No. 646,714. Patented Apr. 3, 1900.

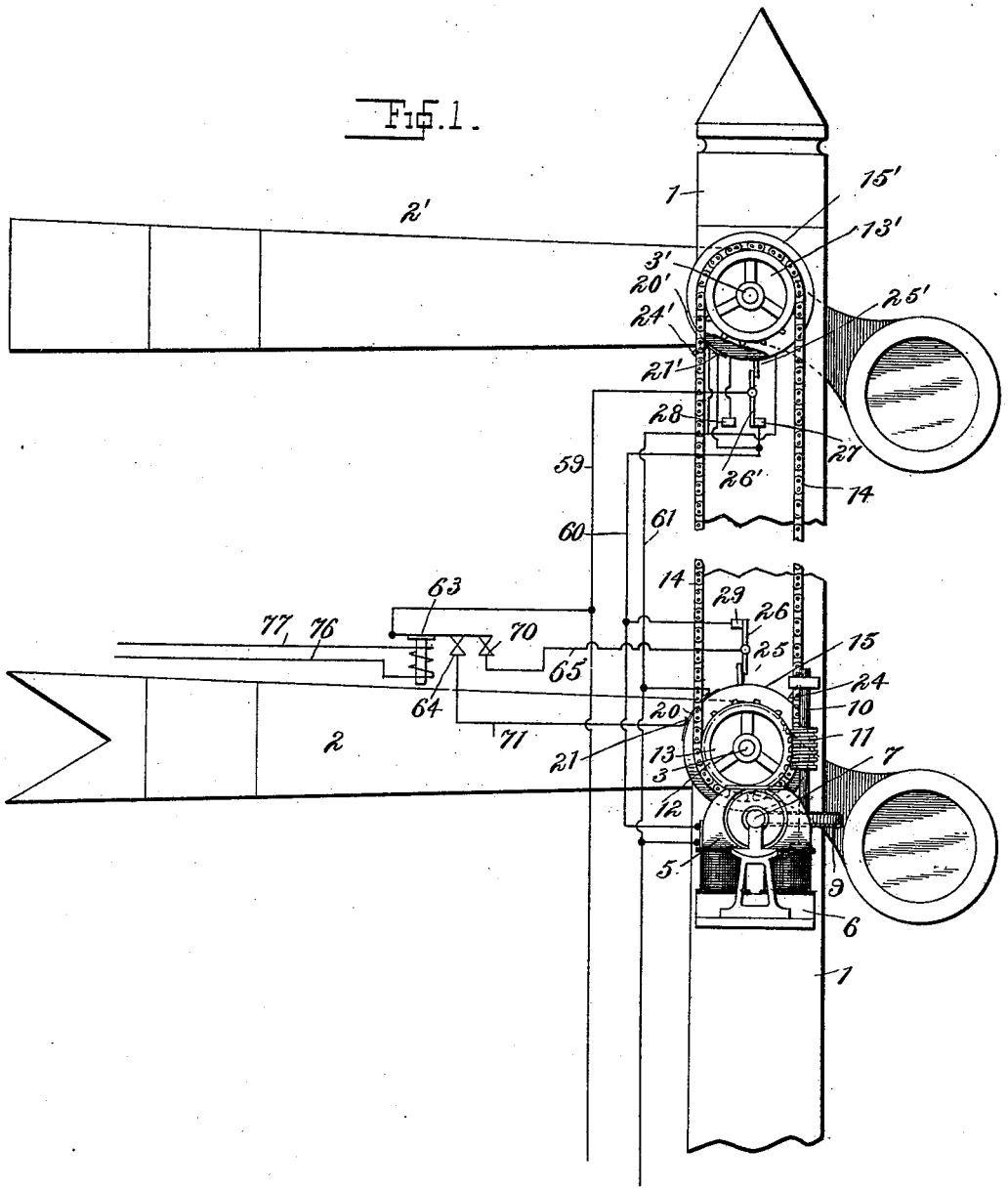
H. B. TAYLOR.

RAILWAY SIGNAL.

(Application filed Nov. 22, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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4 Sheets—Sheet 2.

Fig. 2.

