(No Model.) 4 Sheets—Sheet 1.

J. D. TAYLOR.

AUTOMATIC BLOCK SIGNAL.

No. 516,558. Patented Mar. 13, 1894.

Fig. 1.

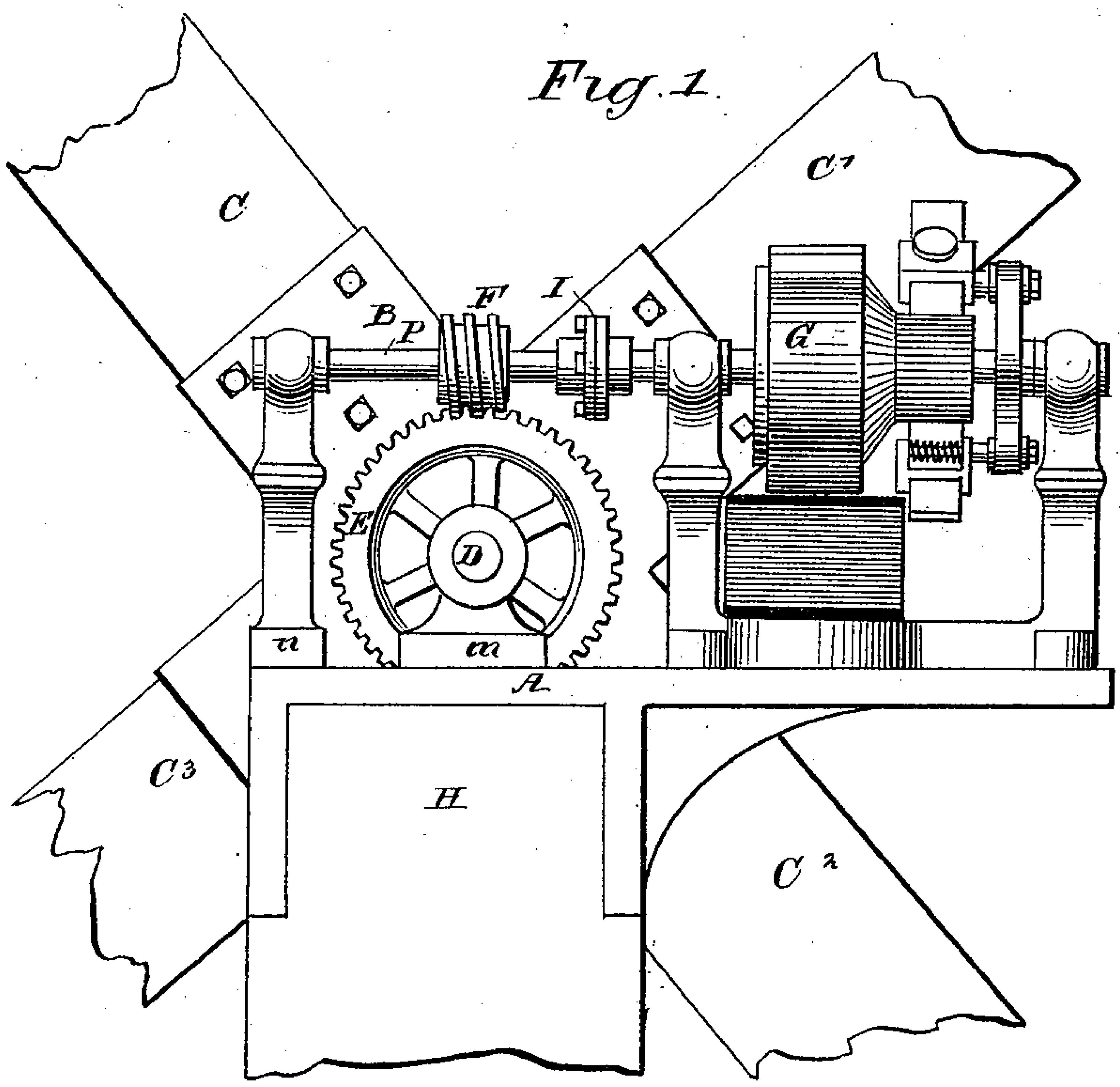


Fig. 2

