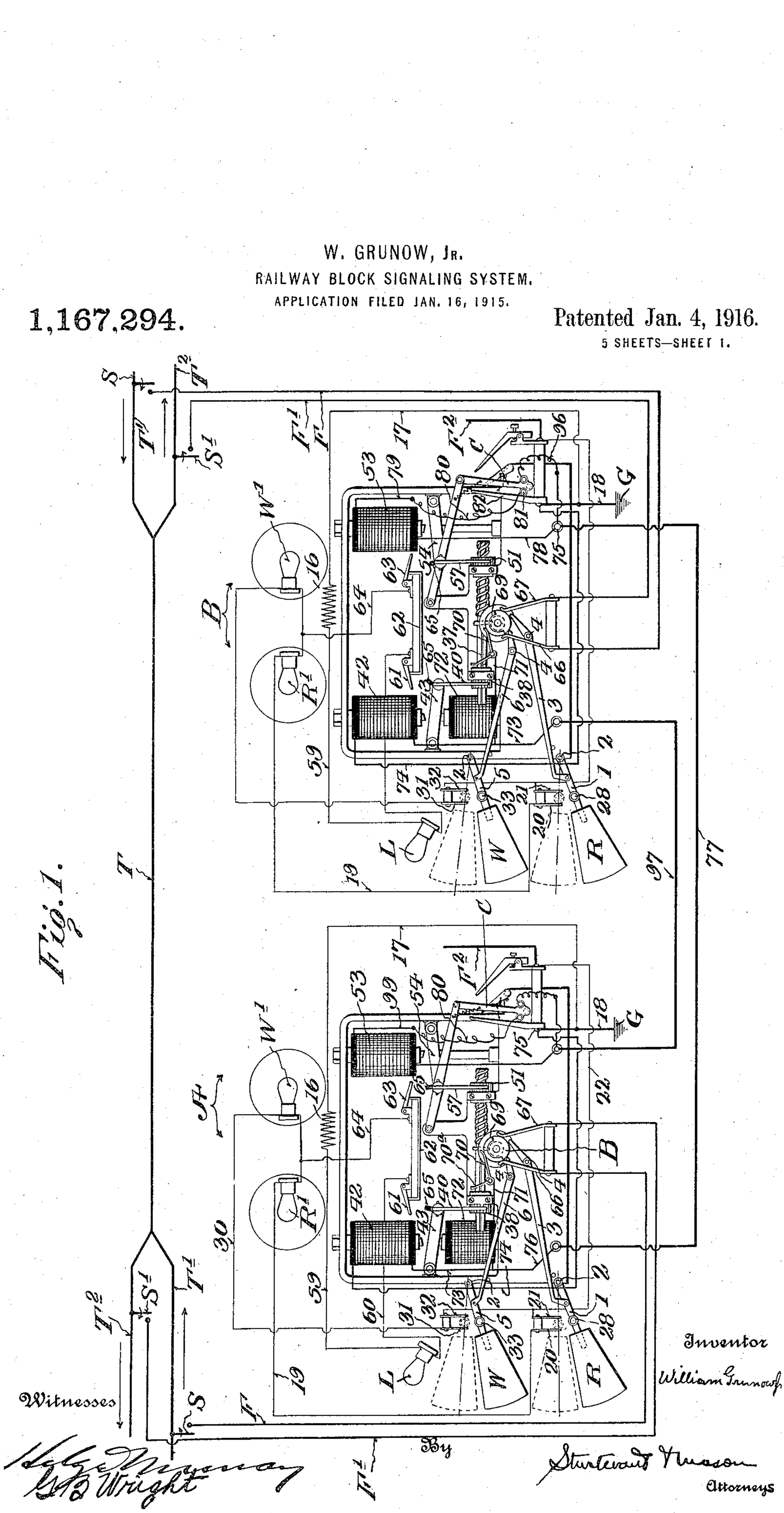
APPLICATION FILED JAN. 16, 1915.

1,167,294.

Patented Jan. 4, 1916.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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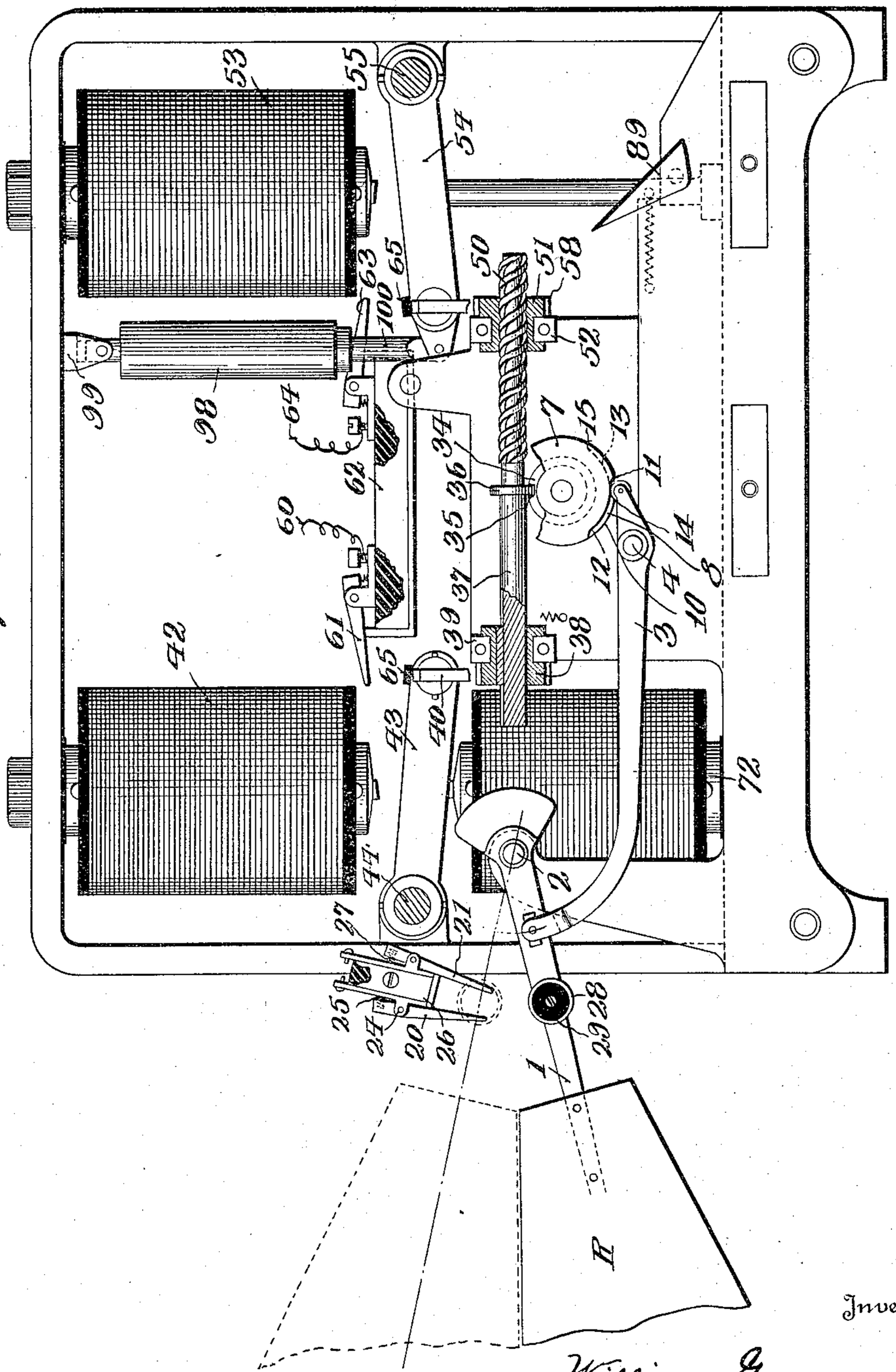
5 SHEETS—SHEET 2.

Fig. 2.