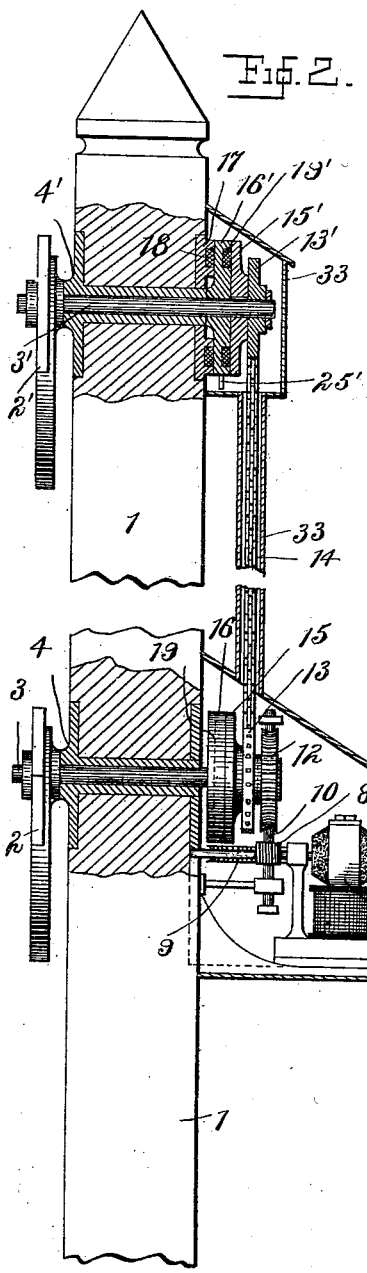
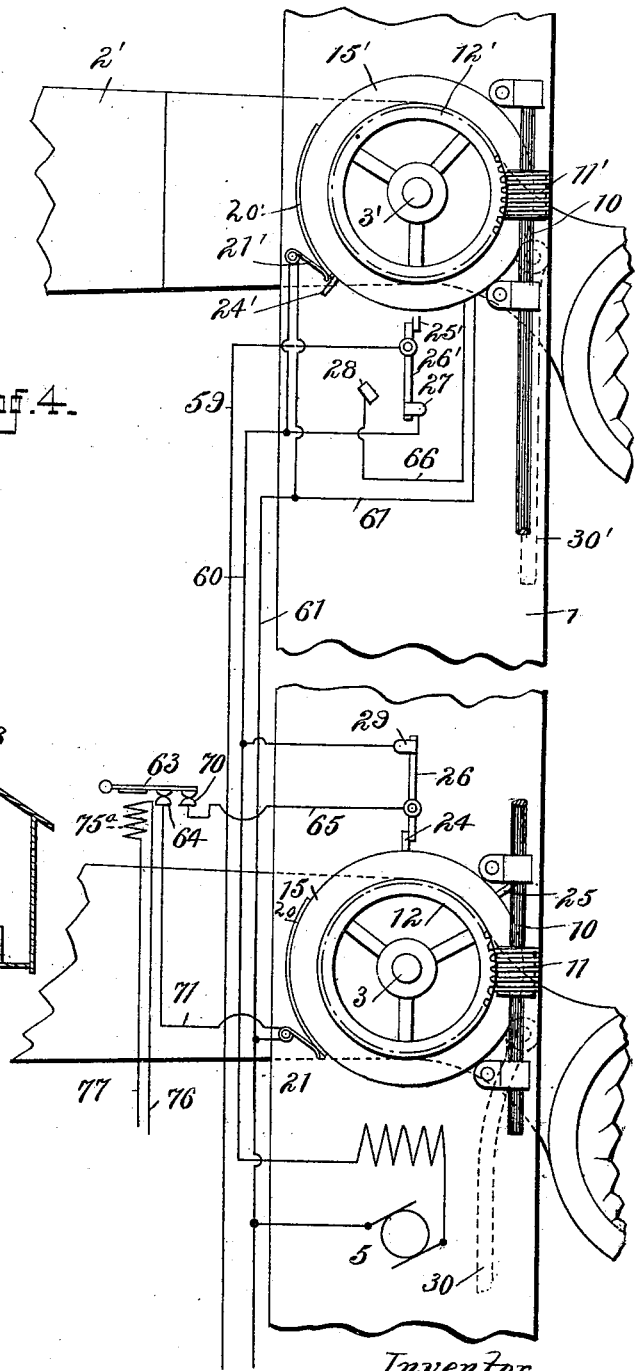


Fig. 4.



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(No Model.) 4 Sheets—Sheet 3.

