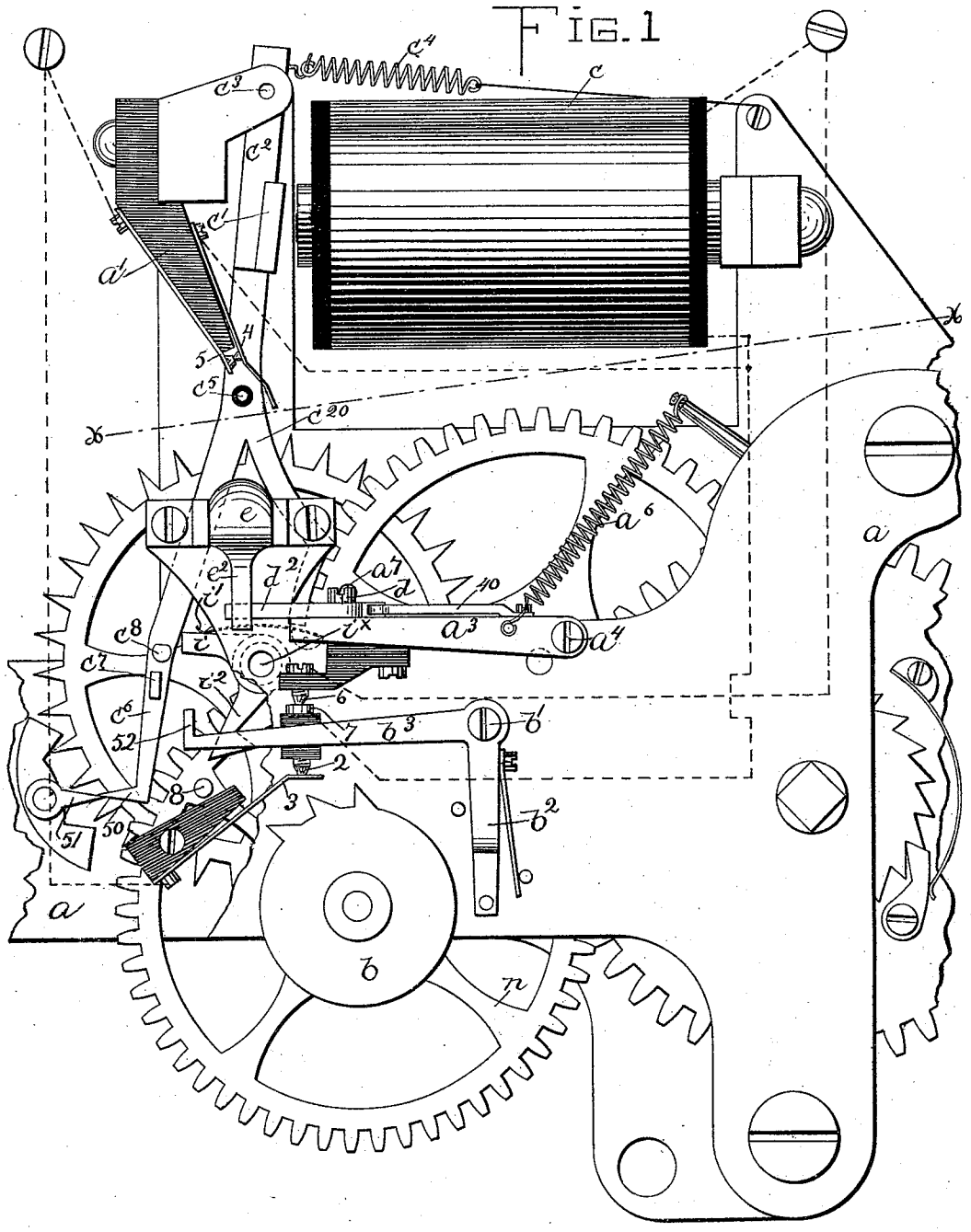
(No Model.) 4 Sheets—Sheet 1.

F. W. COLE.

SUCCESSIVE NON-INTERFERENCE SIGNAL BOX.

No. 553,840. Patented Feb. 4, 1896.

FIG. 1



Witnesses.
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F. W. COLE.

SUCCESSIVE NON-INTERFERENCE SIGNAL BOX.

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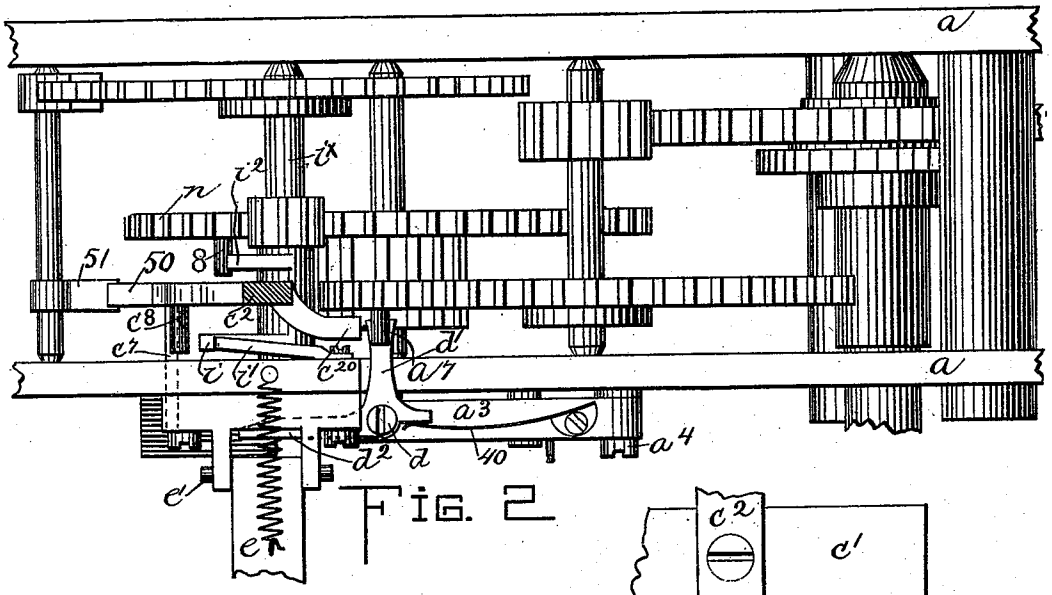

