No. 755,822. PATENTED MAR. 29, 1904.

G. P. WHITTLESEY.

TRAIN CONTROL SYSTEM.

APPLICATION FILED SEPT. 26, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1

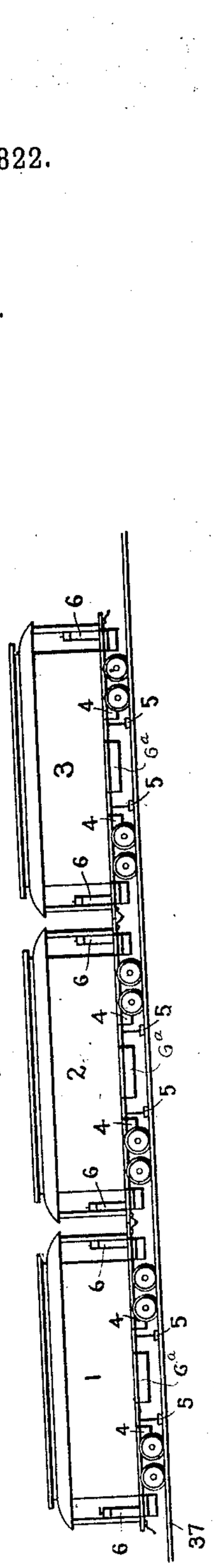
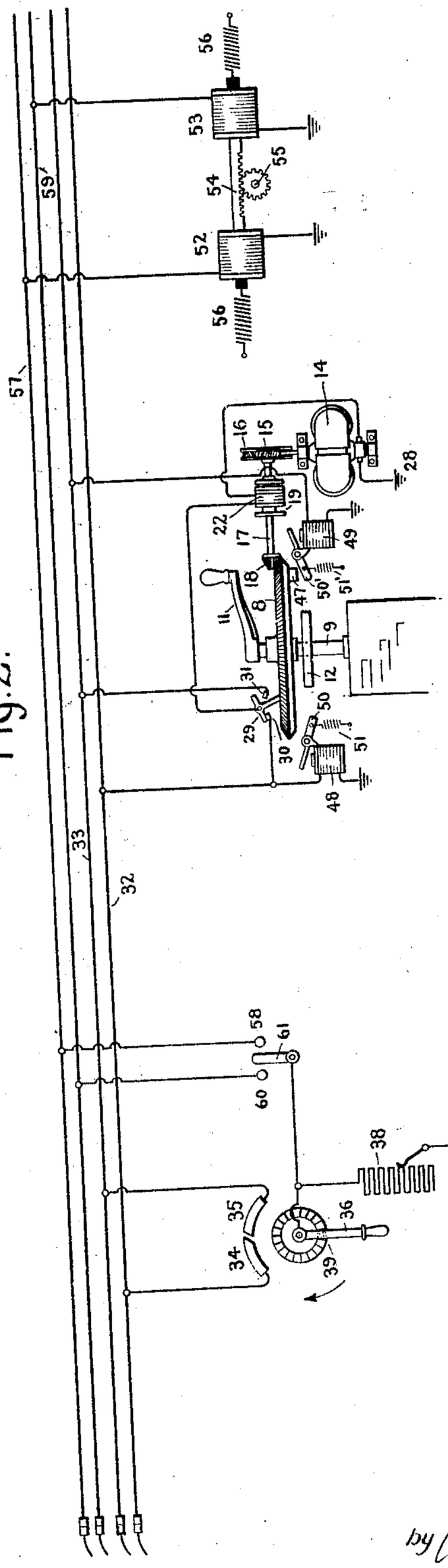


Fig. 2.



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No. 755,822.

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NO MODEL.

3 SHEETS—SHEET 2.

Fig. 3.