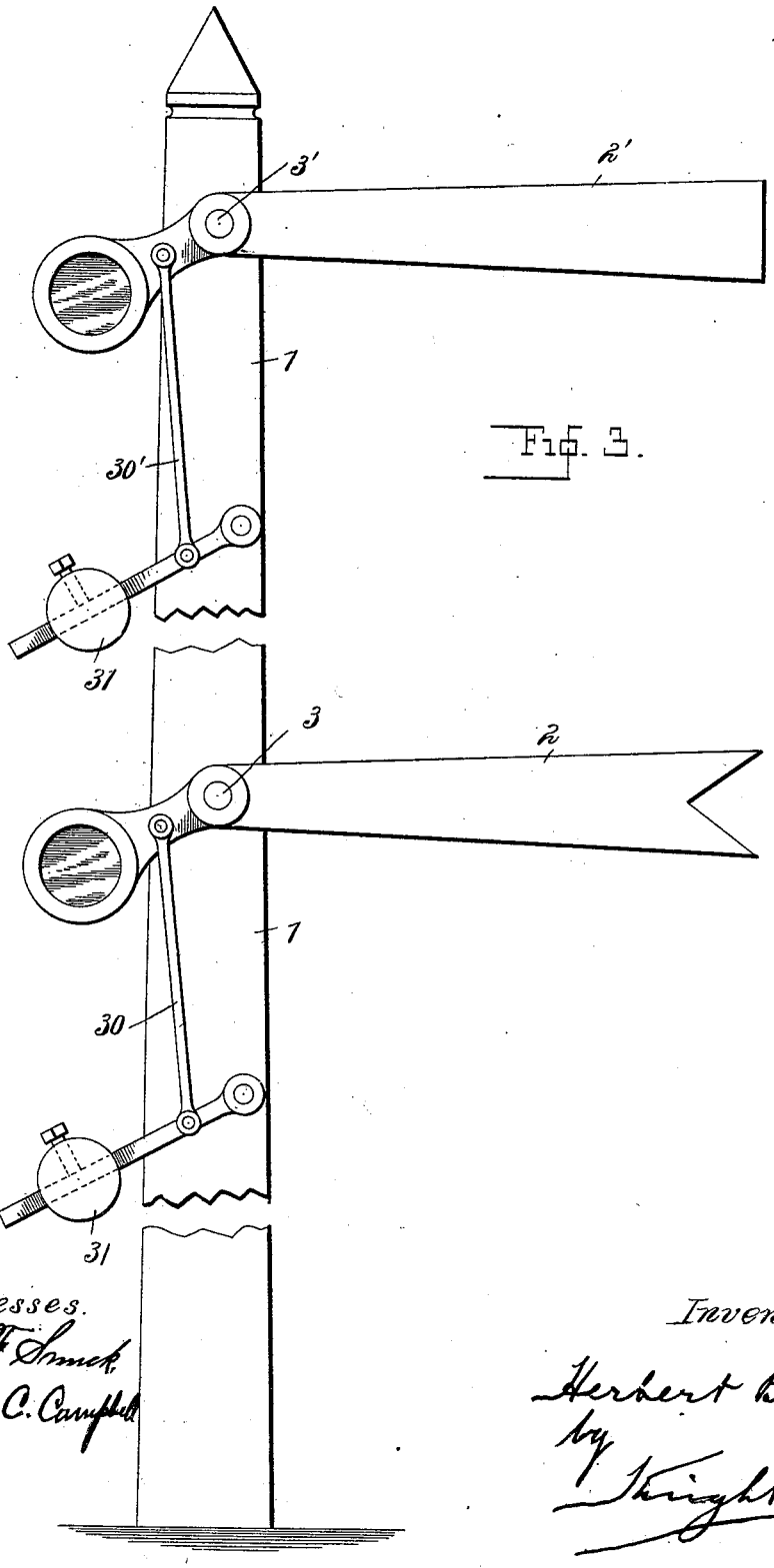

Fig. 3.

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(No Model.) 4 Sheets—Sheet 4.