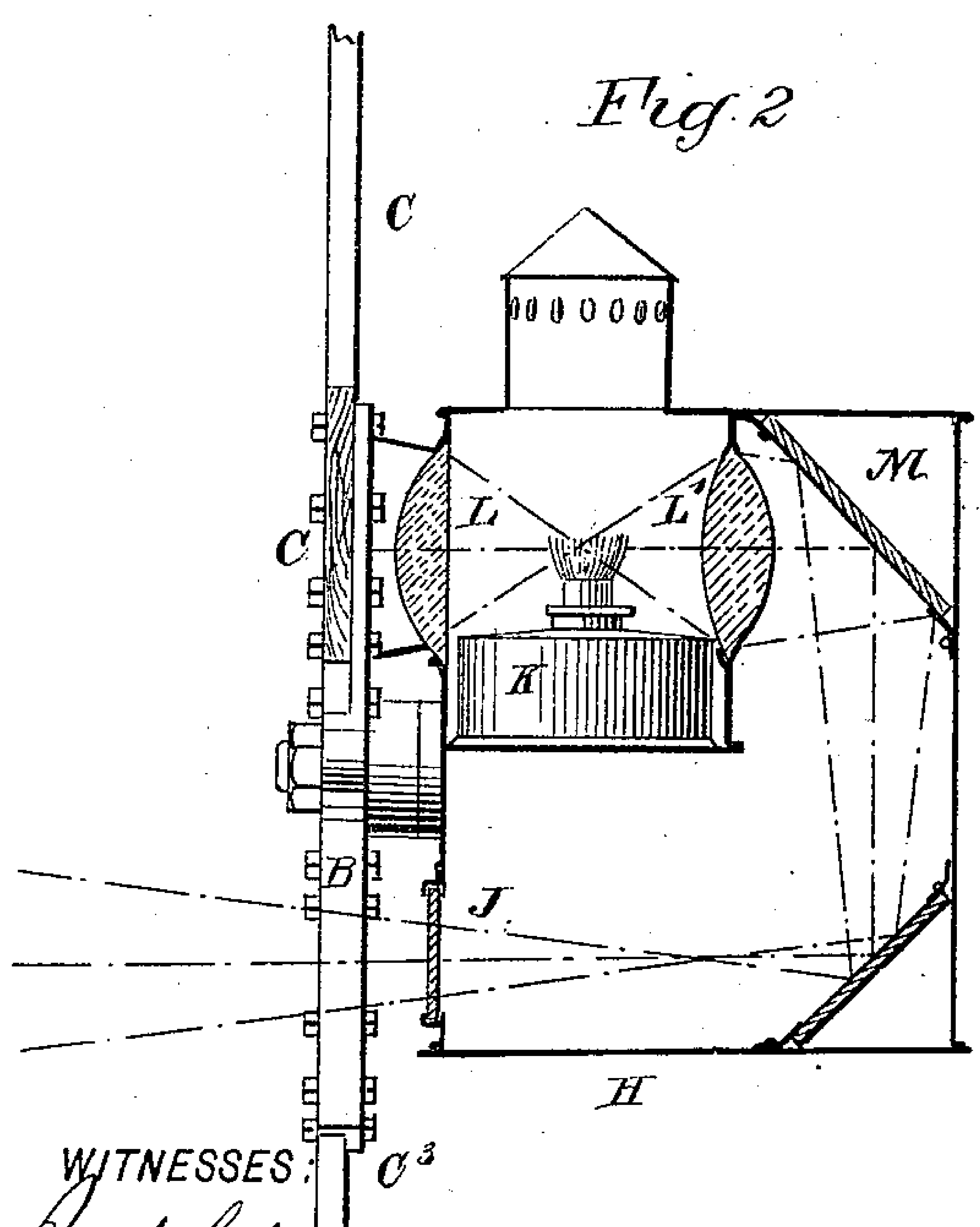
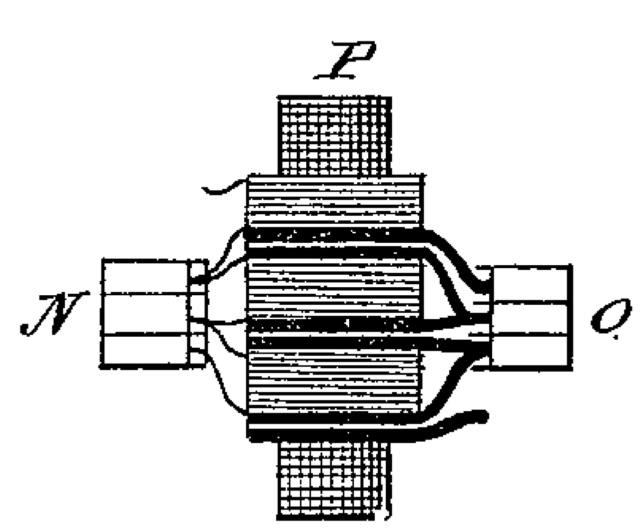


Fig. 3



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J. D. TAYLOR.
AUTOMATIC BLOCK SIGNAL.