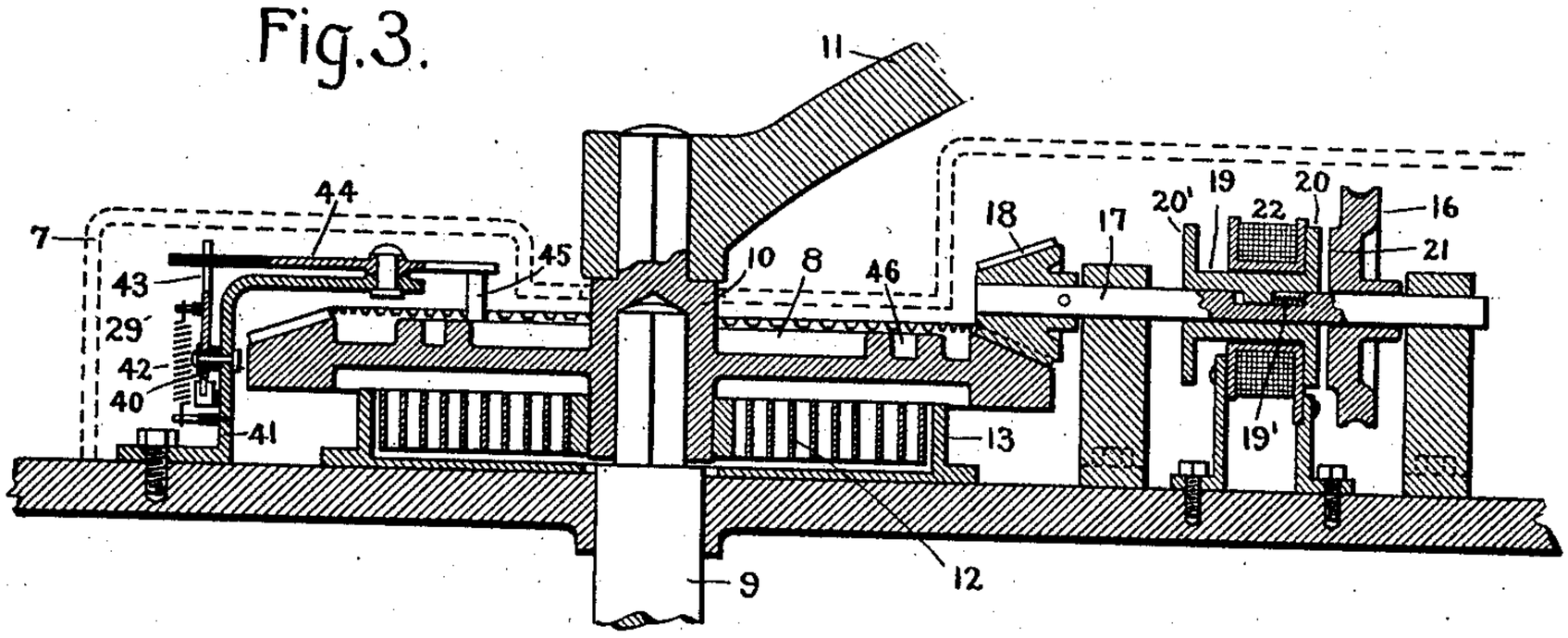


Fig. 4.