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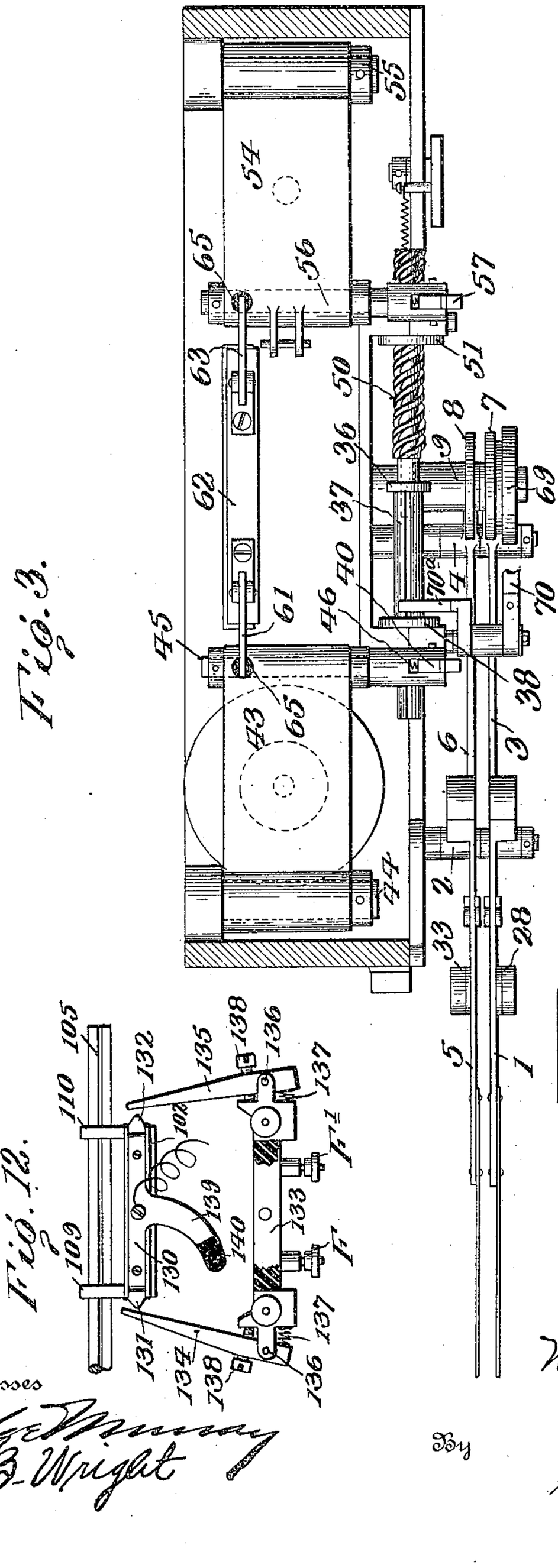

Fig. 3.

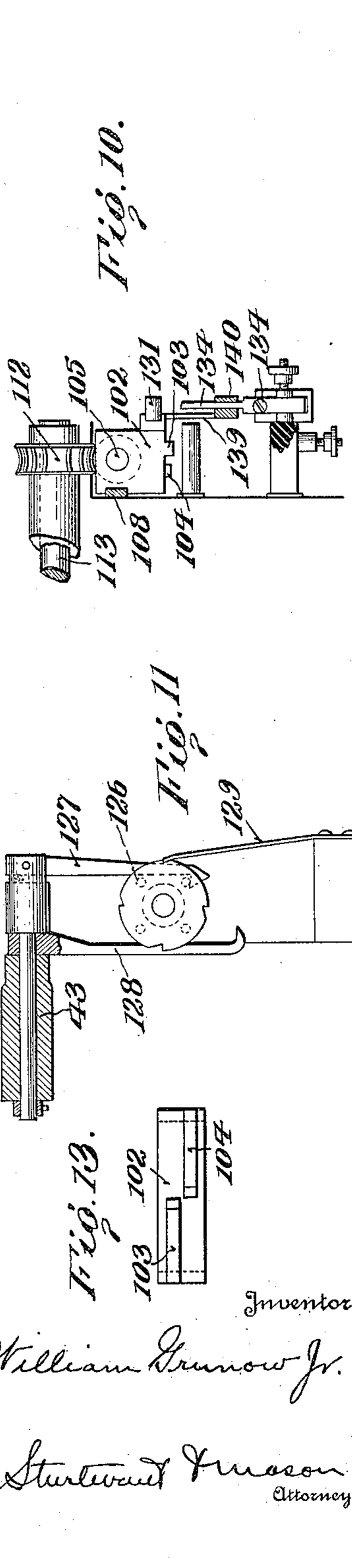

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

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5 SHEETS—SHEET 4.

Fig. 4.

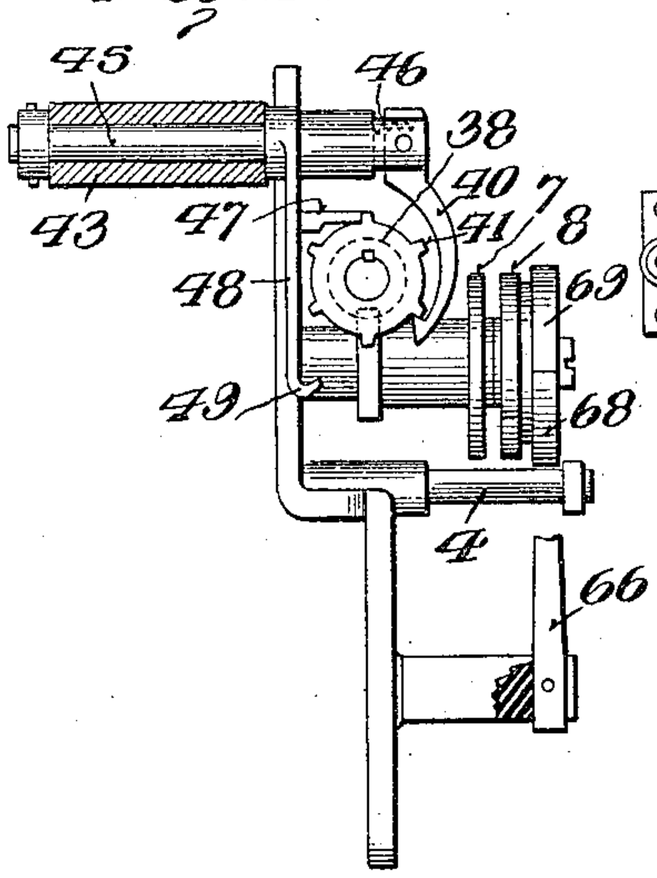


Fig. 5.

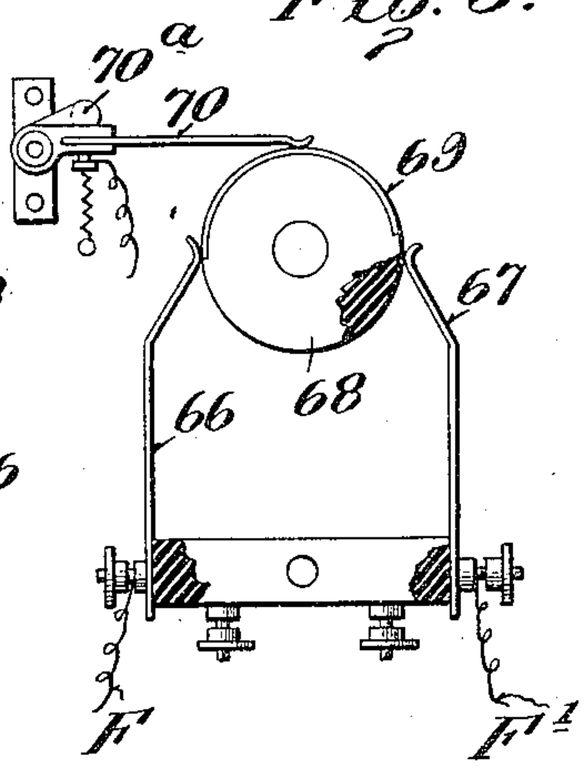


Fig. 6.

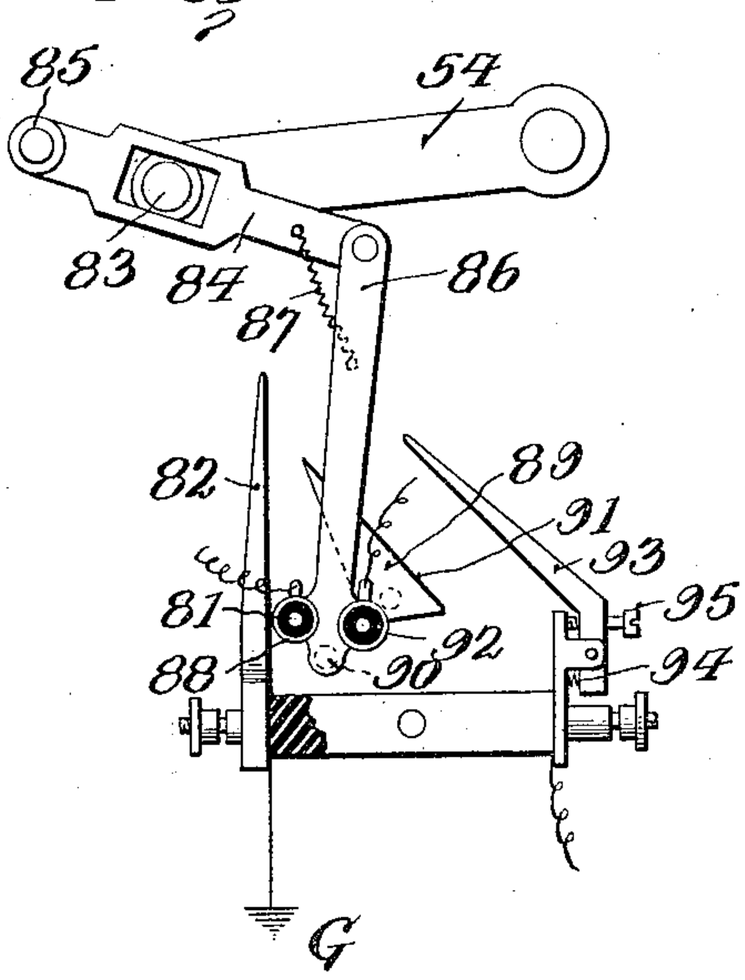
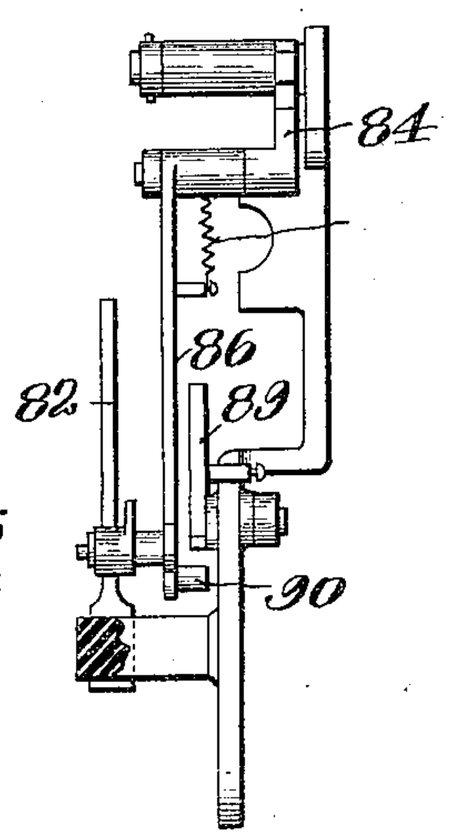


Fig. 7.