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Fig. 4

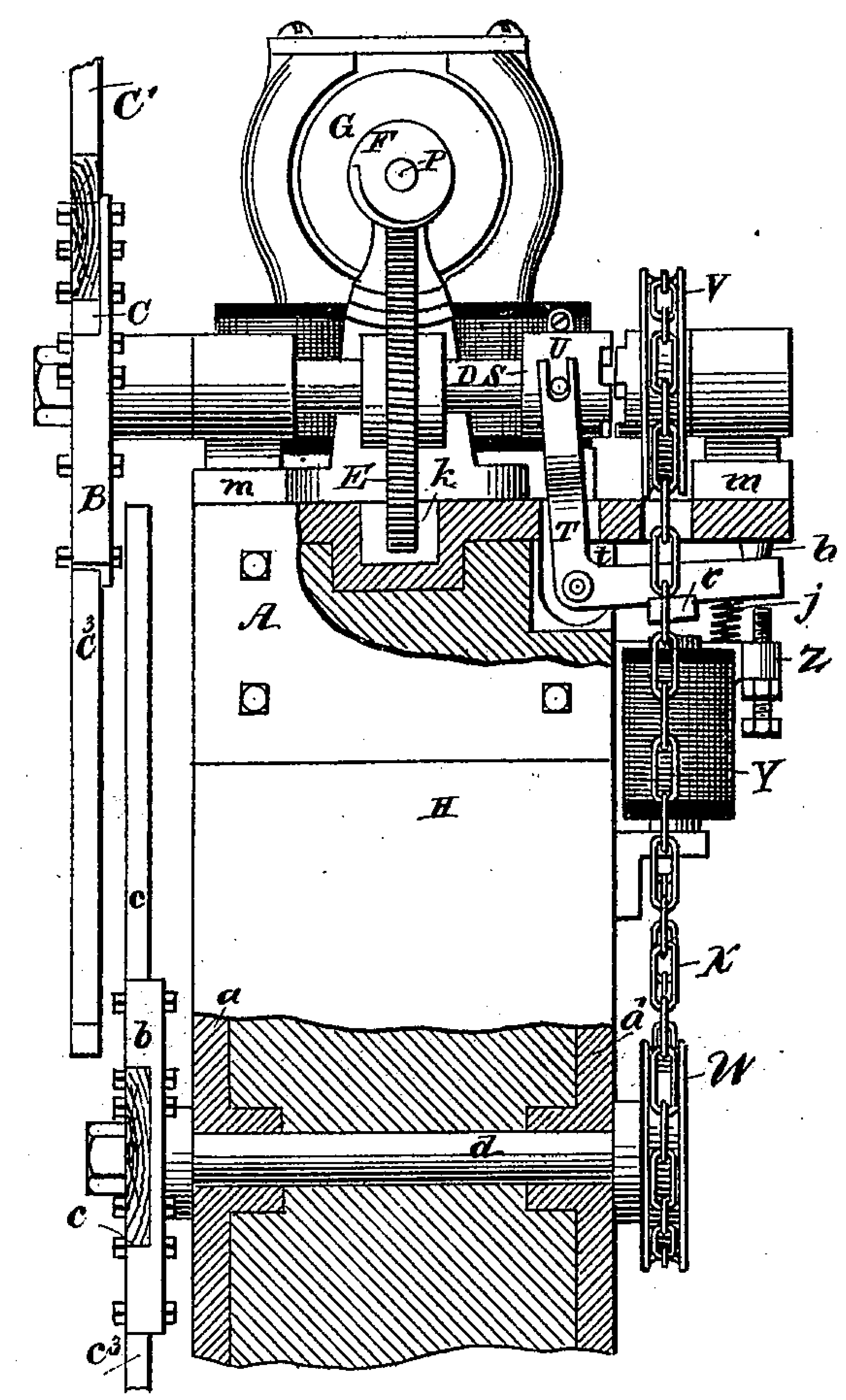
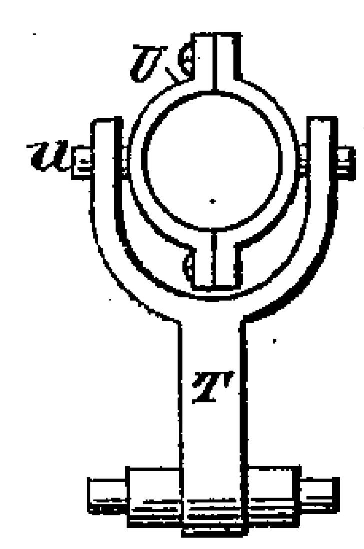


Fig. 5.

Fig. 6.



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AUTOMATIC BLOCK SIGNAL.