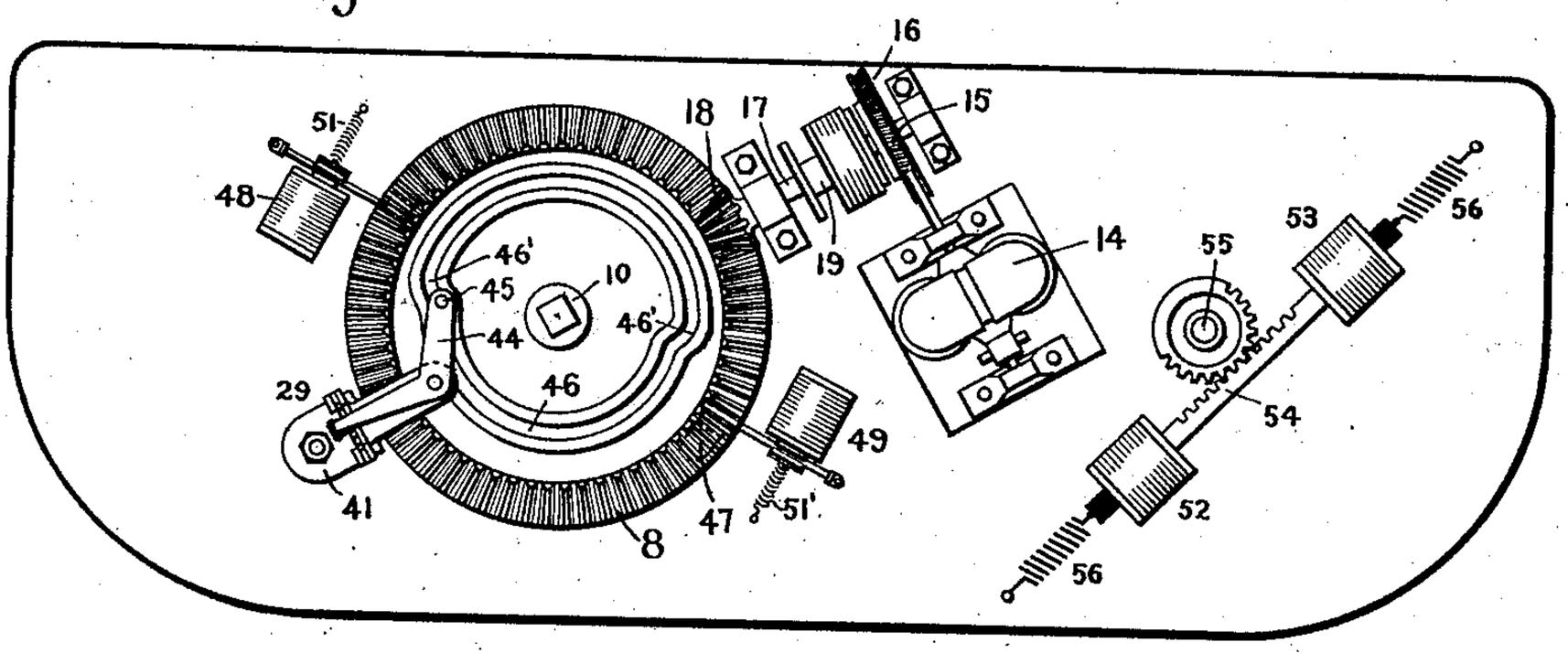


Fig. 5.

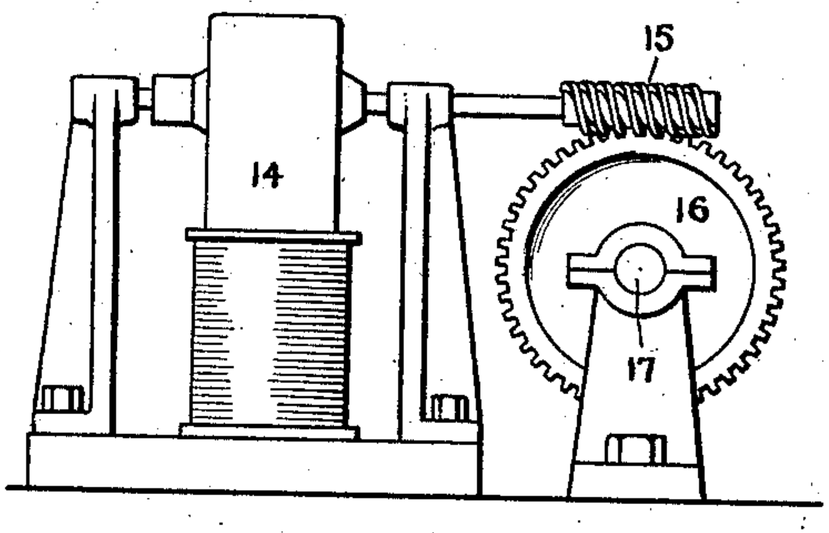


Fig. 6.

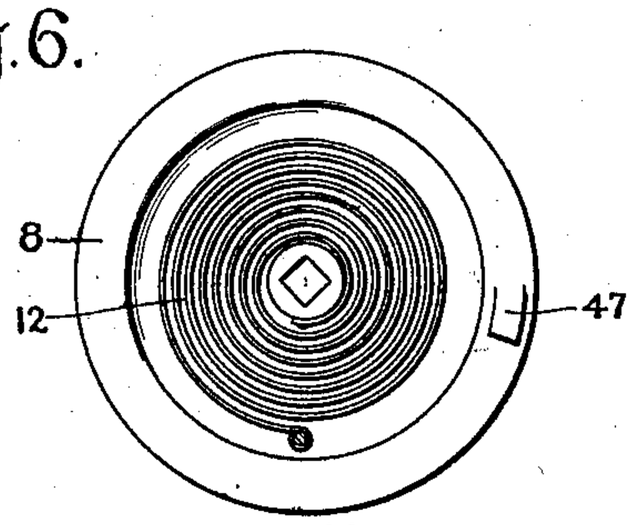


Fig. 7.

