No. 684,881. Patented Oct. 22, 1901.

H. B. TAYLOR.

RAILWAY SIGNAL.

(Application filed Aug. 7, 1900.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.

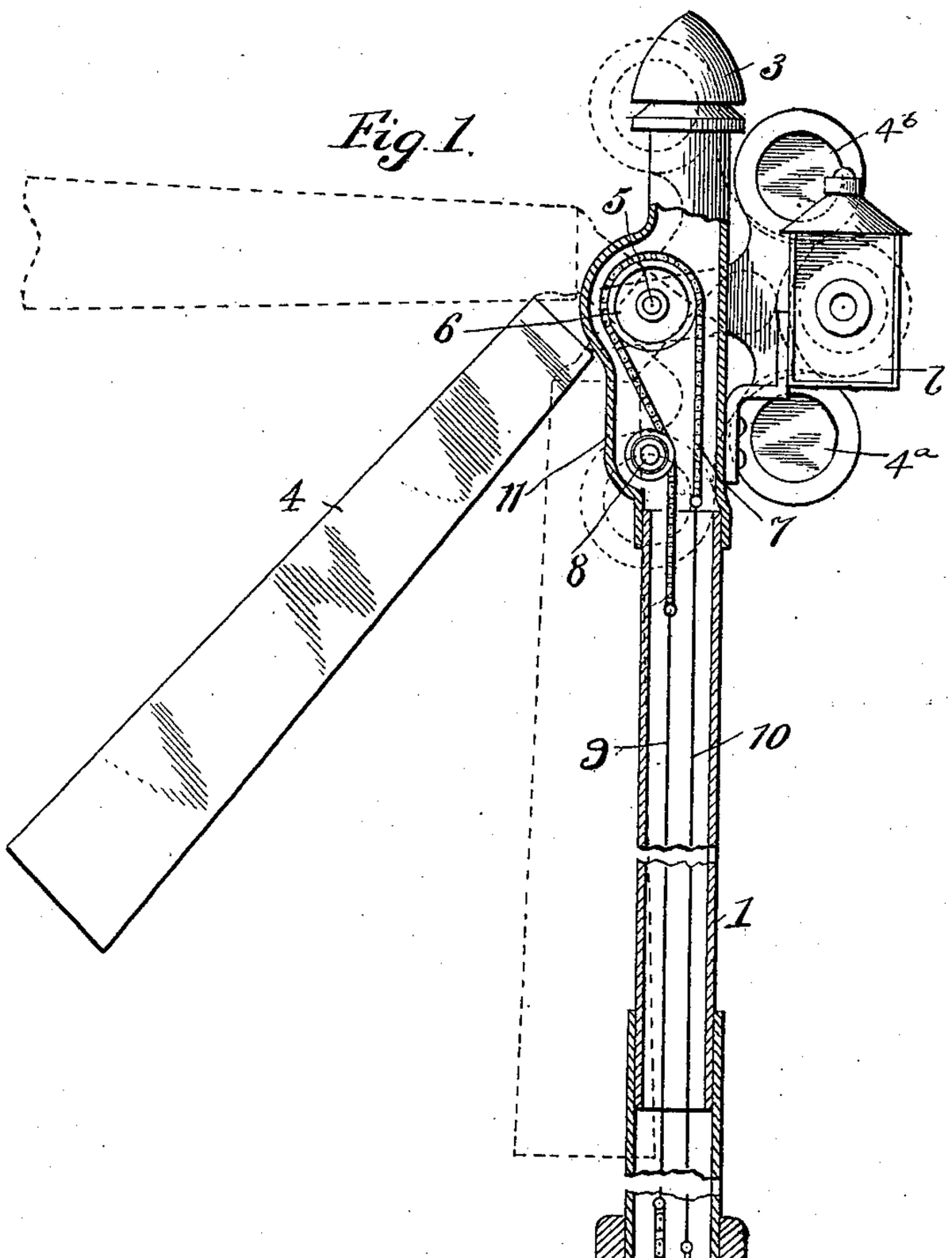
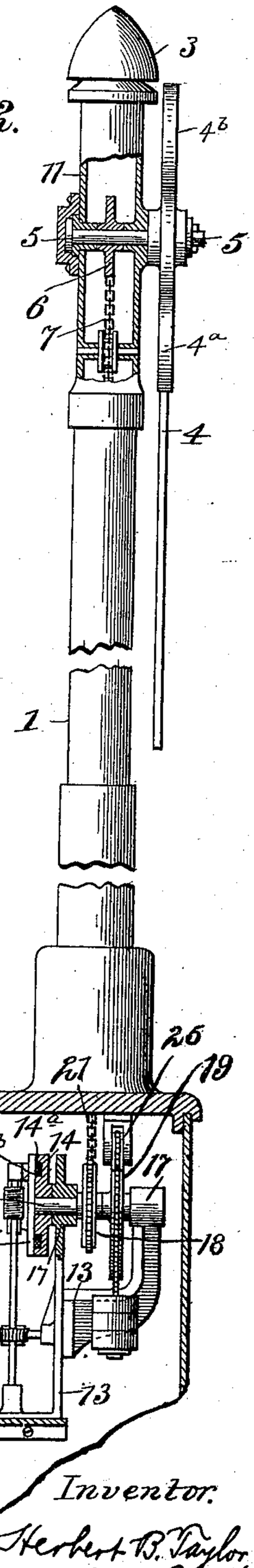