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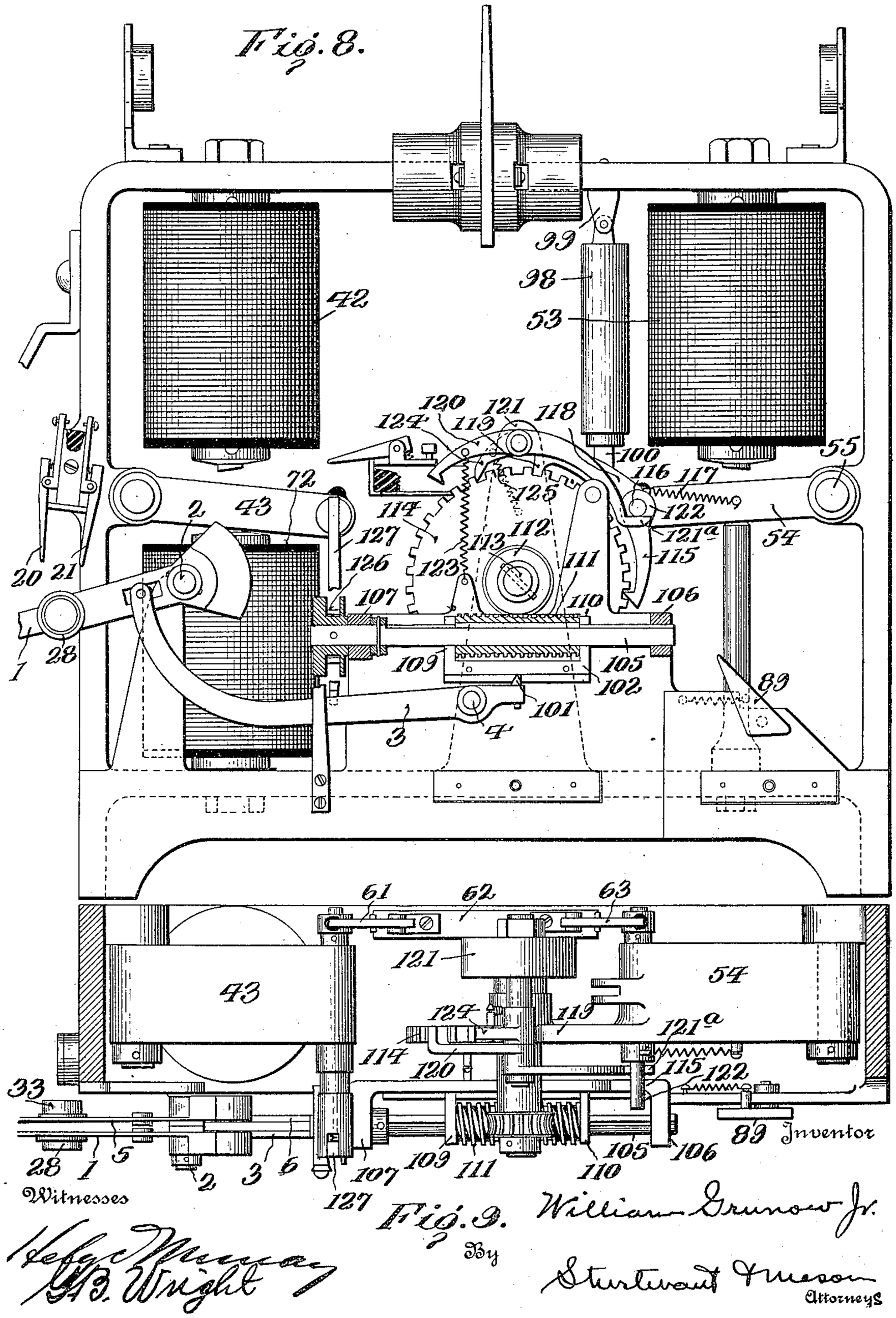
5 SHEETS—SHEET 5.

Fig. 8.



Witnesses

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Fig. 9.

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UNITED STATES PATENT OFFICE.

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RAILWAY BLOCK-SIGNALING SYSTEM.

1,167,294. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed January 16, 1915. Serial No. 2,686.

To all whom it may concern:

Be it known that I, WILLIAM GRUNOW, Jr., a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Railway Block-Signaling Systems, of which the following is a description, reference being had to the accompanying drawing and to the figures of reference marked thereon.

The invention relates to new and useful improvements in railway block signaling systems, and more particularly systems of this character wherein the signals are automatically set and released by the car as it enters and leaves a block.

An object of the invention is to provide a signal system wherein the danger signal at the end of the block is first set by a car entering the block, and the permissive signal is subsequently set, the setting of the permissive signal being determined entirely by the setting of the danger signal, so that any breaking down of the system which would prevent the proper setting of the danger signal results in a failure to give the permissive signal.

A further object of the invention is to provide a signal system of the above character, wherein an outgoing car leaving the block first releases the permissive signal at the entrance to the block, after which the danger signal at the outgoing end of the block is released, which insures that any breaking down of the system which would prevent the releasing of the permissive signal will likewise prevent the releasing of said danger signal.

A further object of the invention is to provide a signal system of the above type with devices for causing a time interval between the setting of the danger signal and the setting of the permissive signal, and likewise a time interval between the releasing of the permissive signal and the releasing of the danger signal, whereby the system may be operated on two independent circuits, one for each direction of travel, an energizing current passing in one direction in a circuit for the first operation and being repeated over said circuit from a separated feeder for the second operation.

A further object of the invention is to provide a signal system wherein the electromagnet for the permissive signal is in multiple with the electromagnet for the danger signal, and wherein a third electromagnet is in series with and opposed to the electromagnet for the permissive signal when the danger signal is being set for preventing the setting of said permissive signal, and wherein said electromagnet for operating the permissive signal is alone in circuit when the current is repeated over the circuit after the danger signal is set.

A further object of the invention is to provide a signal system wherein the signals are operated automatically by a car entering or leaving either end of the block with devices for cutting out the ingoing controlling switch at one end of the block upon the closing of the ingoing switch at the other end of the block by a car entering the block.

A still further object of the invention is to provide a signal system wherein the signals are automatically operated by the cars, and wherein several cars may enter the block from the same end, said cars being counted in and counted out by the signal-operating devices with means for preventing the operation of the signal devices by an ingoing car when a predetermined number of cars have entered said block until after a car in the block operates the outgoing switch for said signal devices.

These and other objects will in part be obvious, and will in part be hereinafter more fully described.

In the drawings,—Figure 1 is a diagrammatic view showing two signal units at the opposite ends of a railway block for automatically controlling the cars entering and leaving the block; Fig. 2 is an enlarged front elevation with parts in section, showing a portion of the signal apparatus; Fig. 3 is a view partly in section and partly in plan, showing the devices actuated by the electromagnets for setting and releasing the signals; Fig. 4 is a detail partly in section and partly in side elevation, showing the actuating cams for the signals and the means for oscillating the same; Fig. 5 is an enlarged detail showing the reversing switch; Fig. 6 is a detail in front elevation showing the repeating switch and the devices for operating the same from the armature of the electromagnet controlling the danger signal; Fig. 7 is a side elevation of the same; Fig. 8 is a view similar to Fig. 2, showing a modified form of mechanism for actuating the signals; Fig. 9 is a view similar to Fig.

3, of the structure shown in Fig. 8; Fig. 10 is a view partly in end elevation and partly in section, showing the cradle and the devices for operating the same; also the reversing switch for this modified form of the invention; Fig. 11 is a view partly in section and partly in end elevation, showing the ratchet and its actuating mechanism for moving the cradle in one direction; Fig. 12 is a view in front elevation, showing the reversing switch for the modified form of the invention; Fig. 13 is a bottom plan view of the cradle.