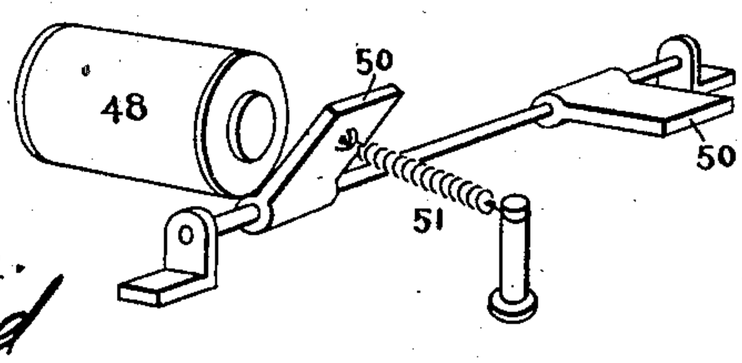
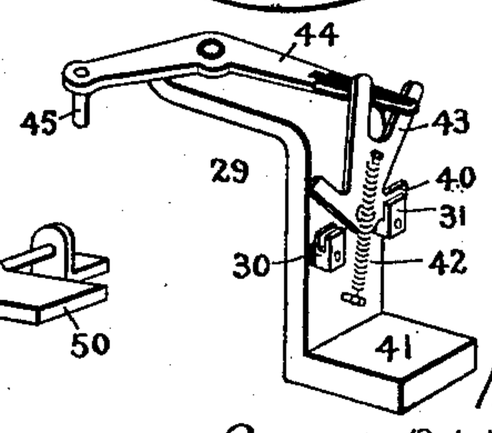


Fig. 8.



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No. 755,822. PATENTED MAR. 29, 1904.

G. P. WHITTLESEY.

TRAIN CONTROL SYSTEM.