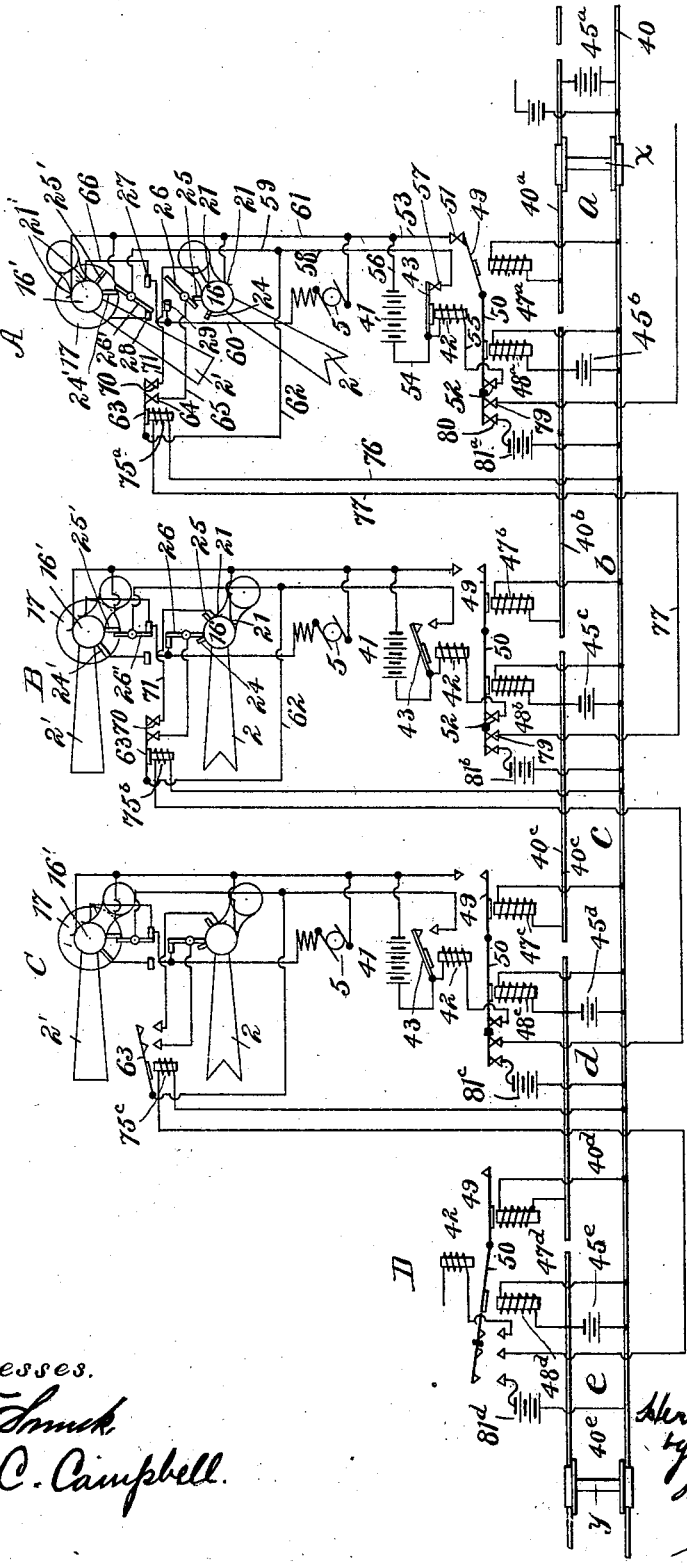

FIG. 5.

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UNITED STATES PATENT OFFICE.

HERBERT B. TAYLOR, OF NEWARK, NEW JERSEY.

RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 646,714, dated April 3, 1900.

Application filed November 22, 1899. Serial No. 737,868. (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 means for operating economically a signal or for operating a number of signals, either one at a time or all together, and at the same time accurately controlling their operation, thereby affording the greatest possible security to those depending upon said signals.

This particular invention is an improvement on the signal apparatus shown in United States Letters Patent No. 627,243, granted to me June 20, 1899. The apparatus disclosed in the said patent operates the signal positively in both directions. As there is some objection to this method I overcome the same by using a counterweight to return the signal to danger position.

The invention comprises in combination with the usual type of semaphore worm-gearing and a locking and clutch device in the form of an electromagnetic clutch with annular magnet.

The invention is particularly applicable to the operation of multiple signals and is explained herein with particular reference to duplex signals, each signal-post thus covering by two separate signals the "home" section and a "distant" section—for example, the next section in advance. The said signals may be connected together in various ways, as hereinafter explained.

In operating the signals I may use either the normal danger or the normal safety system by simply making the necessary changes in the circuits. The normal danger system is, however, preferred for the following reasons: First, most engineers prefer to see the signal change from the danger to the safety position as they enter the section, as it is impossible to be sure that a signal always at "safety" is not out of order; second, the normal danger system is considerably more economical than the normal safety in that it does not require any electric current to keep the signal in the danger position, whereas in the safety system current is constantly used to hold the signal locked down, and, third, in case of severe sleet and snow storms if the danger signal should freeze in danger position no harm could result aside from stopping the train; but in case a safety signal should freeze down in safety position the engineer having a clear signal would proceed through the section, and if there was a train or a misplaced rail on the track ahead a wreck might result. I therefore prefer to arrange the apparatus so that the signal normally stands in danger position and is only moved to safety position when a train comes onto the section and the track is clear and my invention includes certain novel arrangements of the circuits for controlling the signals in this manner, especially in connection with multiple-signal apparatus.

In the accompanying drawings, Figure 1 is a rear elevation of a signal constructed according to my invention. Fig. 2 is a vertical section of same at right angles to Fig. 1. Fig. 3 is a front elevation of the apparatus. Fig. 4 shows a modification of the apparatus. Fig. 5 is a diagram of the system of circuits used in connection with this apparatus.

Referring to Figs. 1 and 2, the signal-post is represented at 1, and at 2 2′ are shown two semaphores mounted on said post, said semaphores being carried on pivots or shafts 3 3′, which are mounted to turn in suitable bearings 4 4′ on the post. An electric motor 5 is supported on a bracket 6, secured to the post 1, and its shaft 7 carries a worm 8, engaging with a worm-wheel 9, carried by a vertical shaft 10, which is mounted in suitable bearings and carries a worm 11, engaging with worm-wheel 12, loosely mounted on semaphore-shaft 3. Rigidly connected with the worm-wheel 12 is a sprocket-wheel 13, connected by a chain 14 with a sprocket-wheel 13′, loosely mounted on the other semaphore-shaft 3′. The two sprocket-wheels 13 13′ are connected to their respective shafts 3 3′ by electromagnetic clutch mechanisms, each of which comprises a disk armature 15 or 15′, through which the shaft 3 or 3′ passes loosely, said disk armature being rigidly connected with the corresponding sprocket-wheel, and an annular magnet 16 or 16′, which is fast on