The invention consists generally in providing a railway block signal system wherein there is a signal unit at each end of a block. Each signal unit has two feeders connected to a source of supply current at the end of the block, and there is a normally open switch for each feeder, one switch being operated by an ingoing car and the other by an outgoing car. Each signal unit has a permissive signal and a danger signal; these signals are set and released by actuating devices which lock the signal in set position. The actuating devices are operated by the movable armatures of electromagnets. The electromagnet of the permissive signal in one signal unit is in circuit with the electromagnet of the danger signal of the other signal unit, and there are, therefore, two separate circuits connecting the signal units at the ends of the block. The feeders lead to a shiftable bridge which operates when a car enters a block to cut in the switch at the opposite end of the block for an outgoing car and to cut out the switch for the ingoing car at that end of the block. This shiftable bridge also counts in and counts out the cars entering the block one after the other in the same direction. The signal-actuating devices likewise count in and count out the cars, so that the last car in a block as it actuates the outgoing switch will restore the signal units to normal released position.

A locking magnet is associated with the operating magnet for the permissive signal, and prevents the operation of the same when setting the danger signal. A switch and time element is associated with the electromagnet for the danger signal, which repeats a current over the connecting line for the units for operating the electromagnet of the permissive signal alone for setting said signal, so that the danger signal is always set first and after a time interval the permissive signal is set, thus preventing the setting of the permissive signal if the system should break down.

Referring more in detail to the drawings, I have illustrated my invention as applied to a railway for third rail or trolley service, where cars are obliged to travel over a section of single track from opposite directions. The trolley or third rail and the single section of track are indicated in Fig. 1 at T. The ingoing tracks are indicated at T′, while the outgoing tracks are indicated at T². At each end of the block there is a signal unit, one of which is indicated at A and the other of which is indicated at B. These signal units are alike in construction, and a description of one will answer for the other. Like letters and numerals of reference have been applied to the signal units. Each signal unit includes a permissive or "home" signal and a danger or distant signal. The permissive signal is in the form of a white semaphore, indicated at W, and a light indicated at W′ is placed back of an ordinary white lens. The danger signal is in the form of a red semaphore indicated at R, and a light indicated at R′, which is in the rear of a suitable red lens. The red semaphore is carried by an arm 1 freely pivoted on a support 2. A lever 3 fulcrumed at 4 engages the arm between its pivot and the free end thereof, and has a sliding connection therewith, as indicated in Fig. 2 of the drawing. The white semaphore W is carried by an arm 5, which is also freely pivoted on the support 2. The arm 5 is raised and lowered by a lever 6, fulcrumed on the supporting stud for the lever 3, and has a sliding connection with the arm 5 similar to the connection between the lever 3 and the arm 1. The lever 3 at its inner end is adapted to rest against an actuating cam disk 7, while the lever 6 at its inner end rests against the cam disk 8. These cam disks 7 and 8 are fixed to a shaft 9, mounted in suitable bearings in the frame, and project forwardly therefrom. As more clearly shown in Fig. 2, the cam disk 7 has a cut-away section 10, which extends from the point 11 to the point 12 in the disk. The cam disk 8 is also provided with a cut-away section, as indicated at 13 in dotted lines in Fig. 2. This cut-away section extends from a point 14 to a point 15 in the disk. When the disks 7 and 8 are in the position shown in Fig. 2, the inner end of the lever 3, which may be provided with a friction roller, rests on the extreme inner face of the cut-away section, and consequently the outer end of the lever 3 is in its extreme lower position and the semaphore R controlled by the lever is also in its extreme lower position. A rotating of the cam disk 7 in a clockwise direction will cause the roller on the end of the lever 3 to ride up on to the extreme outer surface of the disk 7, and this will depress the inner end of the arm and raise the outer end, thus raising the red semaphore. During this movement of the shaft carrying the disks 7 and 8, the end of the lever 6 is riding on the cut-away portion indicated in dotted lines at 13 in Fig. 2, and as a consequence the white semaphore is not raised. A movement of the disks 7 and 8 in a counter clockwise direction from the position shown in Fig. 2, will cause the

roller on the end of the lever 6 to ride up on to the extreme outer surface of the disk 8, and this depressing of the inner end of the lever 6 will raise the outer end and thus raise the white semaphore. During this counter clockwise movement of the disk from the position shown in Fig. 2, the roller on the end of the lever 3 remains in the depressed or cut-away section and the red semaphore is not raised. It will, therefore, be apparent that a turning of the shaft 9 in a clockwise direction from the position shown in Fig. 2, will raise the red semaphore only, and a turning of this shaft in a counter clockwise direction will raise the white semaphore only. It will be understood, of course, that this signal apparatus is placed in a suitable casing having a window therein, such as indicated in dotted lines in Fig. 1. When the semaphore is in raised position, it will be placed in front of the open window, and when in lowered position it will be hidden by the casing of the signal apparatus.

The lamp R′ is located in a circuit closed by the setting of the danger signal R. This lamp is connected to the feeder F^2 through a line 22 which is connected to the terminal 21 of the switch, the other terminal of which is connected through the line 19 to one terminal of the lamp R′. The terminals 20 and 21 of the switch are normally spaced from each other. These terminals are yieldingly mounted on their support. As shown in Fig. 2, the terminal 20 is pivoted at 24 to a supporting bracket, and a spring 25 normally presses the lower end of the terminal, so that it rests against the stop plate 26. This stop plate and the supporting bracket are preferably formed of insulating material. The terminal 21 is simultaneously mounted, and is pressed by a spring 27 against this same stop plate.

The arm 1 which supports the red signal, carries a ring 28, mounted on suitable insulating material 29, and this ring is adapted when the arm is raised to move between the terminals 20 and 21 and make a connection between these terminals, so as to establish the circuit for producing the light at R′ at the same time the red semaphore is raised. The other terminal of the lamp R′ is connected through the line 64 with an interrupter 63, thence through the contact plate 62 with an interrupter 61 and thence through the line 60 to the lamp L, which is located in the semaphore box, and thence through the line 59 and the resistance 16 to the line 18 and thence to ground. The lamp W′ is located in a circuit closed by the setting of the permissive signal W. This lamp is also supplied with current from the feeder F^2 through the line 22 which is connected to one terminal 32 of a switch. The other terminal 31 of this switch is connected through the line 30 with the lamp W′; the other terminal of the lamp is connected through the line 64 with the same interrupters, the lamp L and resistance 16 to ground. The arm 5 supporting the white semaphore carries a ring 33, adapted to make contact between the terminals 31 and 32 in a similar manner to that described in connection with the terminals 20 and 21. When, therefore, the white semaphore is raised, the circuit is established so as to produce a light in the lamp W′.

The semaphore W and the light W′ will be hereinafter referred to as the "permissive" signal, while the red semaphore R and the light R′, will be referred to as the "danger" signal.

The shaft 9 which controls the position of the disks 7 and 8 is given a partial rotation either in a clockwise direction or a counter-clockwise direction, through the following devices: Said shaft carries a rib or collar 34, provided with a groove at 35 adapted to receive a projecting disk 36 formed integral with a shaft 37. The shaft 37 is capable of endwise movement in suitable bearings, and when said shaft is moved in one direction, the disks 7 and 8 will be moved in a counter-clockwise direction, and when the shaft 37 is moved in the opposite direction, these disks 7 and 8 will be moved in a clockwise direction. One end of the shaft 37 is journaled in a ratchet hub 38, splined to the shaft, so that the shaft may move freely endwise in this hub, but is held from rotation relative to the hub. This hub is mounted in a suitable bracket 39. The hub has been referred to as a ratchet hub for the reason that said hub is rotated at times through the operation of a pawl 40. The ratchet hub 38 has projecting teeth 41.

Secured to the upper part of the supporting frame for the apparatus is an electromagnet 42. Said electromagnet 42 has associated therewith an armature 43. The armature is pivoted at 44 to a suitable projecting lug mounted on the frame of the apparatus. This armature at its inner end carries a rod 45 which projects beyond the side face of the armature and on this rod is pivoted the pawl 40. A spring 46 normally presses the lower end of the pawl to the left, as viewed in Fig. 4. The purpose of yieldingly mounting this pawl, is to permit the same to ride over the teeth of the ratchet hub. When the armature 43 is swung upward, the ratchet hub will be turned one step in a counter-clockwise direction, as viewed in Fig. 4. A locking pawl 47 is mounted on a depending arm 48 and as the armature rises, this locking pawl is withdrawn from the rear of the tooth on the ratchet hub and permits the same to be turned. The arm 48 extends downward, and is provided with a hooked end 49, adapted to be brought up

into the path of the teeth of the ratchet hub on the upward movement of the armature, and prevents overthrow of said ratchet hub. From the above, it will be apparent that when the electromagnet 42 is energized, the armature 43 will be raised, which will in turn raise the pawl 40 and turn the ratchet hub one step or one tooth. This rotation of the ratchet hub will cause a step rotation in the shaft 37. The shaft 37 at the opposite end is provided with a spiral thread 50, and this spiral thread 50 engages a similar thread in a ratchet nut 51. The ratchet nut 51 is mounted to rotate in a suitable bracket 52 carried by the frame of the apparatus.