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

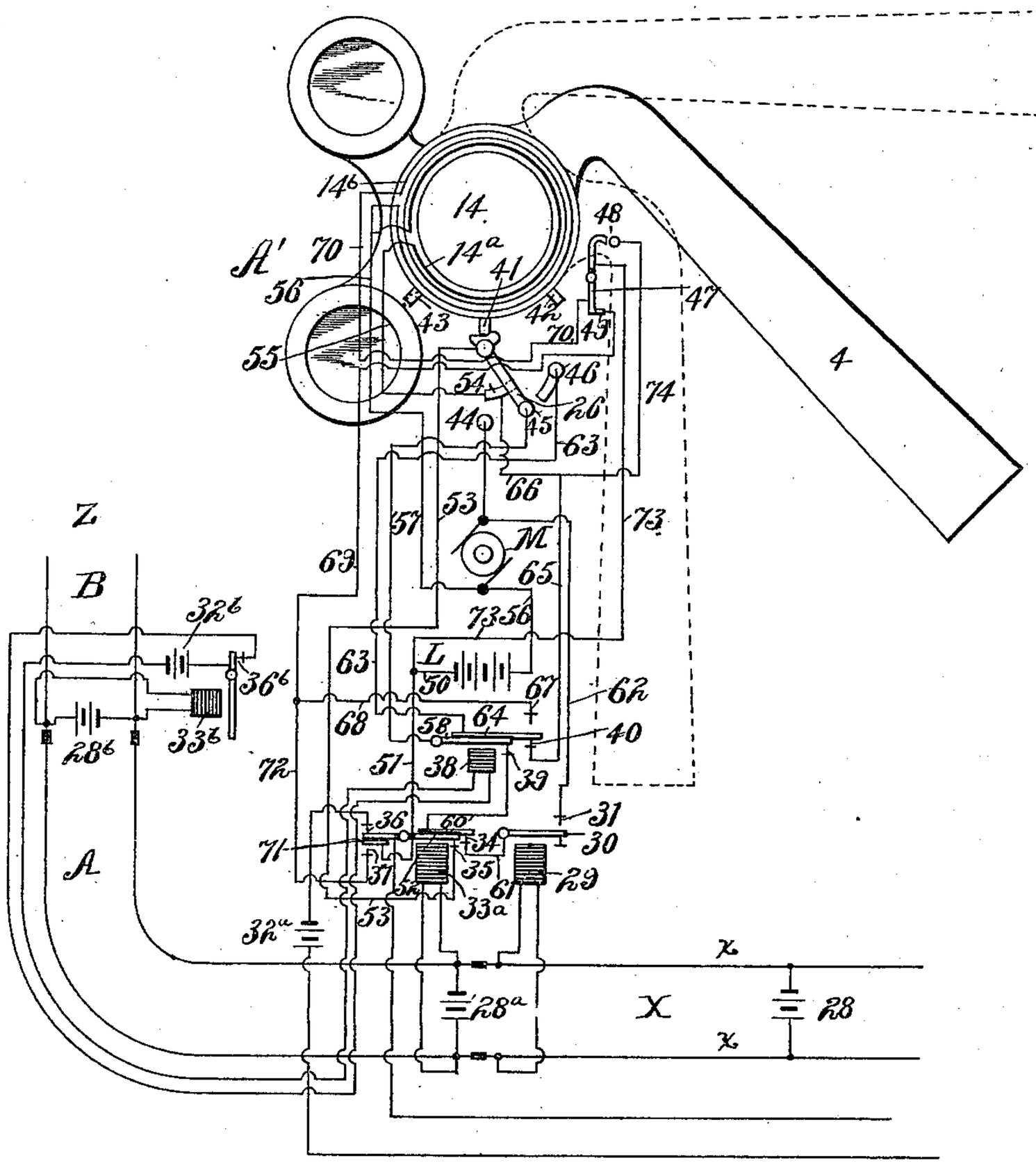

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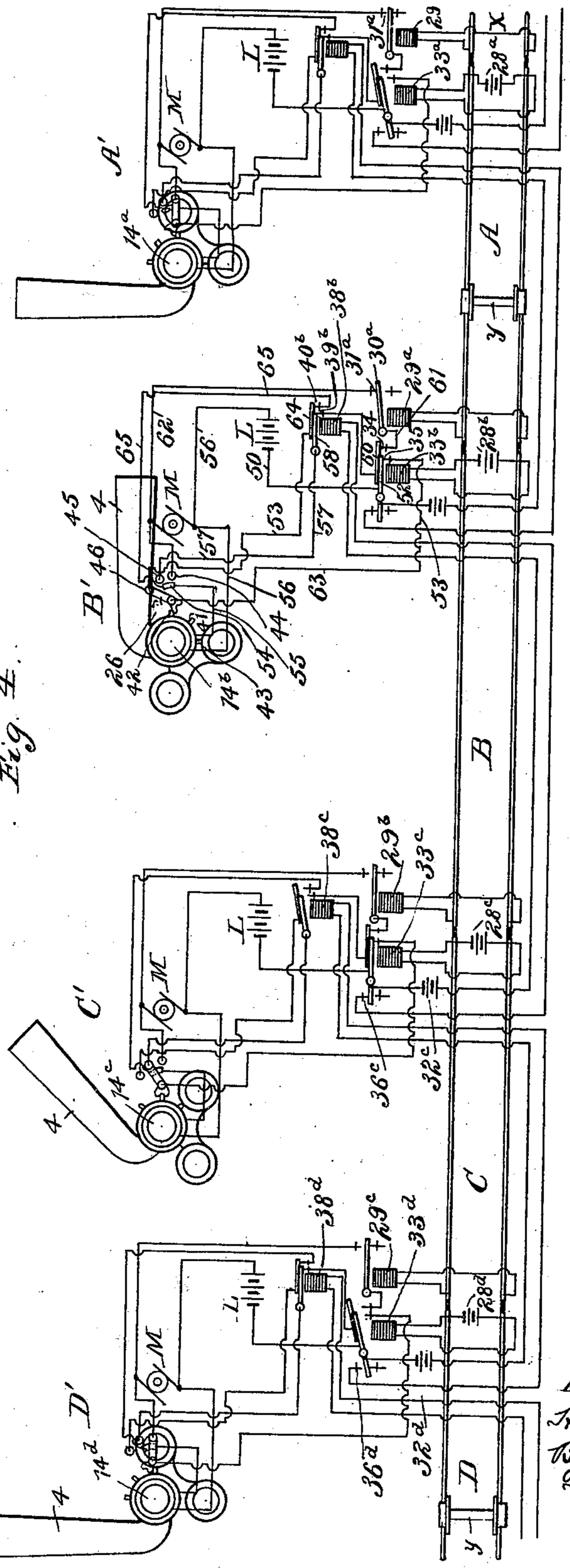
Fig. 4.



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UNITED STATES PATENT OFFICE.

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RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 684,881, dated October 22, 1901.

Application filed August 7, 1900. Serial No. 26,128. (No model.)

To all whom it may concern:

Be it known that I, HERBERT B. TAYLOR, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Railway-Signals, of which the following is a specification.

This invention relates to improvements in railway signal apparatus and systems; and its object is to provide a signal more simple in construction and operation and more sensitive to the action of the controlling devices, and therefore affording a much greater degree of security to trains depending on them.

This particular invention relates to improvements in systems using the three-position signal and also to improvements in some parts of the mechanical devices. I prefer, however, to use for directly actuating the signals the apparatus shown in United States Letters Patent No. 646,714, granted to me April 3, 1900, with such changes in circuits and details as are necessary to insure the accurate working of this invention.

The invention comprises, in combination with the apparatus described in the aforesaid Letters Patent, a semaphore or other signal capable of occupying three different positions, a new feature being that the signal is held normally at the caution position, although with the proper changes in the circuits the signal may be operated on the normal safety or normal danger plan. The advantage of the "normal caution" over the other mentioned systems is apparent, as a train-runner is always proceeding with caution. If signals are out of order or sections ahead occupied, the signal will not stay at "caution," but will automatically assume the danger position, giving the engine-runner a positive stop-signal. If a train is approaching a caution-signal at a very high rate of speed and sections ahead are clear, the signal will assume the all-clear position, the runner not having to decrease speed in the least. With the normal danger-signal if the signal were a little slow in moving to the clear position the engineer approaching at high speed would undoubtedly slow down, thereby losing time. Although this signal is particularly adapted to automatic control and is preferably shown so controlled, it is well adapted to manual control wherein such control consists in closing the motor and clutch circuit by hand, the release being effected either by the operator or by the train itself.