the corresponding shaft 3 or 3', and is therefore rigidly connected with the semaphore, these annular magnets and disk armatures being concentric with the respective shafts. The armatures 15 15' are adapted to engage frictionally with the poles of the respective annular magnets 16 16', so as to clutch or lock the respective semaphores 2 2' into connection with the corresponding sprocket-wheels. The upper semaphore 2' is preferably the home signal, corresponding to the nearest section of the track, and it is desirable to provide means for locking this signal independent of the magnetic clutch constituted by the annular magnet 16' and its armature 12'. For this purpose an annular magnet 17 is provided, fixed in or to the post 1 concentrically with the shaft 3' and at the back or neutral side of annular magnet 16', so that the back portion of said magnet 16' acts as an armature for the magnet 17. The annular magnet 17 has a coil 18 embedded therein and connected to the controlling-circuits, as hereinafter set forth. The respective annular magnets 16 16' have coils 19 19' embedded therein and connected to the respective sets of collector-strips 20 20', upon which bear brushes 21 21', connected to the controlling-circuits. If magnet 16' is energized and 17 is deënergized, the semaphore 2' will be clutched to its actuating sprocket-wheel, so as to be rotated thereby or to be locked from rotation when said sprocket-wheel is stationary; but if fixed magnet 17 is energized while magnet 16' is deënergized the semaphore 2' will be locked from rotation by frictional engagement of fixed magnet 17 with the back of armature 15', while the sprocket-wheel 13' and attached armature 15' are free to rotate independently of said semphore 2'.

Projecting radially from the peripheries of the respective magnets 16 and 16' are pins 24 25 and 24' 25', which in the rotation of the said magnet are adapted to engage opposite sides of the tail of switch-levers 26 26', so as to operate the said switches alternately in opposite directions as the magnets reach the limit of movement in one or the other direction. The switch 26' for the upper signal coöperates with contacts 27 28 to transfer the battery connection from magnet 16' to magnet 17, or vice versa, and at the same time control the motor-circuit, while the switch 26 for the lower signal coöperates with a contact 29 to control the motor-circuit.

Tie-rods 30 30' are connected to the respective semaphores and to the usual counterweight devices 31, as indicated in Fig. 3.

A suitable housing or casing 33 is provided for the several actuating parts above described—namely, the motor, magnetic clutches, and connecting mechanism.

In place of connecting the armatures 15 and 15' by sprocket-wheel-and-chain connection they may be connected in any other suitable manner. For example, as shown in Fig. 4, the vertical shaft 10 may extend up to the upper semaphore and carry near its upper end a worm 11', engaging with a worm-wheel 12', loosely mounted on the upper semaphore-shaft and rigidly connected to the disk armature 15 of the magnetic clutch of the upper semaphore. In this case the sprocket-wheels and chain are omitted, the magnetic clutch-armatures being both connected to the actuating-shaft through the respective worm-wheels 12 12' and worms 11 11'.

The arrangement of the circuits is indicated in Fig. 5, where 40 represents one rail of a track, such rail being electrically continuous, while the other rail is insulated in sections 40^a 40^b 40^c, &c., corresponding to the blocks or sections *a b c*, into which the length of the track is divided for signal purposes. For each section *a b c*, &c., of the track there is provided a signal-post or installation, (indicated at A B C, &c.,) such installation comprising the distant and home semaphores 2 2', with their operating-motor 5, magnetic clutches, (indicated at 16 16',) and switches 26 26', a local battery 41 for supplying current to such motor and to the electromagnetic friction-clutches for the respective semaphores, a local magnet 42 controlling such local operating-circuits through its armature or switch 43, and relays controlled from the track and from the one or more of the distant signals to control the local operating-circuits. Each section of the track has a track-battery 45^a 45^b, &c., connected directly across between the corresponding sectional rails 40^a 40^b, &c., to the rail 40. Track-relays 47^a 47^b, &c., at the respective signal-posts are connected directly across the rails of the corresponding track-section, while track-relays 48^a 48^b, &c., which at such respective signal-posts are connected between the rails of the next section in advance, so that a train on any section will short-circuit the magnet of the home signal of that section and the distant relay for the next section in the rear. The armature-levers 49 50 of the magnets 47^a 48^a, &c., are electrically connected together and coöperate, respectively, with contacts 51 52. Contact 51 is connected to wire 53, from which a wire 56 leads to one side of the local battery 41, from the other side of which a wire 54 leads to the coil of local magnet 42, which at its other end is connected by wire 55 to contact 52. When armatures 49 50 are attracted, they open the circuit at contact 51 and close circuit at contact 52. If magnet 47^a be deënergized while magnet 48^a is energized, circuit of the local magnet 42 will be closed, such circuit being traced from battery 41, through wire 54, coil of local magnet 42, wire 55, contact 52, armatures 50 and 49, contact 51, and wires 53 and 56, back to the other side of the local battery. When the magnet 42 is thus energized, its armature-lever 43 comes against a contact 57, and thus closes connection from the local battery to the motor and to the magnetic clutches. The motor-circuit may be traced from battery 41, through

wire 54, armature 43, and contact 57, to the wire 58. From this wire the current may proceed either by way of the upper semaphore or the lower semaphore, or both. The connection for the upper semaphore is from wire 58 by wire 59 to the switch 26′ of the upper semaphore. This switch being normally closed on its contact 27, as shown for signal-post B in Fig. 5, the connection continues through wire 60 to the motor, the other side of which is connected to a return-wire 61, leading to the other side of the battery. The motor connections for the lower semaphore lead from wire 58 by wire 62 to a switch 63, which is normally closed on a contact 64, connected by wire 65 to switch-lever 26 of the lower semaphore. This switch being normally on its contact 29, connected to the motor-wire 60, the connection is continued through the motor, as before traced.