Mounted in the upper part of the frame is an electromagnet 53. Associated with the electromagnet 53 is an armature 54 pivoted at 55 to a suitable lug carried by the frame of the apparatus. This armature at its inner end is provided with a rod 56, mounted to oscillate freely in the free end of the armature. The rod projects sidewise from the armature, and carries a pawl 57 constructed and mounted in a manner similar to the pawl 40. This pawl 57 coöperates with the teeth 58 on the ratchet nut 51. Said armature is also provided with a similar locking pawl, and a pawl to prevent overthrow, so that the ratchet nut 51 is rotated step by step when the armature 54 is raised and lowered, and said ratchet nut is locked from movement when the armature is in its extreme lower position. As shown in the drawings the armature 54 is in its lower position. Let us assume that the armature 43 is raised through the magnetic coil 42 being energized. This movement of the armature 43 will move the ratchet hub 38 through the distance of one tooth. The ratchet nut 51 is held from movement, and consequently the rotation of the shaft 37 will cause the spiral thread 50 to turn out of the nut 51, and the shaft will move in an endwise direction to the left, as viewed in Fig. 2. This endwise movement of the shaft 37 will through its connection with the cross shaft 9, rotate the cam disks 7 and 8 in a counter-clockwise direction, thus setting the white semaphore or permissive signal. Also, as shown in the drawings, the armature 43 is in its extreme lower position. Now let us assume that the armature 54 is raised. The upward movement of the armature 54 will turn the ratchet nut 51. The ratchet hub 38 is held from rotation through the locking pawl carried by the armature 43. This turning of the ratchet nut 51, which, of course, is held from endwise movement in its supporting bracket, will force the shaft 37 to the right, as viewed in Fig. 2. If the parts are positioned as shown in Fig. 2, the shaft 9 will be turned in a clockwise direction and this will cause the lever 3 to be raised, thus raising the red semaphore or setting the danger signal. Let us assume once more that both the armatures 43 and 54 are raised substantially simultaneously, which would be caused by energizing both the electromagnets 42 and 53, although in actual practice, one is necessarily moved slightly in advance of the other. The raising of the armature 43 through the ratchet hub will turn the shaft 37 in a counter-clockwise direction, as viewed in Fig. 4. The raising of the armature 54 will turn the ratchet nut 51 also in a counter-clockwise direction, as viewed in Fig. 4. This movement of the ratchet nut and this rotation of the spirally threaded shaft, will in effect neutralize each other, so there will be no final endwise movement whatever of the shaft 37. As a consequence, the energizing of both the magnets 42 and 53 would have no lasting effect upon the signals. If there be a danger signal set, it will remain set; if there be a permissive signal set, it will likewise remain set.

Let us assume the armature 43 is operated a number of times in succession. The first operation will turn the ratchet hub 38 one tooth, which will raise the permissive signal. The next operation of the armature 43 will turn this ratchet nut 38 a second step, which will move the shaft 37 endwise a second step, still holding the permissive signal set, as the roller on the end of the lever 6 still rides on the extreme outer surface of the disk 8. The continued movements of the armature 43 will produce continued endwise movements of the shaft 37 in the same direction. After the armature 43 has been operated a certain number of times in succession, let us assume the armature 54 is then operated a number of times in succession. The armature 54 will move the shaft 37 endwise in the opposite direction, and after this armature is operated the same number of times as the armature 43, it will again restore the parts to the normal position shown in Fig. 2, releasing the permissive signal.

The interrupters 61 and 63 are actuated respectively by the armatures for the electro-magnets when the same are raised in the following manner: The armature 43 carries a projecting pin 65, which strikes the interrupter 61 when said armature is raised. The armature 54 likewise carries a pin 65 which strikes the interrupter 63 when said armature is raised. It will thus be apparent that when either armature is raised by the energizing of either the electromagnet 42 or 53, the lamp L will be momentarily disconnected from its source of current and will flash. This will also flash one of the lamps R′ or W′, depending upon which is connected in circuit at this time. This flashing of the light which illuminates the casing for the semaphore, will indicate that the

signaling apparatus has operated to perform its function.

Each signal unit is connected to two feeders. The feeder F leads from a switch S, controlled by an ingoing car to a terminal 66 of the bridging or reversing switch D. The feeder F′ leads from a switch S′ controlled by an outgoing car, to the terminal 67 of said bridging or reversing switch. These switches S and S′ may be of any desired construction, but are preferably so formed as to be operated by a car when moving in one direction only past the switch, and are also preferably so formed as to be normally open and to be momentarily closed by a passing car. It will thus be seen that the signal units are normally disconnected from the current supply, and that these signal units are operated through a current supplied momentarily to the electromagnets as a car passes and closes the switch.

On the end of the shaft 9 is a disk of insulating material 68. Said disk carries a contact plate 69 which is in the form of a segment of a circle, and of such length so that when the terminal 66 is in contact with one extreme end thereof, the terminal 67 is out of contact therewith. A contact finger 70 rests on the contact plate 69. This contact finger 70 is connected to a line 71, which leads to a magnetic coil 72. The line 71 after passing about the magnet 72 is connected with a line 73 leading to the magnet 42; thence to a line 74; to the terminal 75; and thence to ground at G. The line 71 after leaving the magnet 72 also connects with a line 76 which connects with the main line 77 leading from one signal unit to the other. Following the line 77 from the left hand signal unit in Fig. 1 to the right hand figure therein, said line leads to a terminal 75 and thence through a line 78 to the electromagnet 53. The other terminal of the coil on the electromagnet 53 is connected to a line 79 which in turn is connected through a flexible line 80 with a terminal 81. The terminal 81, as shown in Fig. 1, rests against a contact plate 82, connected through a line 18 to ground at G. When the parts are positioned as shown in Fig. 1 with the terminal 66 in engagement with the contact plate 69, and the switch S is closed, current will pass through the contact finger 70, through the line 71 about the electromagnet 72, thence about the electromagnet 42 to ground, and through the main line 77 to the electromagnet 53 in the other signal unit, and thence to ground. It will thus be seen the electromagnets 42 and 53 are in parallel or multiple. The electromagnet 72 is in series with the electromagnet 42 and is opposed to the same, so this electromagnet 72 becomes a locking magnet which prevents the armature 43 from being raised when the electromagnet 42 is energized in the manner above described. When the switch S, therefore, is closed, the electromagnet 42 becomes ineffective to raise its armature, while the electromagnet 53 will raise its armature 54, thus rotating the ratchet nut 51, which in turn will move the shaft 37 endwise to the right as viewed in Fig. 2, and this gives a clockwise movement to the disks 7 and 8, which will set the danger signal in the signal unit which is at the opposite end of the block from the switch operated by the car.

The armature 54 of the electromagnet 53 controls a repeating switch indicated at C in the drawings. This repeating switch is shown in detail in Fig. 6. The armature 54 carries a projecting pin 83, which engages a lever 84 pivoted at 85 to a bracket on the supporting frame of the apparatus. When the armature is raised, this lever 84 will also be raised. Pivotally connected to the free end of the lever 84 is a bar 86. A spring 87 attached to this bar and lever normally holds a ring 88 at the terminal 81 in engagement with the contact plate 82. When the bar 86 is raised, the pivoted switch block 89 yields to permit a pin 90, carried by the bar 86 to pass above the switch block, and when the bar 86 is again lowered, this pin will run on the inclined surface 91 of the pivoted switch block and force the bar 86 at its lower end to the right, as viewed in Fig. 6, thus moving the ring 88 out of engagement with the contact plate 82. This breaks the circuit between the electromagnet 53 and the ground. The downward movement of the bar 86, as above noted, forces the lower end of the same to the right, as viewed in Fig. 6, and causes the ring 92 to engage with a contact plate 93. This contact plate is pivotally supported and a spring 94 normally presses the upper end thereof to the left, while a stop screw 95 limits this movement. When this bar 86 reaches the extreme lower end of its movement, the pin 90 will pass below the switch block 89 and the spring 87 will at once move the same to the left, again causing the ring 88 to engage the contact plate 82. The contact plate 93 is in circuit with a feeder F^2. When the ring 92 engages this contact plate 93, a circuit is established from the feeder F^2 through the flexible line 96 to the terminal 75. The electromagnet 53 at this time is disconnected from its ground and the current from the feeder F^2, therefore, passes back through the line 77 and the line 76 to the line 73, thence about the electromagnet 42 to the line 74, to the terminal 75 of the signal unit at the left, and thence to ground. The switch S was only momentarily closed, so that the coil of the electromagnet 72 is open, and this repeated current through the main line 77 has no effect upon the locking coil, but energizes the coil 42 which in turn will rotate the ratchet hub, moving the shaft 37 of the left hand signal

unit to the left, and this through the turning of the disk 8 will set the permissive signal. From the above, it is to be noted that the closing of the switch S by a car entering the block T first operates through the electromagnet 53 to set the danger signal at the opposite end of the block. The setting of the danger signal, after the trolley switch circuit has been opened, causes a current to be repeated through the main line 77 to the electromagnet 42, which will in turn set the permissive signal.

I have above described the circuits for the electromagnet controlling the permissive signal in the left hand signal units, and for controlling the electromagnet for setting the danger signal in the right hand signal unit. The circuits for controlling the permissive signal in the right hand signal unit and the danger signal in the left hand signal unit, are precisely the same as those above described, with the exception that there is a separate or independent main line 97.