Referring to the accompanying drawings, Figure 1 is a sectional rear view, and Fig. 2 is a side view, partly in section, of the signal, both showing a hollow construction of the signal-support. Fig. 3 is a detailed diagram of all the apparatus pertaining to a single signal, showing said signal in its normal position. Fig. 4 is a system diagram showing several of the units of Fig. 3 with several of the minor details omitted for simplifying the description.

In Figs. 1 and 2 the support or post is shown as a tube, although a solid post may be used and the apparatus placed on the outside, as in the ordinary construction. 1 is the signal post or support, mounted on box-base 2, preferably of iron, the upper end of tube 1 being surmounted with a wheel-casing 11, which is covered with weather-cap 3. Signal-arm 4 is mounted on shaft or pivot 5, which is suitably mounted in bearings located in or secured to casing 11. This signal-arm has rigidly connected therewith the "safety" and "danger" screens 4^a 4^b, of suitably-colored glass, which in extreme positions of the said arm come in front of the lantern 1, while in an intermediate position of the signal-arm the light shows unobstructed, indicating "caution." Sprocket-wheel 6 is also secured to shaft 5, so that when said wheel is turned the movement of signal-arm 4 is effected. Chain 7 is fitted to sprocket-wheel 6 for the purpose of moving said wheel and runs freely over idler-wheel 8, rotatably mounted in casing 11. The object of this idler 8 is to bring the two portions of chain 7 as close together as possible, permitting the use of a small-diameter pipe or support. To the two ends of chain 7 are connected wires or rods 9 and 10, thus doing away with considerable chain. In the base 2 of the signal is mounted the actuating mechanism secured to shelf 12, which is bolted to the casing 2 and which carries a bracket 13 for supporting the actuating mechanism. This actuating mechanism is that described in Patent No. 646,714, above referred to, and is composed of a motor M and double worm-gearing engaging with a magnetic clutch.

The motor is mounted on shelf 12. The magnetic clutch is composed of magnet 14 and armature 15, which are mounted on shaft 16, journaled in bearings 17 on the bracket 13. Magnet 14 is secured to shaft 16 and turns with it. Armature 15 is loosely mounted on shaft 16 and is adapted to turn said shaft only when magnet 14 is energized and the motor is running. A sprocket-wheel 18 is rigidly secured to shaft 16, and chain 21, passing around sprocket-wheel 18, is connected with the ends of the wires 9 and 10, thus forming an endless driving-belt. A turnbuckle 27 may be arranged in either of the wires 9 or 10 for taking up any slack in said driving-belt. Idler-wheel 24 is loosely journaled in casing 2 and forms a guide for chain 21 for the same reason as stated for idler 8. A sheave-wheel 19 is also rigidly secured to shaft 16, and a chain 22, carrying counterweights 23, is fastened to wheel 19, so as to turn back the shaft 16 when the clutch is released. An idler 25 is shown for guiding the chain 22 to a point away from bracket 13; but it may be dispensed with and chain 22, with counterweights 23, be permitted to hang directly from sheave-wheel 19. In either case the counterweight exerts the same leverage in all positions of the signal. Switch 26 is actuated by the signal and controls the magnetic-clutch devices and circuits, as shown in Fig. 3. Suitable means, such as an opening with weather-tight cover, may be provided for each of the casings 11 and 2, so that the different parts of the mechanism may be inspected and adjusted.

Referring to Fig. 3, 4 represents the signal-arm; 14, the magnetic clutch, which for the purpose of simplifying the description is shown mounted on the same shaft as the signal-arm, thus omitting the chain and wires and sprockets. 14^a is the magnetic-clutch-energizing coil, and 14^b is the residual magnetism neutralizer or dissipator or demagnetizing-coil. Coil 14^a may be used as the demagnetizing-coil, if desired, by reversing the direction of the current through it. This, however, would necessitate more complicated devices for controlling the circuits and would therefore be more expensive than two coils. Track-section X is energized normally by battery 28, which feeds through the rails x and relay 29, holding armature 30 against stop and holding open the circuit at contact 31. Section A, which is controlled by signal A′, has a battery 28^a connected across the rails, said battery energizing relay 33^a and holding its armature against its poles or stops and closing circuits at contacts 34, 35, and 36 and holding circuit open at contact 37. Relay 38 is energized by a battery 32^b, the circuit from said battery being controlled by the armature of relay 33^b, which opens and closes contact 36^b, relay 33^b being energized by battery 28^b across the rails of the section B in advance of section A. When contact 36^b is closed, relay 38 is energized and holds its armature against the stop, closing circuits at contacts 39 and 40. The switch 26 is actuated by insulated pins 41 42 43, located at proper points on the periphery of magnet 14. Normally, as shown, the blade of switch 26 engages with contact 45, but under different conditions may engage contact 44 or 46. Double switch 47 is actuated by pin 42 and is normally open at contact 48 and closed at contact 49, but when moved by pin 42 contact 48 is closed and 49 opened. The function of this switch will be hereinafter explained. M represents the operating-motor and may be of any desired type. L is the source of electrical energy for operating the signal motor and clutch.