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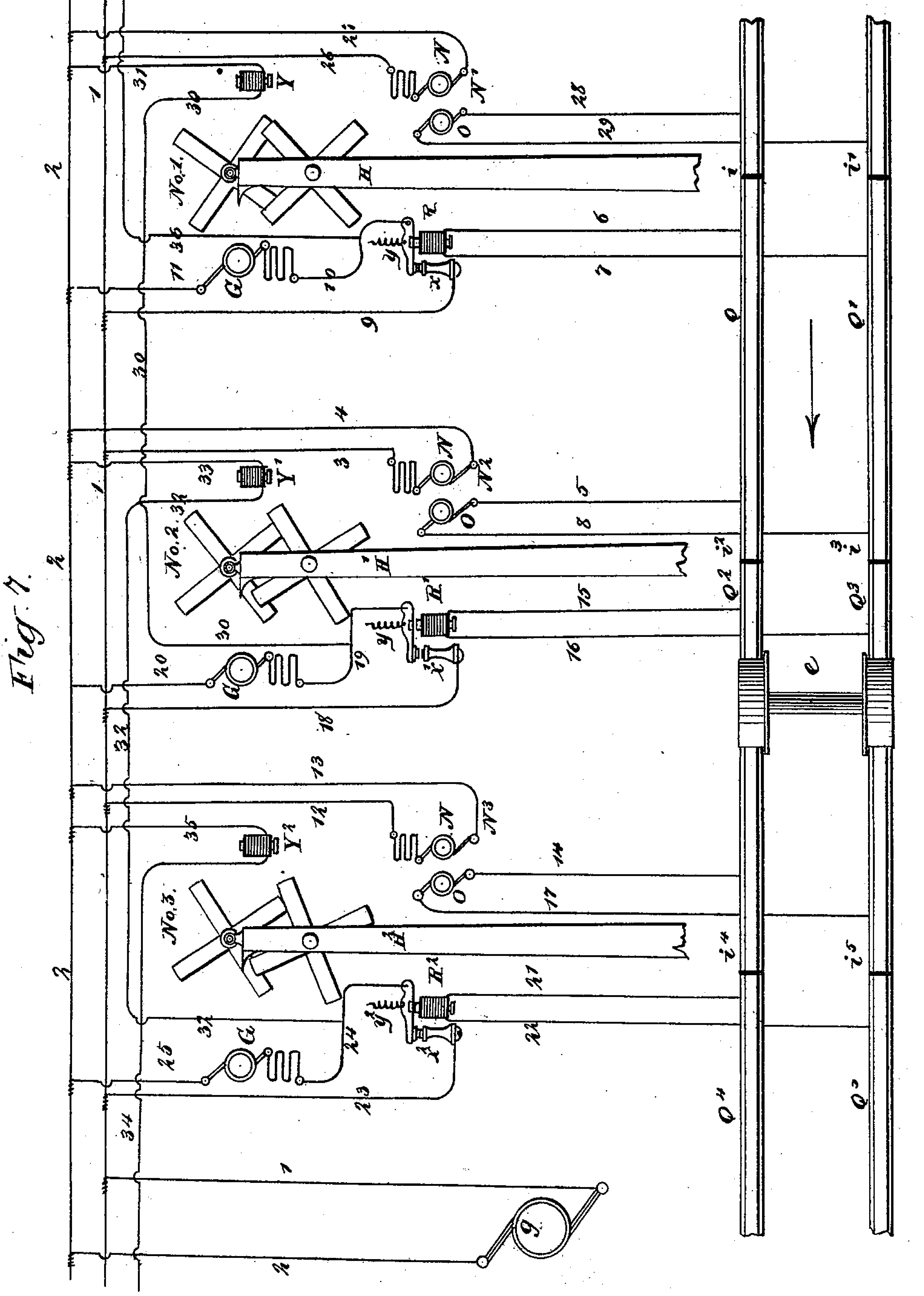

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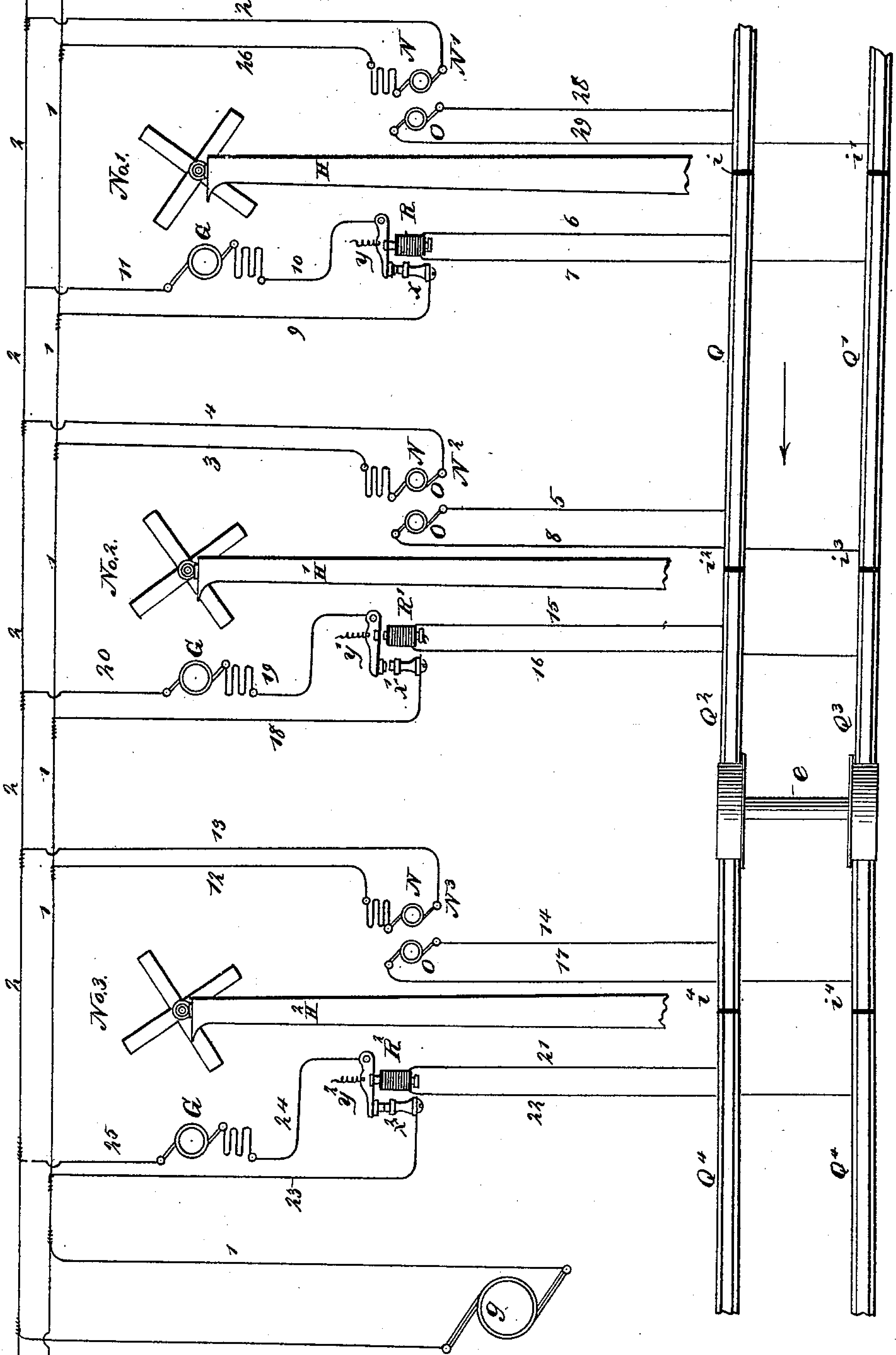
Fig. 8.