In order that there may be a sufficient time interval between the closing of the repeating switch and the switch controlled by the car, I have provided a dash pot consisting of a cylinder 98, which is pivotally attached to a supporting lug 99 carried by the frame of the apparatus, and a piston 100 pivoted to the armature 54. This dash pot is so arranged that when the armature drops through the action of gravity, it will drop very slowly. Furthermore, it will be noted the repeating switch is closed on the downward movement of the armature, and the downward movement of the armature only occurs after the circuit has been broken at the switch S. It will, therefore, be apparent that I am able to use a single line connecting the signal units, and that the current is fed over this line from one end of the block to the other for operating the danger signal, after which the repeating switch is closed and a current is fed over this same line in the opposite direction for operating the permissive signal at the entrance to the block.

The setting of the danger signal in the signal unit at B, Fig. 1, rotates the shaft 9 carrying the bridge contact plate 69 in a clockwise direction, which disconnects the terminal 66 from said bridge plate and connects the terminal 67 thereto. The closing of the switch S at the left of Fig. 1, which causes the setting of this danger signal at the right or at the signal unit B, turns the shaft 9 in a counter-clockwise direction at the signal unit A, and this maintains the terminal 67 disconnected from the bridge contact plate 69. Therefore, when a car enters the block from the left, closing the switch S at the entrance to the block, the operation of the signal units in setting the danger signal at the opposite end of the block and the permissive signal at the entrance of the block, also disconnects the switch for the incoming car at the opposite end of the block from the signal unit A by the disconnecting of the terminal 66 from the contact plate 69. This same action also connects the switch S′ at the outgoing end of the block with the signal unit B and this is accomplished by causing the terminal 67 to engage the contact plate 69. The entrance of the car, therefore, into the block at the left, disconnects the switch for the incoming car at the other end of the block, so a car approaching can get no signal whatever at the signal unit B. Furthermore, the switch S′ which was normally disconnected from the signal unit B, is now connected thereto, so that when the car leaves the block the signal units will be operated. A closing of the switch S′ by an outgoing car, connects the feeder F′ and the terminal 67, with the contact plate 69, and through the line 71 about the electro-magnets 72 and 42 in series and as these magnets are opposed to each other, there will be no effect on the armature 43 at the signal unit B. The current passes through the main line 97, thence to the electromagnet 53, which will turn the shaft 37 so as to move the same endwise to the right, thus rotating the disk 8 which holds the permissive signal set so as to release the permissive signal. As soon as the permissive signal is released, and the switch S′ is again opened, the armature of the magnet 53 in the signal unit A drops, which closes the repeating switch in the signal unit A connecting the feeder F^2 at the signal unit A with the line 97, which will energize the electromagnet 42 alone in the signal unit B, and this will actuate the armature 43 in the signal unit B and rotate the shaft 37 so as to move the same endwise to the left, and this will turn the disk 37 so as to release the danger signal. It will, therefore, be apparent that a car passing from the block must first release the permissive signal on the entrance to the block, after which the feeder at the entrance to the block is connected through the repeating switch, so as to actuate the controlling cam disk for the danger signal at the end of the block and release the same.

In Figs. 8 to 13 inclusive, I have shown a modified form of the actuating devices for setting and releasing the signals. In this form of the invention, there is a casing supporting the various parts of the apparatus. Certain of these parts are similar in construction and operation to those already described. The red semaphore is carried by an arm 1 fulcrumed at 2, and this arm is raised by the lever 3 fulcrumed at 4. The white semaphore is carried by the arm 5 fulcrumed on the same stud as the arm 1, and this arm 5 is raised by a lever 6. Each of the levers 3 and 6 is provided with a projecting wear plate 101. As a

means for lifting the arms of the semaphores and locking the same in raised position, I have provided an endwise shiftable cradle 102. This cradle, as clearly shown in Figs. 10 and 13 is provided with two ribs 103 and 104. The rib 103 is adapted to cooperate with the wear plate 101 on the lever 3, while the rib 104 coöperates with the wear plate on the lever 6. These ribs terminate adjacent the center of the cradle and are formed with inclined ends. The inclined ends are so positioned that when the wear plate of the lever 3 is released from the rib, the wear plate of the lever 6 is also released from the rib, and both the semaphore arms are down. The shifting of the cradle to the right, as viewed in Fig. 8, will cause the rib 103 to depress the inner end of the lever 3 and raise the red semaphore. A shifting of the cradle to the left from the position shown in Fig. 8 will cause the rib 104 to depress the inner end of the lever 6, and thus raise the white semaphore. When the semaphore arms are raised, the ends of the levers bear on the ribs and said arms are, therefore, positively held raised until the ribs are withdrawn from contact with the wear plates on the levers. The cradle 102 is mounted to slide freely endwise on a shaft 105. The shaft 105 is mounted in suitable bearings 106, 107, and is held from endwise movement therein. The cradle is held from rotating on the shaft by a rib 108 carried by the frame and engaging a groove in the rear face of the cradle. Said cradle has to upwardly projecting arms 109 and 110, which engage the shaft 105, and between these arms is a sleeve 111 having a worm gear on its outer face. This sleeve is splined to the shaft 105, and is free to move endwise thereon. The worm gear of the sleeve 111 meshes with a gear 112, fixed to a shaft 113. The shaft 113 is mounted in suitable bearings in the frame of the apparatus and carries a ratchet wheel 114. The ratchet wheel is turned step by step by the electromagnet 53, which is energized in precisely the same manner as described in connection with Figs. 1 to 7 inclusive. This electromagnet 53 operates upon the armature 54, pivoted at 55. The armature 54 carries a depending pawl 115, pivoted at 116 to the armature, and a spring 117 normally forces the pawl into engagement with the teeth of the ratchet wheel 114.

The armature is also provided with a rigid arm 118, carrying a locking pawl 119. When the armature is in its lower position, the locking pawl 119 engages the teeth of the ratchet wheel 114 and holds the same from movement. When the armature is raised, this locking pawl is lifted from engagement with the ratchet teeth and the operating pawl 115 will turn the ratchet wheel one step in a counter-clockwise direction. The pawl 120 pivoted to the frame 121 operates to prevent overthrow of the ratchet wheel. This pawl has a rearwardly extending arm 121, adapted to be engaged by a pin 122 movable with the armature 54. A spring 123 tends to throw the outer end of the pawl into engagement with the ratchet wheel. When the armature is raised, this pawl is released and the outer end thereof engages between the teeth of the ratchet wheel and limits the throw thereof. Return movements of the ratchet wheel are prevented by a pawl 124, which is also pivoted to the frame 121 and is pressed by a spring 125 into engagement with the ratchet teeth. The above mechanism operates to hold the ratchet wheel from rotation when the electromagnet 53 is ineffective, and rotates the ratchet wheel one step when said electromagnet is energized. A rotation of the ratchet wheel 114 in a counter-clockwise direction causes the gear 112 to turn on the worm gear and the sleeve 111 as a rack, and this forces the worm gear and cradle to the right as viewed in Fig. 8. On the end of the shaft 105 there is fixed a ratchet hub 125. This ratchet hub, as shown in Fig. 11, is provided with four laterally projecting pins 126. The ratchet hub 125 is actuated by the electromagnet 42, energized in precisely the same manner as described in connection with Figs. 1 to 7. There is also a locking magnet 72. The armature 43 carries a depending pawl 127. This pawl is pivoted to a projecting rod carried by the armature and is yieldingly pressed against the pins 126. Overthrow of the ratchet hub is prevented by a depending arm 128 carried by the armature 43, which has a hook-shaped end adapted to engage the pins 126 and limit the movement of the ratchet hub. Return movement of the ratchet hub is prevented by a yielding pawl 129 carried by the frame and adapted to engage notches or teeth formed in the outer face of the hub. When the armature 43 is raised, the ratchet hub will be rotated one step, which in turn will rotate the shaft 105. This rotation of the shaft 105 when the gear 112 is held for movement, will cause the worm gear of the sleeve 111 to move endwise to the left, as viewed in Fig. 8. If the first movement of the armature 43 is followed by a second, then the shaft 105 will receive a second step rotation and will move the cradle another step to the left, as viewed in this figure. Let us suppose that both the electromagnets 42 and 53 are substantially simultaneously energized, so that both armatures 43 and 54 will be substantially simultaneously raised. This will result in a rotation of the ratchet hub, which would tend to move the cradle to the left as viewed in Fig. 8, and also a rotation of the gear 112 in a counter-clockwise di-

rection, which would tend to move the cradle 102 to the right as viewed in Fig. 8, and as these movements occur at the same time, one will neutralize the other, as has been described more fully in connection with the structure shown in Figs. 1 to 7. In this last form of the invention, I have also modified the reversing switch. This reversing switch is shown in detail in Fig. 12. Mounted on the cradle 102 is a contact plate 130, which has projecting ends 131 and 132. Mounted on the frame of the apparatus is an insulated plate 133. This insulated plate carries a terminal 134, which is the equivlent of the terminal 66 of the structure shown in Figs. 1 to 7. The plate 133 also carries a terminal 135, which is the equivalent of the contact plate 67, as shown in Figs. 1 to 7. The plate terminal 134 is normally in engagement with the projecting end 131 of the contact plate 130, while the terminal 135 is out of engagement with the projecting end 132 thereof. The feeder F is connected to the terminal 134, while the feeder F′ is connected to the terminal 135. Each of these terminals is pivoted as at 136 and a spring 137 normally forces the outer end of the terminal toward the contact plate 130. Stop screws 138 limit the movement of these terminals. When the cradle moves to the left as viewed in Fig. 8, which results in a setting of the permissive signal, the contact plate 130 will move to the left and maintain its engagement with the terminal 134. The cradle is successively stepped to the left when one car after another enters the block in the same direction. In order to disconnect the signal units when a predetermined number of cars have entered the block, I have provided the cradle with a depending arm 139, which has an insulated outer end 140. This insulted end of the arm engages the terminal 134 and causes the same to be disengaged from the projecting end 131 of the contact plate 130; this breaks the connection between the feeder F and the signal unit. In the construction shown in Figs. 1 to 7, I accomplish this disconnection of the signal unit from the feeder by providing the contact finger 70 with an upwardly projecting shoulder 70ª, adapted to be engaged by the projecting rib or collar 36 when the shaft moves endwise to the left a sufficient distance to bring these parts into engagement, and this will lift the contact finger from the contact plate 69, thus breaking the circuit.