The operation of the different devices shown in Fig. 3 is as follows: In the normal caution position, as shown, the clutch-magnet which holds the signal in said position is energized by a circuit from battery L, wires 50 and 51, lever 52 of magnet 33^a, contact 35, wire 53 to switch 26, thence through switch-blade 26 to contact 54 and wire 55 to energize coil 14^a, thence by wire 56 to negative side of battery L. It will therefore be seen that the signal will remain in this position so long as there is no change in the circuits. The amount of energy required to hold the signal in this position is very small, being only one-tenth of a watt, owing to the great amount of surface in actual magnetic contact between the clutch and its disk armature. We will assume now that the sections in advance of A are all clear and that a train enters section X or that the current through relay 29 is otherwise interrupted. Armature 30 of relay 29 drops back and closes the circuit at contact 31. This starts the signal-operating motor and shifts the signal to the clear or vertical position. The circuit is as follows: from battery L through wires 50 and 51, lever 52, contact 35, wire 53, switch 26, contact 45, wire 57, lever 58 of relay 38, contact 39, wire 59, lever 60 of relay 33, contact 34, wire 61, armature 30 of relay 29, contact 31, wire 62 to motor M, thence by wire 56 to battery L. As the signal approaches the clear position insulated pin 42 on magnet 14 engages switch 26 and shifts its blade from contact 45 to 46. As the switch-blade, which still has a circuit to the positive side of battery L, strikes contact 46, which is a long contact, it energizes the magnet-coil 14^a through a new circuit independent to some extent of the one described above. It is as follows: from switch 26 to contact 46, wire 63, lever 64 of relay 38, contact 40, wires 65 and 66 to contact 54, wire 58 to coil 14^a, thence back to battery L by same circuit as before. It will be seen that before the clutch-circuit is broken at 45 it is made at 46, so that there is no deënergizing of the magnet 14 or slipping of its armature 15. The object of this change of circuit will be fully explained directly. If now magnet 33^b, section B, becomes deënergized for any reason, magnet 38