The energizing-circuits for the clutch-magnets may be traced as follows: For the upper clutch-magnet 16′ the connection leads from wire 58 by wire 59 to switch-lever 26′. In the normal position of the switch-lever the connection is continued from contact 27 of said lever by wire 66 and a brush 21′ to annular magnet 16′ and thence by the other brush 21′ to the return-wire 61. When the switch-lever 26′ is in shifted position, the connection leads from contact 28 through fixed magnet 17 and wire 68 to return-wire 61. For the lower clutch-magnet 16 the connection leads from wire 58 through wire 62 and switch-lever 63 to a contact 70, upon which the said switch-lever normally bears, said contact being connected by wire 71 with a collector-brush 21 of the lower annular magnet 16, the other collector-brush 21 thereof being connected by wire 73 to the return-wire 61.

It will be noted that the motor and magnetic clutch connections for the lower semaphore are made through the switch-lever 63 and its coöperating contacts, while the corresponding connections for the upper semaphore are independent of such switch. This switch-lever constitutes or has attached thereto the armature for a magnet, which is indicated at 75^a 75^b, &c., at the respective signal-points, whose coil is connected at one end by a wire 76 to the continuous rail 40, while the other side is connected through a wire 77 to a relay device at the next signal-post in advance. Such relay device consists of a switch, bridge or contacts (indicated at 78) attached to the armature-lever 50 of the relay-magnet—say 48^b—(see section B) coöperating with fixed contacts 79 80, connected, respectively, with the wire 77 and through a battery 81^b with the continuous rail 40, there being a battery 81^a 81^b, &c., for each of the signal-posts. When the armature 50 is attracted by track-relay 48^b, switch 78 is closed and the electromagnet 75 of the next signal in the rear is energized, keeping the circuit closed on switch 63 64 70 for the local circuits of lower semaphore of signal-post A in closed condition, except in so far as these circuits may be broken at the local switch 43.

The operation of the apparatus and system may be described as follows: When all the sections are clear and the circuits are in operative condition—that is, there is no obstruction or defect in any part of the track or system—all of the signals will stand in the position shown at B and C and the semaphores will stand at "danger." Under these circumstances all the relay-magnets 47^a 48^a, &c., as well as all the magnets 75^a, &c., will be energized, connections 50 52 will be closed, but connections 49 51 will be open, thus opening circuit of local magnets 42, with the result that all the local signal-circuits through contact 57 will be open and the motors, as well as the electromagnetic clutches, will be deënergized. Semaphore-switches 26 26′ will be held by semaphore-pins 27 against contacts 27 29, respectively, leading to the electromagnetic clutch-coils, and magnets 75^a will be energized, closing lever 63 on contacts 64 70, so that as far as the distant control is concerned the motor and clutch-magnet connections for the distant signal are closed. If now a train (indicated by a pair of wheels at *x*) comes onto section *a*, it will short-circuit that section and deënergize magnet 47^a, allowing armature-lever 49 to close with contact 51. Section *b* being clear, magnet 48^a remains energized, and connections through lever 50 and contact 52 remain closed, so that the circuit of the local battery is closed through magnet 42, as above explained, and armature 43, closing on contact 57, establishes connection from the local battery 41 to the wire 58 and thence to the motor and clutch-magnet circuits. For the upper or home signal semaphore this connection proceeds from wire 58 through wire 59, switch 26′, contact 27, wire 66, to clutch-magnet 16′, thence by wire 61 to the other side of the battery, thus energizing the clutch for that semaphore, and from contact 27 the current also proceeds by wire 60 to motor 5 and return-wire 61, thus energizing the motor. At the same time, the section *c* being clear, magnet 75^a is energized and connections through contacts 64 and 70 are closed, thus enabling the current from local battery 41 of signal part A to also proceed through the lower or distant-signal semaphore circuits, as follows: from wire 58 through wire 62 to switch 63, thence by contact 70 and wire 71 to clutch-magnet 16 and through said magnet to return-wire 61, and also from switch 63 by switch 64, wire 65, switch 26, contact 29, and wire 60 to the motor. Both clutch-magnets 16 16′ will thus be energized, and the motor 5 will also be energized, so that through the worm or worm-and-chain mechanism above described the signals will both be depressed to safety position, as shown for signal-post A in Fig. 5, indicating that the next two sections ahead—namely, *b* and *c*—are clear. When the semaphores have been fully raised, then pins 24 24′ strike the