The operation of my improved block signaling system is as follows: Let us suppose a car enters the block T from the left as viewed in Fig. 1. This will cause a momentary closing of the switch S of the signal unit A, which through the feeder F will furnish the current to the magnetic coils 42 and 72 in series, but as these coils are opposed to each other there will be no effect upon the armature 43. In other words, the coils are so porportioned and balanced that when both are energized by the same current, the armature will remain in its lower position. The current passing about the coils 72 and 42 in series will pass to ground at G. Part of the current passing through the coil 72 will, however, pass through the main line 77 and about the coil 53 of the signal unit B and thence to ground. This will energize the coil 53 of the signal unit B, which in turn will move the actuating device for the signals so as to set the danger signal. The setting of the danger signal also disconnects the terminals 66 of the signal unit B from its bridging contact member, and this, therefore, disconnects the switch S for the ingoing cars at the opposite ends of the block, so any car approaching the block T will be unable to get any setting of the signals. The operation of the actuating parts for setting the danger signal at the signal unit B, after the trolley circuit has been broken, brings into operation the repeating switch C, which breaks the ground connection of the electromagnet 53 and establishes a connection between the feeder F^2 of the signal unit B and the main line 77, so that a current is repeated or sent in the opposite direction from the feeder F^2 over the line 77 to the electromagnet coil 42 only, and thence to ground, and this energizes the coil 42 in the signal unit A, raises the armature thereof and sets the permissive signal in this signal unit. It will, therefore, be seen that the entering of a car into the block through the action upon the switch S sets first the danger signal at the opposite end of the block, and the setting of the danger signal after the switch S is opened brings about the setting of the permissive signal at the entrance to the block. Furthermore, this entrance of the car into the block cuts out the switch for ingoing cars at the other end of the block, so they can receive no signal. If a second car should follow the first one into the block, the switch S would be again closed, and would repeat the operation above described. This operation does not release the danger signal or the permissive signal, and would only cause a flashing of the lamp L through the actuation of the interrupters 61 and 63, which would indicate that the signal units are in operation and the car entering has been counted into the block. The result on the apparatus is to move the cam disks or the cradle another step in the same direction as previously moved. When a car leaves the block T, the switch S′ at the signal unit B will be closed, and this through the feeder F′, which is now connected through the terminal 67 with the contact plate of the signal

unit B, will energize the electromagnets 42 and 72 of the signal unit B, but as these electromagnets are opposed to each other, there will be no effect upon the armature 43 of this signal unit. The current will also pass to the electromagnet 53 of the signal unit A, energizing the same and lifting the armature thereof. This will move the controlling disk or cradle of the signals one step to the right as viewed in Fig. 1, and if there is only one car in the block it will bring these controlling disks or the cradle back to normal position, so as to release the permissive signal. If, however, there are two cars in the block, it will only return the disks one step toward the releasing position. This actuation of the armature of the electromagnet 53 sets into action the repeater switch of the signal unit A, which connects the feeder F^2 of this unit with the main line 97 and the current is repeated or returned over this line to the electromagnet 42 of the signal unit B, which energizes the same, operates the armature thereof and moves the controlling disks or the cradle of the signal unit B one step to the left. If there is only one car in the block, this will bring the controlling disks or cradle to normal position, relasing the danger signal. If there is more than one car in the block, it will merely bring these parts one step toward their normal releasing position. Let us suppose there is a car approaching the block from each end and that the switches S for the ingoing cars at the ends of the block are simultaneously operated. This will simultaneously connect the feeders F with their respective signal units A and B, and as these signal units are connected by two separate main circuits 77 and 97, the effect will be to substantially simultaneously operate the ratchet hub and the ratchet nut of the construction shown in Figs. 1 to 7, and as above described, when these parts are simultaneously operated there will be no shifting of the shaft endwise, and consequently no effect will be produced upon the signals. This results, therefore, in neither car receiving a signal. The cars may back out, as this will have no effect upon the switches S, and as they again approach, whichever car closes the switch first will set a danger signal against the other car and receive a permissive signal. The same operation is true in connection with the structure shown in Figs. 8 to 13. Let us assume again that a car leaves the block simultaneously with the entering of a car into the block; in other words, the switch S of the signal unit A is operated simultaneously with the switch S′ of the signal unit B. First it must be considered that the car which is to leave the block in entering the block has set the danger signal and also the permissive signal, so the parts are not in the position shown in Fig. 1, but on the contrary, the bridging or reversing switch of the signal unit B has been turned so as to make contact with the terminal 67. The operating of these two switches simultaneously, connects the feeder F with the signal unit A and connects the feed F′ with the signal unit B. The feeder F operates through the main line 77 to energize the electromagnet 53 of the signal unit B, which in turn causes an energizing of the electromagnet 42 of the signal unit A. The feeder F′ operates through the line 97 to first energize the electromagnet 53 of the signal unit A and this causes through the repeating switch the energizing of the electromagnet 42 of the signal unit B. In other words, both of the actuating electromagnets in both units are substantially simultaneously energized. The lifting of the armatures substantially simultaneously produces movements which are neutralized, and there is no resulting endwise movement of the shaft or endwise movement of the cradle, and as a consequence there will be no shifting of the signals and only a flashing of the light L. A car entering at the same time a car leaves, avoids the necessity of counting in or counting out the car, as the one balances the other, and, therefore, it is proper that the signal system should remain in exactly the same condition and not be affected by these two cars which simultaneously operate the switches stated.

From the above description, it will be apparent that the "home" or permissive signal, and the distance or "danger" signal are both rendered inoperative should the main lines be broken or become grounded in any manner. Furthermore, with this system the home or permissive signal is obtained only after the distant or danger signal has been first set, and this gives absolute assurance to the entering car of its right of way to proceed with safety through the block. The fact of having received the home or permissive signal is a proof that the danger or distance signal has operated; also that the line circuit wires are in operative connection; otherwise the home or permissive signal could not be obtained.

It will be obvious that minor changes in the details of construction and the apparatus employed, may be made, without departing from the spirit of the invention as set forth in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal, a separate movable danger signal, electrically operated devices movable in one

direction for setting the danger signal and in the other direction for setting the permissive signal, means operated by each car entering a block for moving said devices in the signal unit at the opposite end of the block in a direction for setting the danger signal, and means controlled by each of said movements of the last named devices for moving the devices in the signal unit at the entering end of the block in a direction for setting the permissive signal.

2. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal, a separate movable danger signal, electrically operated devices movable in one direction for setting the danger signal and in the other direction for setting the permissive signal, means controlled by each car entering a block for moving said devices in the signal unit at the opposite end of the block in a direction for setting the danger signal, means controlled by each of said movements of the last named devices for moving the devices in the signal unit at the entering end of the block in a direction for setting the permissive signal, means operated by a car leaving a block for moving the operating devices in the signal unit at the entering end of the block in a direction for releasing the permissive signal, and means controlled by each movement of said last named devices for actuating the operating devices in the signal unit at the outgoing end of the block in a direction for releasing the danger signal.

3. A railway block signaling system comprising signal units at each end of the block, an ingoing and an outgoing switch at each end of the block, each unit including a movable permissive signal, a separate movable danger signal, electrically operated devices movable in one direction for setting the danger signal and in the other direction for setting the permissive signal, means operated by the closing of the ingoing switch at the entering end of the block for moving said devices in the signal unit at the opposite end of the block in a direction for setting the danger signal and for simultaneously cutting out the ingoing switch at that end of the block, and means controlled by each of said movements of the last named devices for moving the devices in the signal unit at the entering end of the block in a direction for setting the permissive signal.

4. A railway block signal system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for setting the danger signal, and means when moved in the opposite direction for setting the permissive signal, electrically operated devices actuated by a car entering the block for moving said member in the signal unit at the opposite end of the block in a direction for setting the danger signal, and means controlled by each movement of said last named devices for moving the member in the signal unit at the entering end of the block in a direction for setting the permissive signal.