APPLICATION FILED SEPT. 26, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

Fig.9

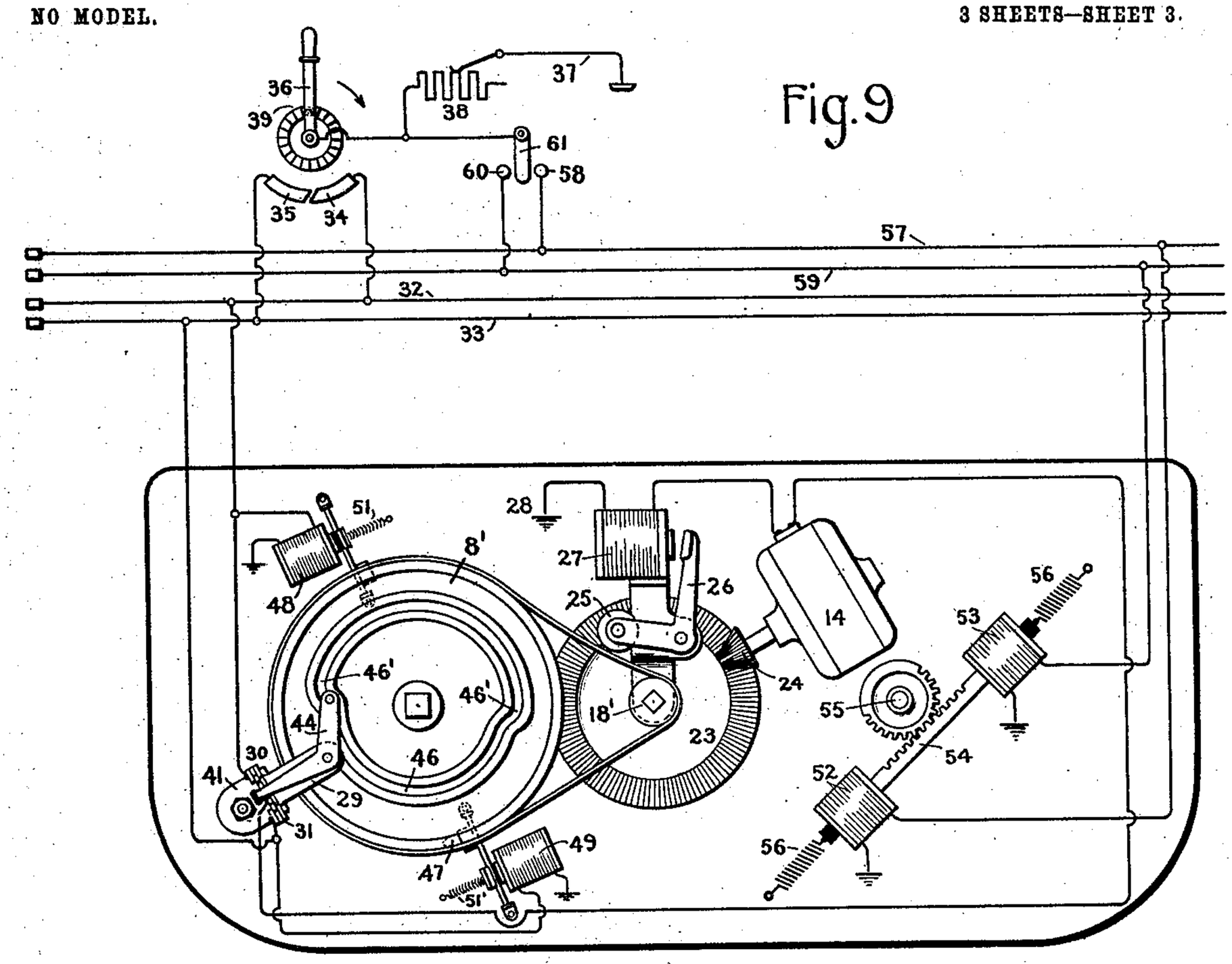


Fig.10.

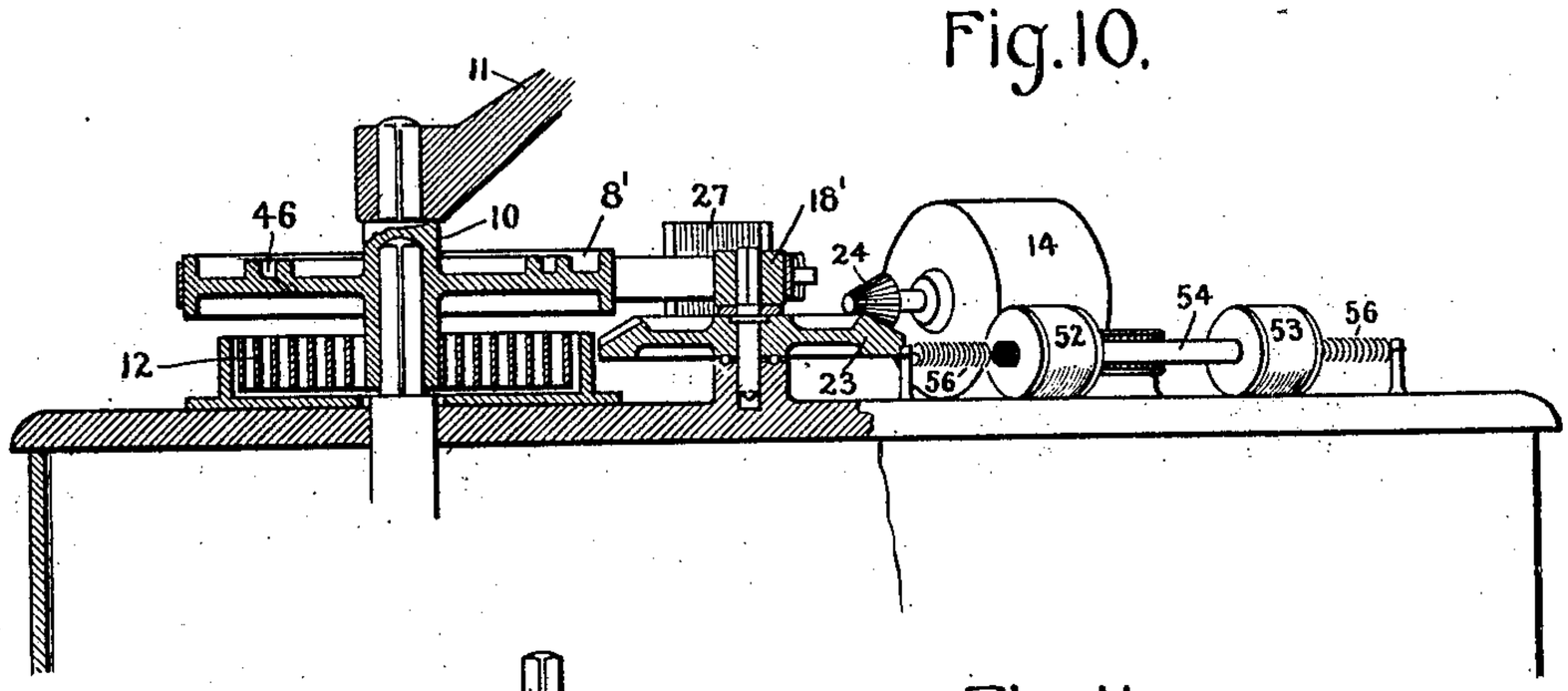
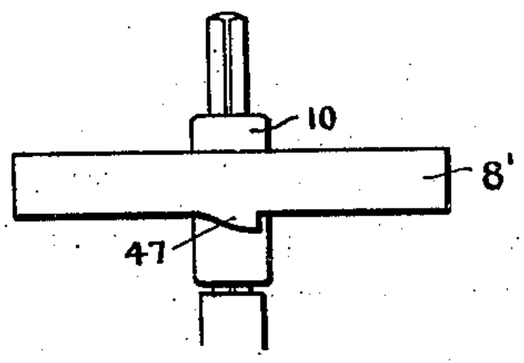