will also become deënergized. Suppose that a train should enter section B from point Z while section A is still clear. Magnet 33^b would be deënergized, breaking the circuit of battery 32^b at contact 36^b, deënergizing magnet 38. The armature of magnet 38 would drop away from its poles and open contacts 39 and 40. This action would break the circuit by way of contact 46 at contact 40, deënergizing clutch-magnet 14 temporarily. This permits the signal, with the weight of its counterweight, to start to move to the danger position; but it is arrested at the intermediate or caution position by the action of pin 41 in throwing switch 26 back, the contact 54 again completing the other circuit through magnet 14, which is then energized and locks the signal in that position. In addition to the counterweight for returning the signal to this position a circuit through demagnetizing-coil 14^b in magnet 14 is closed in the following manner: As lever 64 of magnet 38 is released it falls against contact 67, while switch 26 is still on contact 46, and the current flows from contact 46 through wire 63, to lever 64, contact 67, wires 68 and 69, contact 49 on switch 47, wire 70, and through coil 14^b to return-wire 56, in a reverse direction to that of coil 14^a, demagnetizing magnet 14 and allowing the signal to move very rapidly until switch 26 is moved by pin 41 to contact 45, whereby contact 46 is opened, deënergizing the demagnetizing-circuit and restoring the circuit through the clutch-magnet coil 14^a, which acts as an instantaneous break and stops the signal from further movement. The breaking power of this magnet is very great, owing, as before mentioned, to the frictional contact. In fact, I depend on the amount of surface in contact rather than on the density of the magnet-flux for this holding power, and it will be seen that the demagnetizing-coil may be of very high resistance, using about one twenty-fifth of a watt, this being quite sufficient energy to reverse the direction of the magnetic flux in magnet 14. Before, however, the direction of the magnetic flux in magnet 14 is reversed a condition of absolute neutrality exists which permits an entirely free movement of the signal, and as the signal returns so rapidly the demagnetizing-circuit is opened before the reversal of the flux can take place, and in the event of a reversal of the flux before the signal assumes the correct position the very small magnetic pull exerted, owing to the small magnetomotive force, is far from sufficient to overcome the effect of the counterweight. Now assume that the train in section B enters section A or that a train in section X enters section A. Magnet 33^a becomes deënergized, releasing its armature and opening the several circuits at contacts 34, 35, and 36 and closing a circuit at contact 37, and the result is as follows: The circuit from the positive side of battery L to the switch 26, as before described, is opened, deënergizing the motor-circuit and circuit of clutch-magnet 14^a, and at the same time current flows from battery L through wires 50 and 51, lever 71 of magnet 33, contact 37, wires 72 and 69, contact 49 of switch 47, wire 70, and through the demagnetizing-coil back to negative side of battery L, permitting the signal to return to the danger or horizontal position. The signal in returning brings pin 42 in contact with arm of switch 47, which projects into its path, closing contact 48 and opening the demagnetizing-circuit at contact 49. This action brings into effect the braking-circuit as follows: Current from positive pole of battery L flows by wires 50 and 73 to long lever of switch 47, which is insulated from the short lever of same switch, contact 48, wire 74 to contact 54, and wire 55 through coil 14^a, thus energizing magnet 14 and retarding the signal. Before the signal comes to rest, however, pin 42 becomes disengaged from switch 47, opening the brake-circuit at 48 and closes the demagnetizing-circuit at 49, permitting the signal to come to rest against a positive mechanical stop placed at a suitable point. If now section A is cleared, the signal will automatically assume the caution position again by the reenergizing of magnet 33^a. If section B be also cleared, the signal-circuits are in such condition that a train entering station X or section B will cause the signal to move to "safety" or "danger," respectively.

Fig. 4 shows a railway-track divided into sections or blocks X A B C D, with signal-stations A′ B′ C′ D′ at the junction of the blocks or sections arranged as shown in Fig. 3, except that I have purposely omitted the circuits pertaining to the demagnetizing-coil and also the retarding or brake circuit, as they are fully explained in the foregoing description of Fig. 3. It will be seen that section A is occupied or blocked by wheels *y* and track-battery 28^a is short-circuited through wheels and axles, deënergizing magnet 33^a and breaking the circuit from battery L to motor M and magnets 14^a of signal A′, which therefore has raised to "danger." The bridging of the rails of this section A also deënergizes magnet 29^a, permitting its armature 30^a to fall against contact 31^a, which closes the circuit from battery L of signal B′ through wire 50, lever 52 of magnet 33^b, contact 35, wire 53, to switch 26, (which normally rests on contacts 45 and 54,) from switch 26 by contact 45, wire 57, lever 58 of magnet 38, contact 39, wire 59, lever 60 of magnet 33, contact 34, wire 61, lever 30, contact 31, wire 62 through motor, and wire 56 to the negative side of battery. Also part of the current leaves the switch 26 at contact 54, wire 55, coil of magnet 14, wire 56, back to battery, energizing said magnet and locking the signal B′ in the position to which it is shifted by the actuating-motor—namely, the safety or clear position. When the signal has moved nearly to the clear position, the insulated pin 42 engages with the end of switch 26 and shifts said switch from contact 45 to 46. In such case

the motor-circuit is broken at 45; but the magnet-circuit is still maintained through contact 46, wire 53, lever 64 of magnet 38, contact 40, wire 65, contact 54, wire 55, to magnet, as before. This magnetic circuit will be maintained until the train enters section B, when battery 28^b will be short-circuited and magnet 33^b deënergized and contacts 34 and 35^b are opened, cutting off battery-current from switch 26 of signal B. At this same time the same action would take place at station C′ as that in the foregoing description of section B, provided sections C and D were unoccupied; but as section D is occupied signal C′ will remain at the caution (or safe one block only) position. As will be seen, a "clear-signal" cannot be obtained, as battery 28^d is short-circuited and magnet 33^d deënergized. The armature of said magnet falling away from the poles of the magnet opens the contact 36^d, thus breaking the current from battery 32^d and deënergizing magnet 38^c. This action opens the motor-circuit and clutch-magnet circuit of section C at contacts 39 and 40^c. Therefore the motor cannot actuate the signal C′ further until section D is cleared, when magnet 38^c will be energized. It will be noticed that the clearing of the signal for a single block—*i. e.*, the movement of the signal from danger to caution position—is effected by the action of the relay adjacent to the signal, while the clearing of the signal for two or more blocks is effected by the joint action of three relays adjacent to the signal, one of them being dependent upon the action of a relay in a succeeding section. It will be observed that any break in the rail-circuits will render inoperative the signal which is governed by that circuit, at the same time setting the signal to the danger position, thus removing the possibility of false signals and permitting the operation of trains at high speeds, which is very desirable. If desired, one rail of the blocks X A B C D, &c., may be a common battery-return, in which case the batteries 32^a, &c., may be connected from the negative side to said rail, as shown and described in my Patent No. 646,714.