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JOHN D. TAYLOR, OF CHILLICOTHE, OHIO.

AUTOMATIC BLOCK-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 516,558, dated March 13, 1894.

Application filed May 29, 1893. Serial No. 475,876. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. TAYLOR, of Chillicothe, in the county of Ross and State of Ohio, have invented a new and Improved Automatic Block-Signal, of which the following is a full, clear, and exact description.

The object of my invention is to provide a signal which will be more plainly visible, and will make a wider distinction between the indications of "danger" and "safety" than is made in signals heretofore used, and which will indicate danger with absolute certainty when danger exists. Also to provide a strong and effective current for controlling the signal.

My invention consists in a signal having two or more radial arms, (preferably four) attached to an axis which can be rotated, an electric motor connected with the axis of the signal, a dynamo driven by a suitable motive power for supplying current to the signal motors, a magnetically-operated clutch for causing one motor to operate two signals, a relay having carbon contacts for controlling the motor and magnets, a motor having two series of windings on the armature, one consisting of a large number of convolutions of fine wire and another consisting of a few turns of heavy wire, a lamp having lenses and mirrors arranged to give two separate and distinct visual signals, and the electrical connections for connecting the different parts in operative relation to each other, all as will be hereinafter more fully described.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar letters and figures of reference indicate corresponding parts in all the views.

Figure 1 is a rear elevation of one of the signals and its operating mechanism as adapted for use at crossings, or for block signalings where it is desired to indicate the condition of the track one block ahead. Fig. 2 is a vertical section through the lamp used for night signaling. Fig. 3 is a side elevation of the armature and part of the coils and commutators of the track circuit generator. Fig. 4 is a side elevation, partly in section, of the signal and operating mechanism adapted to the overlapping system of block signaling. Figs. 5 and 6 are detail views of the clutch and lever for operating it. Fig. 7 is a diagrammatic view of the track, circuits, motors and magnets used in operating the over-lapping system; and Fig. 8 is a diagrammatic view of the track, circuits, motors and magnets used for operating a single block system.

In Figs. 1 and 4, H, is a signal post, to the top of which is secured the casting A, which forms a support for the motor G, and mechanism connecting it with the signal. A shaft D, is journaled in the supports *m*, *m*, and to this shaft is secured the worm wheel E, and spider B which carries the signal arms C, C′, C^2, C^3. The screw F, carried by the shaft *p*, connected with the armature shaft of the motor G by the coupling I, engages the worm wheel E. By this arrangement, whenever the motor G is energized by the current, the worm wheel E will be slowly rotated, thus causing the signal arms C, C′, C^2, C^3 to revolve. When the current is interrupted, the motor will stop and the signal arms will remain at rest and will be locked in position by the screw F.

The rest of the mechanism for adapting the signal to the overlapping block system is shown in Figs. 4, 5 and 6, in which S, is one half of a clutch placed on the shaft D, so as to be free to move longitudinally on the shaft, but prevented from turning thereon by a feather, projecting from the shaft into the groove in the part S. The collar U fits loosely in the circumferential groove in the part S, and is provided with two pins *u*, *u*, at diametrically opposite points, which work in the forked arms of the angled lever T. The chain sheave V, on the boss of which is formed the other part of the clutch, is free to turn on the shaft D, but is prevented from moving longitudinally thereon by a shoulder turned on the said shaft. A shaft *d* is journaled in bearings *a*, *a′*, secured to opposite sides of the post H. To one end of the said shaft *d*, is attached a chain sheave W, which receives the endless chain X passing over the sheave V. To the opposite end of the shaft *d* is secured a spider *b* which carries the signal arms C, C′, C^2, C^3. To the side of the post H are secured the magnet Y and stop Z. The lever T, which is journaled between ears *t* on the casting A, carries on its horizontal arm an armature *r*, which is supported within the field of the magnet Y. When the magnet Y is energized, the armature r is attracted toward it, thus causing the lever T to turn on its fulcrum and move the part S of the clutch, so that it engages the part of the clutch formed on the boss of the sheave V, so that the said sheave V rotates with the shaft D, and transmits motion through the chain X to the sheave W, shaft d and signal arms c, c', c^2, c^3. The screw in the stop Z is set so as to prevent any pressure and unnecessary friction on the clutch S. When the circuit through the magnet Y is broken, the spring j forces back the lever T and separates the parts of the clutch. To cause the upper set of arms to rotate it is necessary for the motor G only, to be energized. To cause the lower set of arms to rotate it is necessary for both the motor G and magnet Y to be energized. To reduce friction of the mechanism to a minimum, the worm wheel E is made to rotate in a body of oil contained in a trough k formed in the casting A.