switches 26 26′ and throw them to the position shown at signal-post A in Fig. 5, thus breaking the motor-circuit in each case, but in the case of the lower or distant semaphore leaving the clutch connections intact, so that the semaphore will be locked to the armature and by means of the worm connection will be prevented from back rotation. The circuit for the upper-semaphore clutch-magnet 16′ is broken. Assuming that the train passes over section *b* and comes into section *c* and that the second section in advance (indicated at *e*) is short-circuited by a train, (indicated at *y*,) the signal-post C of said section *c* will drop the upper semaphore, but will keep the lower semaphore in danger position, indicating that section *d* is clear, but that section *e* is blocked. The effect of short-circuiting of track-section *e* is to deënergize the relay-magnet 48^d of the next section in the rear, allow its armature to be released, as shown, and thus breaking the connection by bridge 78 through wire 77 and the track-rail 40 to the secondary relay-magnet or electromagnetic circuit-breaker 75^c of the next section *c* in the rear. This breaks the connection through the wire 71 and the clutch-magnet for the lower semaphore, so that said clutch remains loose and the semaphore is not raised. The upper semaphore is, however, raised, as before described, since its circuits are independent of the switch 75^c. If now while train *x* is still on section *c* train *y* moves off of section *e*, the consequent energization of magnet 48^d and closing of switch 78 at D causes magnet 75^c to close the circuits for the lower semaphore—namely, the distant signal—such circuits including, as described, both the operating-motor and the lever-clutch magnet. The motor will then operate again and will depress the lower semaphore or distant signal to "safety," the deënergization of magnet 16′ permitting this operation to proceed without interference from the upper signal, as the armature 15′ turns freely or only with slight friction on said magnet, while the said upper semaphore is held in safety position by locking-magnet 17.

My invention has been above described with especial reference to a normal danger-signal system, this being the system I prefer to use; but many features of the invention are applicable to a normal safety system, the only changes required being reversals or modifications of the signal-posts or of the circuits in a manner well understood in the art.

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

1. In a railway-signal, the combination of a signal pivotally mounted on a suitable support and a magnetic friction-clutch mounted on the pivot or shaft of said signal and consisting of an annular magnet and a disk armature and actuating means for the friction-clutch adapted to change the position of the ignal when operated.

2. In a signal, the combination of a signal pivotally mounted on a suitable support, an annular magnet and a disk armature for said magnet mounted on pivot or shaft of said signal and forming a magnetic friction-clutch, one member of which is fast and the other loose on said pivot, the loose member being adapted to be rotated and to frictionally engage with the fast member and operating means for rotating the loose member of the friction-clutch to change the position of the signal.

3. In a signal system, the combination of a signal pivotally mounted on a support, an annular magnet and a disk armature for same mounted on said pivot and forming a magnetic friction-clutch, one member being fast and the other loose on said pivot, a gear loosely mounted on said pivot and fast to the loose member of the clutch-actuating means engaging with said gear, and means for electrically energizing said magnetic clutch.

4. In a signal mechanism, the combination of a signal pivotally mounted on a support, a friction-clutch consisting of an annular magnet mounted on said pivot so as to turn with it, and a disk armature for said magnet loosely mounted on said pivot, and carrying a gear and adapted to engage with and move said magnet and signal when said armature is rotated and magnet energized, and means for rotating said gear and armature.

5. In a signal mechanism, the combination of a signal rigidly secured to a shaft pivotally mounted in a bearing on a suitable support, an annular magnet also secured rigidly to said shaft, a disk armature loosely mounted on said shaft and adapted to engage frictionally with said magnet and carrying a worm-gear, a worm engaging with and turning said worm-gear and a motor for rotating said worm to change the position of the signal.

6. In a railway signal system, the combination of a signal, a magnetic friction-clutch mounted on the signal-shaft, comprising an annular magnet and a disk armature and adapted to change the position of the signal when operated, means for rotating said clutch, an energizing-circuit for said magnetic clutch, a track-circuit and a relay therein controlling the circuit of the magnetic clutch.

7. In a railway signal system, the combination of the signal, a magnetic friction-clutch mounted on the shaft of said signal, comprising an annular magnet and a disk armature and adapted to change the position of said signal when rotated, electrical means for rotating said clutch, a circuit for energizing said clutch, a circuit for energizing the rotating means, a switch mechanism in the circuit for the rotating means operated by the signal mechanism while moving, and a track-circuit controlling the above-named circuits.

8. In a railway-signal, the combination of a signal mounted on a suitable support, a shaft rotatably mounted on a support and connected with said signal, an annular magnet suit-

ably mounted with said shaft extending through it, a disk armature for said magnet adapted to engage with same when energized, forming a magnetic friction-clutch, an energizing-circuit for said magnetic clutch, and means for moving said signal.

9. The combination of a plurality of signals, independent magnetic friction-clutches for the respective signals, an actuating mechanism operatively connected to the clutch of one of the signals, a mechanical connection between the driving members of the clutches of the respective signals and controlling-circuits for the respective magnetic clutches.

10. In a signal system, the combination of a plurality of signals counterweighted to return to danger position, connected together and independently mounted so that they may be moved by a shifting device singly or in parallel, an actuating mechanism for shifting said signals, independent clutch connections from the actuating mechanism to the respective signals and independent means for locking the respective signals in the position onto which they may be shifted and for releasing them without changing the position of the shifting mechanism.