Fig.11.



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No. 755,822. Patented March 29, 1904.

UNITED STATES PATENT OFFICE.

GEORGE P. WHITTLESEY, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TRAIN-CONTROL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 755,822, dated March 29, 1904.

Application filed September 26, 1902. Serial No. 124,898. (No model.)

To all whom it may concern:

Be it known that I, GEORGE P. WHITTLESEY, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Train-Control Systems, of which the following is a specification.

This invention relates to electric railways, and especially to that system of control for a train of electric-motor cars whereby the motors on all the cars can be controlled from any car in the train by means of a master-controller located adjacent to the car-controller and connected with all of said car-controllers by train-wires.

The object of my invention is to simplify the system by utilizing standard car-controllers and by reducing the number of train-wires to four.

Briefly speaking, I take an electric-motor car equipped with one or two standard hand-operated controllers and provide each controller with an attachment by means of which two or more such cars can be made up into a train controllable from either car. The attachment comprises a gear-wheel on the shaft of the controller-cylinder, a small electric motor suitably geared to said wheel, a single-pole double-throw switch constituting a master-controller, two train-wires with which said switch coöperates alternately, a single-pole double-throw switch for connecting the small motor with either of said wires, a cam on the gear-wheel for actuating said second switch, electromagnetic locks for holding the gear-wheel and controller-cylinder in any given position, and a spring for returning the cylinder to the "off" position when unlocked. One of the train-wires may be termed the "series" wire and the other the "parallel" wire. When the master-controller is closed on the series wire, current flows from the trolley-lead through a suitable resistance to the series wire, thence through the motor-switch into the motor, and thence to the ground. The motor turns the controller-cylinder slowly through the several series positions until full series is reached, when the motor-switch is operated by the cam and the motor is switched over to the parallel wire. This being open-circuited at the master-controller, the motor stops and the controller is held by one of the magnetic locks from being thrown back to off position by the spring which has been put under tension by the rotation of the cylinder. The lock is in a shunt around the motor-switch, and thus is not de-energized when said switch is thrown from one circuit to the other. If it is then desired to connect the car-motors in parallel, the master-controller is moved from the series wire to the parallel wire. This open-circuits the electromagnetic lock, but starts up the motor again, and the gear-wheel and controller-cylinder are turned still farther until the several parallel points have been passed over and the car-motors are running in full parallel. At this point the cam throws the switch back to the series wire, and thus open-circuits and stops the motor; but a second electromagnetic lock in shunt to the switch engages the gear-wheel and prevents the spring from acting. When it is desired to return the controller-cylinder to the off position, the master-controller is moved off the parallel wire, thus open-circuiting both wires and both locking-magnets and allowing the spring which has been put under tension by the turning of the gear-wheel to return the cylinder and gear-wheel to the starting-point. When the motor is open-circuited, it is disengaged from the gearing, so that the gear-wheel and controller-cylinder can turn freely. This enables each car to be controlled by hand by means of the ordinary controller-handle when the train-control systems gets out of order or when the cars are to be separately handled in making up or breaking up trains or in moving about the yard or car-barn.

The accompanying drawings illustrate one mode of carrying my invention into practice.

Figure 1 is a side elevation of a train of three motor-cars equipped with my system of control. Fig. 2 is a diagram of the control-circuits for a single car. Fig. 3 is a vertical section of the upper part of a car-controller, showing my attachment. Fig. 4 is a top plan view of the same. Fig. 5 is an end view of the driving shaft and motor. Fig. 6 is a bottom plan view of the gear wheel and spring.

Fig. 7 is a perspective view of the electromagnetic lock. Fig. 8 is a perspective view of the motor-switch. Fig. 9 is a plan view and diagram of a modification. Fig. 10 is a sectional elevation of the same. Fig. 11 is a detail.