Referring to Fig. 2, L, is a lens for collecting the rays of light from the lamp K, and throwing them out slightly divergent along the track in the direction of the approaching train, and L', is a lens upon the opposite side of the flame through which light passes to the mirror M, arranged at an angle of forty-five degrees with the horizon, and the said mirror reflects the light vertically downward to a mirror M' arranged at an angle of ninety degrees with the mirror M, and reflects the light in a horizontal direction toward the approaching train through the plane glass J. The said plane glass J, the mirrors M', M, lenses L, L', and the lamp K, are mounted in a casing and form a lantern which is placed at one side of the shaft D, in such relation to the arms C, C', C^2, C^3, as to render it impossible for the said series of arms to obscure both beams of light emerging from the lantern at one time, in whatever position the arms may be stopped. When the signal is rotated, the light will be seen alternately above and below the signal arms as they pass before the lantern, and the light will appear to have a vertical reciprocating motion, and when the signal is stationary either one or both lights will be seen stationary.

I am aware that a signal lantern has been heretofore constructed to emit a direct beam of light and also a reflected beam of light parallel to the first, and I do not claim this broadly, but only in combination with the movable semaphore arranged to alternately eclipse these beams.

In Fig. 3, P, is the armature core of the track circuit generator, N, the commutator cylinder connected with the fine wire coils, and O, the commutator cylinder connected with the heavy winding of the armature. The field magnet may be of any of the well known types, and needs no illustration here. It may be either series or shunt wound. The coils of fine and coarse wire have no connection with each other, but they should be well insulated. The current in the heavy wire is induced by its rotation in the magnetic field and the rotation is produced by the current passing through the fine wire coils, the current being supplied by a dynamo which operates the system in the manner hereinafter described. When the signal rotates it indicates "safety," and when the signal is stationary it indicates "danger." At night, a light (preferably red) having an apparent vertically reciprocating motion, indicates safety, and either one of two red lights, stationary, indicates danger. Each section of the track, for example, Q, Q', Fig. 8, known as a block, is insulated electrically from contiguous sections by insulating pieces i, i', i^2, i^3. The rails of the section Q, are connected electrically throughout its length, and the rails of the sections Q', Q^2, &c., are connected electrically in the same manner. The dynamo g may be located at any convenient point on the line of the road to be protected, and the current carried to the signals by the wires 1 and 2. The generator g sends a current through wires 1, 3, field wires, and coils of fine wire on the armature of the motor N^2, wires 4 and 2 back to the generator g. This magnetizes the field and rotates the armature of the motor N^2, thus inducing a current in the coils of heavy wire on the armature, and if the block Q Q' is clear, as shown, the said current flows through the wire 5, the rail Q, wire 6, relay R, wire 7, rail Q' and wire 8, back to the commutator O, connected with the coarse wire winding of the armature. Part of this current is wasted by conduction between the rails Q and Q' through the ground and ties when they are dry, but more especially when they are wet, and to make the percentage of loss low, the coils of the relay R are made with very low resistance, and a current of low potential and large quantity is used. To secure this, the resistance of the generator must be very low. With primary batteries heretofore used for track circuit work, this condition would be impossible to maintain on account of the rapid consumption of the battery zincs and liquids. In my system, the current of high potential and small quantity is transformed by the motor-transformer into one of low potential and large quantity. A high potential is necessary in the generator g, in order that the waste due to resistance in the wires 1 and 2 may be small. The current mentioned above flowing through the coils of the relay R, energizes it and causes it to attract its armature and draw the armature lever y down into contact with the stop x. This closes the circuit of the generator g, so that the current flows through the wires 1, 9, contact x, lever y, wire 10, signal operating motor G, wires 11 and 2, to the generator g. This energizes the motor G, causing its armature to rotate, thus causing the signal No. 1 to revolve as before explained. While signal No. 1 revolves, it indicates that the block Q Q' is clear, and so long as the block is clear the signal continues to revolve. Suppose a train to be occupying the block Q^2, Q^3, as shown by the wheels and axle at *e*; the generator *g* sends a current through the wires 1, 12, the motor N^3, wires 13 and 2 back to the generator *g*. This rotates the armature of the said motor, inducing a current in the secondary coils connected with the commutator O, of the said motor; but the current is prevented from reaching the relay R′, on account of being short circuited by the wheels and axle at *e*, consequently the relay R′ is not energized, and the lever *y′* of the said relay is released and drawn away from contact with the stop *x′*, by a retractile spring. The circuit through the signal-operating motor G of signal No. 2 is thus broken, the motor is not energized, and signal No. 2 remains stationary. This condition of the said signal indicates that the block Q^2 Q^3 is occupied by a train or a part of a train. Enough resistance is introduced between the commutator O and the rails to prevent the over-heating of the armature coils when the track is occupied by a train. This is easily accomplished by using carbon brushes on the commutator O. If the block Q^4 Q^5 is unoccupied, the signal No. 3 will be rotated as just described for signal No. 1, indicating to the train approaching at *e*, that the block ahead is clear.