11. In a signal system, the combination of two signals pivotally mounted on suitable bearings on a support, annular magnetic clutches and disk armatures for same mounted on shafts of said signals, one member of each clutch being rigidly secured to one of each of said signal-shafts, the other member being loosely mounted so as to rotate freely, connecting means connecting the loose members of the said clutches together so that they may be rotated simultaneously, actuating means, and means carried by one of said loose members for connecting it with the actuating mechanism, shifting mechanism for moving said loose members and controlling electric circuits for said magnetic clutches.

12. In a signal system, the combination with a suitable support and two signal-shafts mounted thereon, of two signals pivotally mounted on said shafts and adapted to change their positions, annular electromagnetic clutches and disk armatures for same mounted on the shafts of said signals, one member of each of said clutches being rigidly secured to one of each of said shafts, the other members being loosely mounted and having secured to them sprocket-wheels, chains engaging with said wheels and connecting said signals together and electric circuits for energizing and deënergizing said magnets substantially as and for the purpose set forth.

13. In a signal system, the combination with a support and two signal-shafts mounted thereon, of two signals mounted on said shafts and adapted to change their position, an annular magnetic friction-clutch mounted on the shaft of one of the said signals, one member of said clutch being rigidly secured to said signal-shaft, the other member being loosely mounted on same shaft and carrying means for connecting it with the actuating means, an annular magnetic friction-clutch mounted on the shaft of the other signal, one member of said clutch being rigidly, and the other loosely mounted, a connection between the two loose members, actuating means engaging with the loose member of one of said clutches for shifting the signals, controlling electric circuits for each magnetic clutch and a track-circuit controlling the two clutch-circuits.

14. In a signal system, the combination with a support and two signal-shafts mounted thereon, of two signals with a bias to danger, mounted on said shafts, a friction-lock for one of the signals, comprising an annular locking-magnet secured to said support, an annular clutch-magnet rigidly mounted on the shaft of said signal and acting as an armature for said locking-magnet, a disk armature for this second magnet loosely mounted on same shaft, connecting means connecting the disk armature with the other signal, an electric circuit for the locking-magnet controlled by the movement of the signal, an electric circuit for the clutch-magnet controlled by a track-circuit, an annular magnet rigidly mounted on the shaft of the other signal, an armature for said magnet loosely mounted on said shaft, means connecting said armature with the actuating means, means connecting said armature with the armature of the first signal-magnet, actuating means for actuating the said signals, and a controlling-circuit for the last-mentioned magnet controlled by different track-circuit from that which controls the circuit of the other magnet.

15. In a signal system, the combination of two signals pivotally mounted on a support, annular magnetic clutches mounted on shafts or pivots of said signals, a connection between said clutches so that both of them may be moved together, a gear carried by one of said clutches, a motor for rotating said gear, a circuit for said motor and controlling-circuits for each magnetic clutch.

16. In a railway block-signal system, the combination of home and distance signals in each block for indicating the condition of said blocks, annular magnetic clutches mounted with said signals on a suitable support and adapted to engage with, move and lock said signals, means for actuating said signals, energizing-circuits for said magnetic clutches, energizing-circuits for said actuating means, a track-circuit controlling the actuating-circuit and one clutch-circuit, composed of the rails of the section adjacent to said signal, a track-circuit controlling the other clutch-circuits, composed of the rails of sections in advance of the signals, and batteries for energizing said track-circuits.

17. In a railway signal system, the combination of a plurality of blocks or sections, two signals mounted on a suitable support at each section, adapted to change the position of and lock said signals in their changed position when energized, energizing-circuits for said

magnetic clutches controlled by different track-circuits, a track-circuit composed of the rails of the section adjacent to the signal for controlling one of the clutch-circuits, and a track-circuit composed of the rails of sections in advance of the signal for controlling the other clutch-circuits, and batteries for energizing said track-circuits.

18. In a railway signal mechanism, the combination with a signal, of means for turning same comprising a motor and an electromagnetic friction-clutch, and frictional locking means independent of said clutch and comprising an annular magnet and rotary armature for holding the signal in turned position.

19. In a railway signal system, the combination with a signal, counterweight devices for turning it in one direction and means comprising a motor and electromagnetic friction-clutch, for turning it in the other direction, of an electromagnetic friction locking device for holding the signal independently of the action of said clutch, and controlling-circuits for said electromagnetic clutch and locking devices whereby they may be controlled independently.

20. In a railway signal system, the combination with a signal, counterweight devices for turning it in one direction and means comprising a motor and electromagnetic friction-clutch for turning it in the other direction, of an electromagnetic frictional locking device for holding the signal independently of the action of said clutch, operating circuit connections for said clutch and locking-magnet, a switch adapted to transfer the circuit connection from one to the other of said magnets and means operated by the signal to control said switch.

21. In a railway signal system, the combination of two counterweighted signals, a motor having operative mechanical connection with both of such signals, an electromagnetic friction-clutch included in the connection with each signal, an electromagnetic locking device adapted to hold one of the signals independently of the clutch connection, operating-circuits for the motor, for the respective clutch-magnets and for the locking-magnet, adapted to enable energizing of either or both of the clutch-magnets in one position of the signals, and of the locking-magnet in the other position of the signal.

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