The cars 1 2 3 are each provided with the usual propelling-motors 4, current-collectors 5, and hand-operated car-controllers 6, which may be connected directly to the propelling-motors or may be connected to said motors through a motor-controller of the separately-actuated contact type or through any other preferred form of motor-controller. In Fig. 1 I have designated at 6 and 6ª on each car the preferred location of a master-controller and a motor-controller, respectively, such as are employed in the system of train control shown and described in the patent to Case, No. 728,540, granted May 19, 1903, my controller attachment being applied to the master-controllers of said system. On top of each controller I place a casing 7, in which is inclosed the following mechanism: A gear-wheel 8, preferably a bevel-gear, is attached to the shaft 9 of the controller-cylinder, preferably by means of a socketed hub 10, which extends up through the top of the casing 7 and has a polygonal portion to receive the ordinary controller-handle 11, by means of which the controller-cylinder can be turned as usual when desired. Surrounding the hub of the gear-wheel is a coiled spring 12, one end of which is attached to the hub and the other to the controller-case or to an inclosing box 13, secured to said case. This spring returns the controller-cylinder to the off position, when said cylinder is free to move. An actuating electric motor 14 is geared to said wheel 8 by reducing-gearing, so that a motor making one thousand or twelve hundred revolutions a minute will give a speed of not over two revolutions per minute to the gear-wheel 8. Means are provided for disengaging the gearing when the motor is open-circuited, so that said gearing and motor will not interfere with the free movement of the controller-cylinder by the spring or the handle. One mode of accomplishing this result is shown in Figs. 2, 3, 4, and 5, where the motor-shaft has a worm 15, meshing with a worm-gear 16, running loose on a horizontal shaft 17, carrying a bevel-pinion 18, meshing with the gear-wheel 8. Splined on the shaft is an iron hub 19, having one or more flanges 20 20′, the former standing close to a flat face 21 on the worm-gear, the two constituting a friction-disk clutch. To press them together, so that the revolving worm-gear will rotate the shaft, a stationary solenoid 22 surrounds the hub 19, so that the latter can rotate easily therein. The solenoid is in series with the motor, so that when the circuit is closed and the motor starts the solenoid is energized and magnetizes the iron hub 19 and flanges 20 20′, causing them to slide longitudinally into frictional contact with the worm-gear, whose rotation will thus be imparted to the shaft 17, pinion 18, and gear-wheel 8. When the motor is open-circuited, the solenoid is deënergized, and as the friction-disks no longer attract each other they are separated, preferably, by a spring 19′, thus leaving the shaft, flanged hub, and gears free to rotate, while the worm-gear remains stationary. Another mode of accomplishing this result is shown in Figs. 9 and 10, where belt-gearing is used to connect the pulley-wheel 8′ and the pulley 18′, the latter being on a short upright shaft carrying a bevel gear-wheel 23, meshing with a bevel-pinion 24 on the shaft of the actuating electric motor. A belt-tightener 25 is operated by a lever 26 and an electromagnet 27, the latter being in series with the motor, so as to tighten the belt when the motor-circuit is closed. Other equivalent devices may be devised for effecting this general result.

One terminal of the actuating-motor is grounded at 28. The other is connected with a switch 29, arranged to close the motor-circuit on one or the other of two contacts 30 31. The former is connected with a "series" train-wire 32 and the latter with a "parallel" train-wire 33, which are respectively connected with contacts 34 35 of a master-controller located, preferably, on the casing 7 and comprising also a switch-arm 36, adapted to connect either of these contacts with the line-conductor 37 through a resistance 38 if it is desired to cut down the current in the control-circuits. When the switch-arm 36 is in the off position, both circuits are open. The switch-arm is preferably capable of continuous rotary movement and is provided with a ratchet and pawl 39 to oblige the motorman to turn it in one direction only. The contacts 34 35 are so located that the circuit will be closed on the latter just before it is opened at the former in order to start the motor before the electromagnetic lock hereinafter described is deenergized.

The motor-switch 29 is preferably a rocking switch-blade 40, supported on but insulated from a bracket 41 and provided with a spring 42 to give it a snap action in both directions. The blade has a forked arm 43, which loosely engages one arm of a lever 44, fulcrumed on the bracket 41 and provided with a pin 45, entering a cam-groove 46 in the upper side of the gear-wheel 8 or 8′. This groove has offsets 46′ so shaped as to shift the switch at each half-revolution of the gear-wheel and controller-cylinder, a half-revolution being usually necessary to make the circuit changes from the starting-point to full series position and from the latter to full parallel position.