The overlapping system of block signaling is illustrated in Fig. 7. The track circuits and insulation are exactly the same as before described in reference to Fig. 8. The current from the generator *g* flows through the wires 1, 3, motor N^2, wires 4 and 2 back to the generator *g*. This causes the armature of the motor N^2 to revolve, inducing a current in the secondary coils of the motor connected with the commutator cylinder O, and the said current flows through the wire 5, rail Q, wire 6, relay R, wire 7, rail Q′, wire 8, back to the commutator O^2. This energizes the relay R, causing the lever *y* to make contact with the stop *x*, and close the circuit through the signal-operating motor G, so that the current from the generator *g* flows through wires 1, 9, stop *x*, lever *y*, wire 10, motor G, wires 11 and 2 back to the generator *g*. This energizes the motor G, causing the upper set of signal arms in signal No. 1 to revolve as before described. The rotary motion of the upper set of arms indicates to a train approaching that signal and moving in the direction indicated by the arrow that the block Q Q′ is clear. If the block Q^2 Q^3 were unoccupied, the relay R′ would be energized in the manner before described, and a circuit would be formed so that a current from the generator *g*, would flow through the wires 1, 18, stop *x′*, lever *y′*, wire 30, magnet Y, wires 31 and 2 back to the generator *g*; this would energize the magnet Y, causing the clutch S to engage the clutch on the sheave V, which would cause the lower set of arms to be rotated in the manner previously stated. This condition of signal No. 1 would indicate that both the blocks Q Q′ and Q^2 Q^3 were clear; but as we suppose a train to be occupying a block Q^2 Q^3 at *e*, the relay R′ will not be energized and the circuit through the magnet Y will be broken between the contact *x′* and lever *y′*, consequently the clutch S will be disengaged from the sheave V, and the lower set of arms of the signal No. 1 will remain stationary. This condition of signal No. 1 indicates that the block Q Q′ is clear, and that the block Q^2 Q^3 is occupied. The circuit through the motor G of signal No. 2 will also be broken between the contacts *x′* and *y′* as before described, and the motor G will not be energized, consequently both the upper and lower sets of arms of signal No. 2 will remain stationary whether the magnet Y′ is in circuit or not. This condition of signal No. 2 indicates that the block Q^2 Q^3 immediately ahead is occupied. If the block Q^4 Q^5 be clear, the relay R^2 of signal No. 3 will be energized as before described, and the lever y^2 will make contact with the contact x^2, thereby closing two circuits for the current from the generator *g*, one through the wires 1, 23, stop x^2, lever y^2, wire 24 and motor G of signal No. 3, the wires 25 and 2, back to the generator, and the other through the wires 1, 23, stop x^2, lever y^2, wire 32, magnet Y′, wires 33 and 2 back to the generator. The current passing through the circuit first described energizes the motor G of signal No. 3, and rotates the upper set of arms of the said signal, and if the magnet Y^2 be energized, it causes the lower set to be rotated also. The current passing over the second circuit described energizes the magnet Y′, but has no effect on signal No. 2, so long as the motor G′ of that signal is not running. As the train indicated at *e* passes the insulating pieces i^4 i^5, the first pair of wheels that touch the rails Q^4 Q^5, short circuits the relay R^2 and breaks both the circuits named above. This stops the motion of both sets of arms on signal No. 3, and disengages the clutch on signal No. 2. After the last pair of wheels leaves the rails Q^2 Q^3, the current is restored through the relay R′, and by means of the relay, through the motor G of signal No. 2 and the magnet Y of signal No. 1, as before described. This causes the upper set of arms on signal No. 2 to be rotated, and the clutch on signal No. 1 to be engaged, causing the lower set of arms to rotate in conjunction with the upper set. The relay R is provided with carbon contacts as they will not oxidize nor fuse and stick together. The signals are intended to be placed with the plane of the arms and of rotation at right angles to the track. In Figs. 7 and 8 they are shown parallel with the track to facilitate showing them on the drawings. The signal operating motor G should be series wound, the field magnet having about double the number of turns of wire usually put on a series motor of the same size in order that the speed may be slow.