Having now described my invention, what I desire to secure by Letters Patent is—

1. In a signal system, the combination of a three-position signal having a mechanical bias to danger, of means for operating said signal to move it away from danger position, and a single locking means for holding the signal either in a safety position or the intermediate caution position, normally operative track-circuits and connections controlling said locking means to normally hold the signal in caution position, and normally inoperative track-circuits and connections adapted to control said locking means to hold the signal in safety position.

2. In a railway signal system the combination of a single signal adapted to occupy three positions at different times dependent upon the existence of three conditions of the blocks or sections into which the track is divided, a single actuating mechanism for shifting said signal to or from any of the said positions, and a single combined clutching and locking device for holding the signal to the actuating mechanism while being shifted and for locking said signal in the position to which it is shifted and for automatically releasing said signal when conditions permit.

3. In a signal system the combination of a three-position signal, an actuating mechanism for shifting the signal to or from any of the three positions, a combined magnetic clutch and lock adapted to connect the signal with the actuating mechanism while being shifted and to lock the signal in the position to which it is shifted, a circuit and source of electric energy therein for the magnetic clutch or lock adapted to energize said clutch while the signal is moving from the danger to the caution position and while the signal is in caution position, said circuit being controlled by track devices in the block preceding said signal, another circuit for the said magnetic lock energizing said lock while the signal is moving from caution to clear position and while in the clear position, said circuit being controlled by track devices in a block or section succeeding said signal, and blocks or sections containing the said track devices into which the track is divided.

4. In a railway signal system the combination of a three-position signal, an electrical actuating mechanism and source of energy in circuit therewith a combined magnetic clutching and locking device, a source of electrical energy supplying both the said magnetic clutching and locking device and the actuating mechanism, for moving said signal from the caution to clear position, a relay in a track-circuit preceding said signal, controlling said actuating mechanism and locking device, and a relay in a track-circuit succeeding said signal, controlling the same actuating mechanism and locking device for moving said signal from danger to caution position and holding said signal in said position, substantially as shown and described.

5. The combination of a signal adapted to occupy the danger, caution, or clear position, an actuating mechanism for moving the signal to any of the said positions, a single magnetic clutch connection for holding the signal to the actuating mechanism while being shifted, and for locking said signal in any of the three positions to which it is shifted and two separate electrical currents, dependent upon track-circuits in separate blocks or sections, for controlling said magnetic clutching connection for different parts of the signal movement.

6. In a signaling apparatus, the combination of a signal and an operating-motor therefor, of a single combined electromagnetic clutching, locking and braking means, comprising two magnetic members mechanically connected respectively to the motor and the

signal, circuit connections, comprising an energizing-coil for said magnetic members, to release or lock the signal to the motor, and circuit connections, controlled by the signal mechanism and comprising an energizing-coil of the magnetic clutch and locking device, adapted to energize the clutch just before the signal reaches the danger position to prevent any sudden jar on the mechanism—and to deenergize the clutch as the signal reaches the danger position.

7. The combination of a signal adapted to be moved to and held in the danger, caution or clear position, an electrical actuating mechanism for effecting said movements, a combined magnetic clutch and locking mechanism for holding the said signal in the said positions two separately-controlled circuits for the said magnetic locking mechanism another separate circuit for the locking mechanism under control of the signal for retarding or braking the signal in its movements from clear or caution to the danger position, and means actuated by the signal for energizing said retarding-circuit.

8. In a signaling apparatus, a signal, means for shifting said signal, a magnetic locking device for holding the signal in the position to which it has been shifted and comprising two magnetic members connected respectively to the shifting means and to the signal, a controlling-circuit including a portion arranged in energizing relation to one of said magnetic members to energize the locking device, and another controlling-circuit comprising a portion arranged in deënergizing relation to the same magnetic member, to neutralize the residual effect of the first-named circuit and insure release of the lock.