On the under side of the gear-wheel 8 is a lug 47, having one face inclined and the other abrupt. At two diametrically opposite points near the gear-wheel are two electromagnets

48 49, each actuating a pivoted detent 50 50′, which is retracted by a spring 51 51′ when the magnet is deënergized. The detents lie in the path of the lug 47, so that as the wheel 8 is revolved by the motor the lug passes over the detents, its inclined side pressing them down; but owing to the abrupt side of the lug engaging the detent the wheel cannot return so long as one of the detents is held up by its magnet.

The electromagnets 48 49 are respectively in circuit with the train-wires 32 33 and are so located that when the motor has turned the controller-cylinder into full-series position the lug 47 has just passed the detent 50, so that when the motor is open-circuited the detent engages the lug and prevents the spring from returning the cylinder to the off position. When both train-wires are opened, both electromagnets are deënergized and the springs 51 51′ pull the detents out of the path of the lug 47 and permit the coiled spring 12 to operate.

The reversing-switch is operated by two solenoids 52 53, having a common core 54, geared by rack and pinion to the stem 55 of the switch. Springs 56 hold the switch normally in the off position. The solenoid 52 is in circuit with a train-wire 57 and contact 58 and the solenoid 53 with train-wire 59 and contact 60. A switch-blade 61 is connected with the line-conductor and operates to close the circuit of either of said solenoids at will, one placing the reversing-switch in the "forward" position and the other in the "backward" position.

The train-wires are grouped at each end of the car into a flexible cable provided with a suitable coupling for connecting similar wires on adjacent cars.

By means of this invention electric-motor cars can be controlled separately by hand in yards or car-barns and can be made up into trains comprising as many cars as may be desired simply by coupling the cars and the train-wires. At junction-points one or more cars can be dropped off and be capaple of proceeding alone or in another train. If at any time the train-control circuits should get out of order, each car can be independently handled by its own controller.

It is evident that by using more than two offsets in the cam-grooves and a corresponding number of electromagnetic locks the controller-cylinder can be stopped at points intermediate of full series and full parallel.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A system of control for a train of electric-motor cars, comprising one or more standard car-controllers on each car, an electric motor geared to said controller, two motor-supplying train-wires, a switch adapted to connect said wires alternatively with the motor, and means for operating said switch at predetermined points in the rotation of the controller-cylinder.

2. A system of control for a train of electric-motor cars, comprising one or more standard car-controllers on each car, an electric motor geared to said controller, two motor-supplying train-wires, a switch adapted to connect said wires alternately with the motor, means for operating said switch at predetermined points in the rotation of the controller-cylinder, electromagnetic locks for holding the controller-cylinder in predetermined positions, and means for returning the cylinder to the "off" position when unlocked.

3. In a train-control system, the combination with a standard car-controller, of an electric motor geared thereto, two motor-circuits, a switch for opening either circuit and at the same time closing the other circuit, and means rotating with the controller-cylinder for operating said switch to open and close said circuits alternately.

4. In a train-control system, the combination with a standard car-controller, of a motor geared thereto, two train-wires, connections between said train-wires and said motors, a switch for closing either of said connections and at the same time opening the other connection, and means rotating with the controller-cylinder for operating said switch to open one connection and close the other at a predetermined position of the controller-cylinder and for operating said switch to open the last-mentioned connection and close the first-mentioned connection at another predetermined position of said cylinder.

5. In a train-control system, the combination with a standard car-controller, of an electric motor geared thereto, two motor-circuits, a switch controlling both circuits, a wheel rotating with the controller-cylinder and provided with a cam-groove for operating said switch to open and close said circuits alternately, and an electromagnetic lock for the controller-cylinder in each motor-circuit, in shunt to the switch and the motor.

6. In a train-control system, the combination with a standard car-controller, of an electric motor geared thereto, two motor-circuits, a switch controlling both circuits, a wheel rotating with the controller-cylinder, and provided with a cam-groove for operating said switch to open and close said circuits alternately, an electromagnet in each motor-circuit in shunt to the switch and the motor, a pivoted detent operated by each electromagnet, and a lug on said wheel having one inclined side and one abrupt side to coöperate with said detents.

In witness whereof I have hereunto set my hand this 24th day of September, 1902.

GEO. P. WHITTLESEY.

Witnesses:

HELEN ORFORD,

MARGARET E. WOOLLEY.