5. A railway block signal system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for setting the danger signal, and means when moved in the opposite direction for setting the permissive signal, electrically operated devices actuated by a car entering the block for moving said member in the signal unit at the opposite end of the block in a direction for setting the danger signal, means controlled by each movement of said last named devices for moving the member in the signal unit at the entering end of the block in a direction for setting the permissive signal, electrically operated devices operated by a car leaving the block for moving the member in the signal unit at the entering end of the block in a direction for releasing the permissive signal, and means controlled by each movement of said last named devices for actuating the member in the signal unit at the outgoing end of the block in a direction for releasing the danger signal.

6. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each unit having means for raising the danger signal when moved in one direction and means for raising the permissive signal when moved in the other direction, an electro-magnet and devices operated thereby for shifting said member in one direction, an electro-magnet and devices operated thereby for shifting said member in the other direction, means controlled by a car entering a block for energizing the electro-magnet in the signal unit at the outgoing end of the block for shifting the member in a direction for setting the danger signal, and devices controlled by the operation of said electro-magnet for energizing the electro-magnet in the signal unit at the ingoing end of the block for actuating said movable member therein for setting the permissive signal.

7. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each unit having means for raising the danger signal when

moved in one direction and means for raising the permissive signal when moved in the other direction, an electro-magnet and devices operated thereby for shifting said member in one direction, an electro-magnet and devices operated thereby for shifting said member in the other direction, means controlled by a car entering a block for energizing the electro-magnet in the signal unit at the outgoing end of the block for shifting the member in a direction for setting the danger signal and devices controlled by the operation of said electro-magnet for energizing the electro-magnet in the signal unit at the ingoing end of the block for actuating said movable member therein for setting the permissive signal, means controlled by a car leaving said block for energizing the electro-magnet in the signal unit at the entrance of the block for actuating the movable member in a direction to release the permissive signal, and devices controlled by the actuation of said last named electro-magnet for energizing the electro-magnet in the signal unit at the outgoing end of the block for moving said member in a direction to release the danger signal.

8. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each unit having means for raising the danger signal when moved in one direction and means for raising the permissive signal when moved in the other direction, an electro-magnet and devices controlled thereby for shifting said member in one direction, an electro-magnet and devices controlled thereby for shifting said member in the other direction, means controlled by a car entering a block for energizing the electro-magnet in the signal unit at the entrance of the block which controls the movement of said member in a direction for setting the permissive signal and for energizing the electro-magnet in the other signal unit for raising the danger signal, an electro-magnet in the signal unit at the entrance of the block also energized by the car entering the block, said last named electro-magnet being opposed to the energized electro-magnet in said signal unit for preventing the movement of said movable member, and devices actuated by the electro-magnet in the signal unit at the outgoing end of the block for subsequently energizing the electro-magnet in the signal unit at the entrance of the block for setting the permissive signal.

9. A railway block signaling system comprising signal units at each end of the block, each unit including a permisive signal and a danger signal, electrically operated devices controlled by a car entering the block for setting the danger signal at the opposite end of the block, and electrically operated devices controlled by the danger signal setting devices for setting the permissive signal at the entrance to the block, said danger signal setting devices including a time element for causing a time interval between the setting of the signals.

10. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, electrically operated devices for operating said signals, two independent circuits connecting said electrically operated devices, means controlled by a car entering a block for supplying one of said circuits with current to operate the danger signal at the opposite end of the block, means at the opposite end of the block for repeating a current in said circuit for operating the permissive signal, means operated by the car leaving the block for supplying the other circuit with a current for leasing the permissive signal, and means in the signal unit at the entering end of the block for repeating a current over said last named circuit for releasing the danger signal.

11. A railway block signaling system comprising units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, electrically operated devices for operating said signals, two independent circuits connecting said electrically operated devices, said electrically operated devices including a member having means when moved in one direction for setting the danger signal and means when said member is moved in the other direction for setting the permissive signal, means controlled by a car entering a block for supplying one of said circuits with current to operate the member in the signal unit at the opposite end of the block for setting the danger signal, and means actuated by the setting of the danger signal for repeating a current in said circuit for operating the movable member in the signal unit at the entrance of the block for setting the permissive signal, means operated by a car leaving a block for supplying the other circuit with a current for actuating the movable member in the signal unit at the entrance of the block for releasing the permissive signal, and devices controlled by the releasing of the permissive signal for repeating the current over said last named circuit for releasing the danger signal in the signal unit at the outgoing end of the block.

12. A railway block signaling system comprising signal units at each end of the block, each unit including a permissive signal and a danger signal, a movable member having devices for setting the permissive signal when moved in one direction and for setting the danger signal when moved in the oppo-

site direction, electrically operated devices controlled by a car entering the block for actuating the movable member in the signal unit at the opposite end of the block to set the danger signal, and electrically operated devices controlled by the danger setting devices for actuating the movable member in the signal unit at the entrance to the block for setting the permissive signal, said last named controlling devices including a time element for causing a time interval between the setting of the danger signal and the permissive signal.

13. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for actuating the danger signal and when moved in the other direction for actuating the permissive signal, an electro-magnet and devices controlled thereby for moving said member in one direction, a second electro-magnet and devices controlled thereby for moving said member in the other direction, said devices controlled by the electro-magnets being so constructed that when both electro-magnets are energized simultaneously there will be no resulting movement in said movable member.

14. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for actuating the danger signal and when moved in the other direction for actuating the permissive signal, an electro-magnet and devices controlled thereby for moving said member in one direction, a second electro-magnet and devices controlled thereby for moving said member in the other direction, a circuit connecting the electro-magnet for moving said member in one signal unit in a direction for setting the permissive signal with the electro-magnet in the other signal unit for moving said member in a direction for setting the danger signal, and a separate and independent circuit for connecting the other electro-magnets.

15. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for actuating the danger signal and when moved in the other direction for actuating the permissive signal, an electro-magnet and devices controlled thereby for moving said member in one direction, a second electro-magnet and devices controlled thereby for moving said member in the other direction, a circuit connecting the electro-magnet for moving said member in one signal unit in a direction for setting the permissive signal with the electro-magnet in the other signal unit for moving said member in a direction for setting the danger signal, a separate and independent circuit for connecting the other electro-magnets, a controlling electro-magnet in each signal unit coöperating with the electro-magnet for moving the member in a direction for setting the permissive signal, whereby said last named electro-magnet is rendered ineffective when the circuit is energized by the car entering the block, so that the danger signal only will be set by said car in the signal unit at the opposite end of the block.

16. A railway block signaling system comprising signal units at each end of the block, each unit including a movable permissive signal and a separate movable danger signal, a movable member in each signal unit having means when moved in one direction for actuating the danger signal and when moved in the other direction for actuating the permissive signal, an electro-magnet and devices controlled thereby for moving said member in one direction, a second electro-magnet and devices controlled thereby for moving said member in the other direction, a circuit connecting the electro-magnet for moving said member in one signal unit in a direction for setting the permissive signal with the electro-magnet in the other signal unit for moving said member in a direction for setting the danger signal, a separate and independent circuit for connecting the other electro-magnets, a controlling electro-magnet in each signal unit coöperating with the electro-magnet for moving the member in a direction for setting the permissive signal, whereby said last named electro-magnet is rendered ineffective when the circuit is energized by the car entering the block, so that the danger signal only will be set by said car in the signal unit at the opposite end of the block, and devices actuated by the setting of said danger signal for energizing the electro-magnet only which actuates the movable member for setting the permissive signal in the signal unit at the entrance to the block.

17. A signal unit for a railway block signal system comprising a permissive signal, a danger signal, electro-magnets, armatures actuated thereby, devices controlled by said armatures for setting and releasing the signals, said devices including an endwise movable shaft, a ratchet hub splined to said shaft and supporting one end thereof, a ratchet nut supporting the other end of said shaft and having a thread engagement therewith, an actuating pawl

for said ratchet hub operated by one of said armatures, an actuating pawl for said ratchet nut operated by the other armature, and means operated by said shaft for setting and releasing said signals.

18. A signal unit for a railway block signal system, comprising a permissive signal, a danger signal, electro-magnets, armatures actuated thereby, devices controlled by said armatures for setting and releasing the signals, said devices including an endwise movable shaft a ratchet hub splined to said shaft and supporting one end thereof, a ratchet nut supporting the other end of said shaft and having a threaded engagement therewith, an actuating pawl for said ratchet hub operated by one of said armatures, an actuating pawl for said ratchet nut operated by the other armature, a cross shaft adapted to be oscillated by said endwise movable shaft, cam disks carried by said cross shaft, one for each signal, said cam disks being constructed to raise the signal and lock the same in raised position until released by said cam disks.

19. A signal unit for a railway block signal system, comprising a permissive signal, a danger signal, an electro-magnet, devices actuated thereby for setting the danger signal and releasing the permissive signal, a second electro-magnet, devices operated thereby for setting the permissive signal and releasing the danger signal, and a third electro-magnet operating at times in opposition to the magnet for setting the permissive signal for preventing the operation thereof.

20. A signal unit for a railway block signal system, comprising a permissive signal, a danger signal, electro-magnets, armatures actuated thereby, devices controlled by said armatures for setting and releasing the signals, and a repeating switch operated by the return movement of the armature for said danger signal, and means for retarding said movement of the armature.

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

WILLIAM GRUNOW, JR.

Witnesses:
A. M. PARKINS,
E. G. MASON.