9. In a signaling apparatus, the combination of a signal, a signal-actuating mechanism, a magnetic clutch between the signal and its actuating mechanism and comprising two magnetic members a magnetizing-coil arranged on one of said members, and a demagnetizing-coil arranged on the same member and adapted to neutralize the magnetization of said member by the first-named coil, means for energizing one of said coils to energize the clutch, and means for passing current through the other of said coils to deënergize the clutch.

10. In a signaling apparatus, the combination of a signal, a signal-operating mechanism, a single magnetic clutch and locking device for connecting the said signal with the operating mechanism and for holding the signal in any position to which it is shifted, said magnetic clutch comprising two magnetic members and energizing and deënergizing means for one of said members, and circuits for controlling the said energizing and deënergizing means for said clutch and adapted to energize the clutch member and subsequently, by a reverse magnetization to deënergize the same.

11. The combination of a track divided into blocks or sections, a three-position signal normally held in a position indicating caution, means for retaining the signal in the said caution position, said means being controlled by a track-circuit in the block or section in advance of said signal, means for shifting the signal to the safety position said means being controlled by a track-circuit in the block or section preceding said signal and by a track-circuit in a block or section succeeding the section in advance of said signal, and means for shifting the signal to danger position under control of a track-circuit in the block or section adjacent to said signal.

12. The combination of a track divided into blocks or sections, a signal adapted to indicate danger when the block succeeding said signal is occupied, to indicate caution when the block succeeding said signal is clear and to indicate safety when two blocks succeeding said signal are clear, means for normally holding the signal in a position indicating that the block immediately succeeding the signal is clear said means being controlled by a track-circuit in the block succeeding said signal, means for shifting the signal to a position indicating that two blocks in advance of said signal are clear, said means being controlled by two track-circuits jointly, one circuit embracing the section preceding said signal and the other circuit embracing the second section in advance of said signal, and means for shifting the signal to a position indicating that the block succeeding said signal is not clear, said means being controlled by a track-circuit embracing the section succeeding said signal.

13. In a signaling apparatus, the combination with a signal adapted to occupy a danger, safety and an intermediate caution position of a single combined clutching and locking device for holding the signal in engagement with its shifting mechanism and for retaining the signal in the position to which it is shifted, said device being controlled by two separate track-circuits in blocks or sections preceding and succeeding said signal, mechanism for shifting the signal to or from any of the three positions and for normally retaining the signal in the intermediate position, said mechanism being also controlled by the said track-circuits, and blocks or sections for the signals containing the said track-circuits.

14. The combination of a three-position signal, a mechanism for shifting the signal to a position showing the condition of the two blocks immediately in advance of said signal, a magnetic device for holding the signal in the said position, a track-circuit for controlling said device and shifting mechanism from the block preceding said signal, the said device also being adapted to hold the signal in a position indicating the condition of one block in advance of said signal, track-circuits in the two blocks succeeding said signal, and means controlled thereby for re-

leasing the signal from the two said positions and blocks or sections preceding and succeeding said signals into which the track is divided.

15. The combination of a signal adapted to occupy danger, caution and clear positions, and to assume normally the intermediate caution position, an electromagnetic clutch energized by a circuit for holding the signal in the normal position and the same clutch energized by another circuit for holding the signal in the clear position, means for shifting the signal, and track-circuits embracing blocks or sections preceding and succeeding the said signal for controlling the clutch-circuits and shifting means.

16. In a railway signaling apparatus, the combination of a signal, a shifting mechanism for the signal, electromagnetic means for holding the shifting mechanism in engagement with the signal, electromagnetic means for locking the signal in the position to which it is shifted, and electromagnetic means for releasing the signal from its shifting mechanism and retarding the signal in its return from the shifted position, all of said means being combined in a single device controlled by track-circuits in blocks or sections into which the track is divided.

17. In a railway signaling apparatus, the combination of a three-position signal, an actuating mechanism for the signal, a combined magnetic clutch and lock for connecting the actuating mechanism with the signal and holding the signal in the position to which it is shifted, circuits and source of energy for energizing said magnetic clutch and lock and for the actuating mechanism, and a switch actuated by the signal mechanism for opening and closing the signal and clutch circuits as the signal changes its position, and for changing the circuit connections from a condition adapted to arrest the signal at one position, to a condition adapted to arrest the signal at another position, so that when the signal reaches any one of the three positions, it is by means of said switch put under the control of circuit connections controlling its movement to other positions.

18. In a signaling apparatus, the combination of a signal, a motor for changing the position of the signal, an electromagnetic device adapted to retard the signal when returning from the safety position, and carrying two magnetic members attached respectively to the signal and to a part moving with the motor, and means under control of the signal for energizing and deënergizing said retarding device.

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