To describe my method of distribution, I will suppose the signals in use on a portion of double track road ten miles long. I would locate the generating station containing the generator g and an engine for driving it as near the middle of the portion of road to be blocked as possible, in order to save wire. The main wires 1 and 2 would be connected to the terminals of the dynamo and would extend each as far as the system of blocks extends. For a line of this length I would use a dynamo having an electromotive force of one hundred and ten to one hundred and twenty-five volts and a No. 8 copper wire could be used for the main wires. On the east bound track the secondary coils of the transformers N', N^2, &c., would be connected to the rails at the east end of the sections or blocks and the relays R, R', R^2, &c., would be connected to the west ends of the blocks. On the west bound track this order of course would be reversed but it is only necessary to describe the operations on one track. The primary coils and field coils of the rotary transformers would be connected with the main wires 1 and 2 at the nearest point to the transformer. The motors G, G', &c., would be connected to the main wires 1 and 2 through the contact points of the relays R, R', &c. The transformers and signal motors would be connected to the main wires 1 and 2 in parallel, the same as incandescent lamps. The transformers would always be in circuit and would run continuously but the signal motors, G, would only be in circuit when the contacts of the corresponding relays were closed. The secondary coils of the transformers consist of such a number of turns of wire that an electromotive force of two or three volts will be induced in them by their rotation in the magnetic field of the transformer field magnets, and the wire in the coils is of such a size that it will carry ten or fifteen ampères of current without overheating. Coils of this description would have a very low resistance and the difference of potential at the terminals would be almost constant, that is, no matter how many paths are afforded the current, each one would get as much current as though it were the only one. The object of this arrangement is to keep the current through the relay R as nearly constant as possible, so that when more paths are offered the current, as when the ground is wet, the relay will still get as much current as it would if the ground were dry. This is not perfectly attained because if the potential were absolutely constant, when the secondary coils are short circuited by a train the resistance of which is almost nothing, the current would be almost infinite and either primary or secondary coils would be fused. In order to prevent this just enough resistance is introduced in circuit with the secondary coils to keep the current within the safe limits of ten or fifteen ampères. But the object is much more nearly attained in my method of using transformers than by the old method of using gravity batteries the current from which on short circuit will not exceed one-fourth ampère and the amount circulating in the coils of the relay would not exceed one-twentieth ampère while by my method I can easily get one ampère through the relay R. The current induced in the secondary coils of the transformer flows through the rails and through the relay at the other end of the block. This energizes the relay and causes it to close the circuit through the signal motor G. The current which actuates the motor G comes direct from the dynamo g through the wires 1 and 2.

I am aware that I am using the common rotary transformer and for that reason do not think a more extended description and illustration necessary, but I am using it for an entirely new purpose, for the purpose of removing the greatest difficulty that has heretofore been in the way of automatic block signaling. I could not use a dynamo having an electro motive force of only two volts at the generating station without using an enormously large wire to carry it to the various signals, but I can work the signals economically to a distance of five miles each way from the generating station with an electro motive force of one hundred and twenty-five volts and a No. 8 wire as conductor. With two hundred and fifty volts I could work twenty miles each way with a No. 8 wire and the same amount of loss due to resistance. The signal motors, G, are wound to suit and are worked direct from this electro motive force. As the loss due to conduction between the rails in the track circuit is proportional to the square of the electro motive force used, it is advisable to make this as small as possible, two or three volts is sufficient to force current enough through the rails to operate the relay at the other end of the block. To obtain this electro motive force from the main source of supply, I use the one hundred and twenty-five volts from the mains 1 and 2 to drive a small rotary transformer as any motor would be driven by an electric current. The secondary coils of this rotary transformer are so constructed as to have induced in them an electro motive force of two or three volts. The current obtained from the secondary coils is greater than that required to drive it in the ratio that the electro motive force is less.

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

1. In electrical signaling apparatus for railways, the combination of a dynamo driven by power, a series of electrically operated and electrically controlled semaphore signals, a series of transformers, one at the exit of each block for transforming the current derived from the dynamo to one of low potential, a low potential circuit formed of the secondary winding of the transformer, the track rail, and either the wheels and axles of the train

or the relay at entrance of block, and electrical connections, substantially as shown and described.

2. In a block signal system for railways, the combination, with a revoluble signal, of a source of light yielding two light beams, the said revoluble signal being aranged to eclipse the light beams in alternation, substantially as specified.

3. In a block signal system, the combination of a revoluble signal, an electric motor connected with the signal, an auxiliary revoluble signal connected mechanically with the motor-driven signal, and electro-magnetically-operated clutch mechanism for connecting and disconnecting the auxiliary signal, substantially as specified.

4. In a block signal, the combination of the primary circuit the transformer and secondary circuit, the track circuit taking the current from the secondary circuit of the motor-transformer at one signal, the relay placed in the track circuit at the preceding signal, the signal-operating motor controlled by the relay, and the revolving signal operated by the motor, substantially as specified.

5. The combination, in an overlapping signal, of the motor G, shaft D, arms C, C′, C^2, C^3, the shaft *d*, the arms *c*, *c′*, c^2, c^3, sheaves V, W, chain X, clutch S, lever T, and the magnet Y, substantially as specified.

6. In a block signal system, the combination, with the revolving signal provided with light eclipsing arms, of the lamp K, the lenses L, L′, and the reflectors M, M′, substantially as specified.

7. In a block signal, the combination of the motor G, screw F, worm wheel E oil chamber *k* shaft D, spider B and arms C, C′, C^2, C^3, substantially as shown and described.

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