FIG. 2

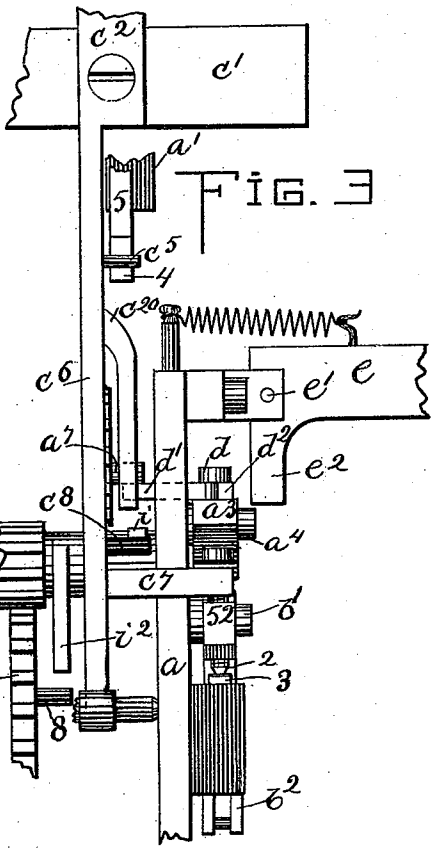

FIG. 3

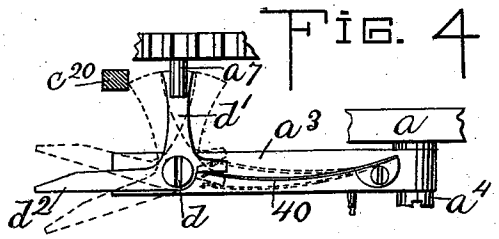

FIG. 4

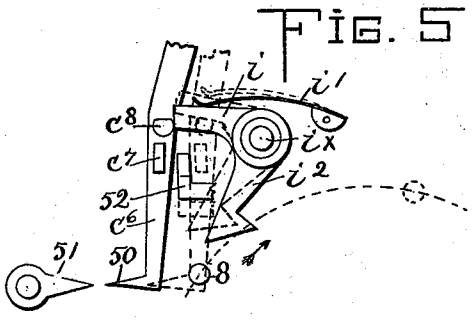

FIG. 5

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Fig: 6.

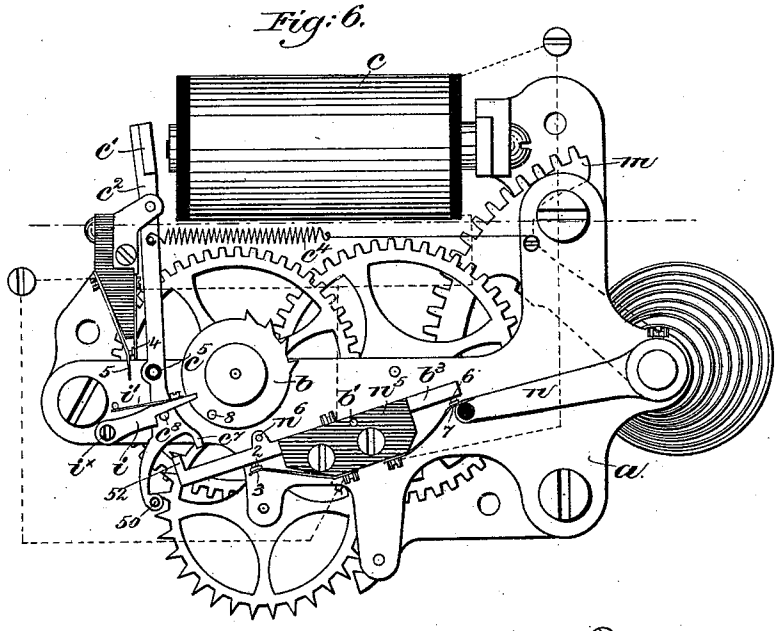

Fig: 8.

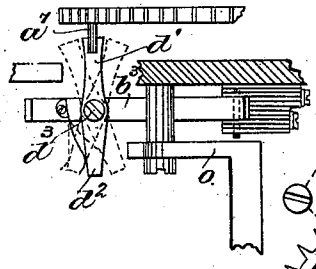

Fig: 7.

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(No Model.) 4 Sheets—Sheet 4.

F. W. COLE.

SUCCESSIVE NON-INTERFERENCE SIGNAL BOX.

No. 553,840. Patented Feb. 4, 1896.

Fig. 9.

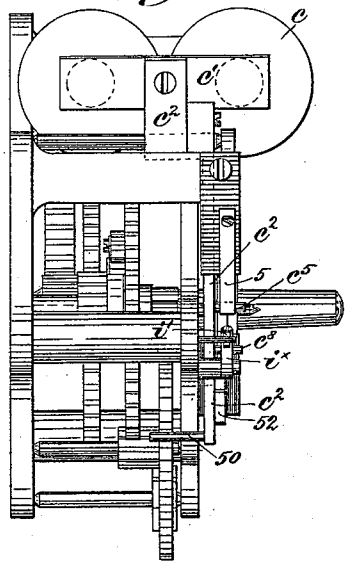


Fig. 10.

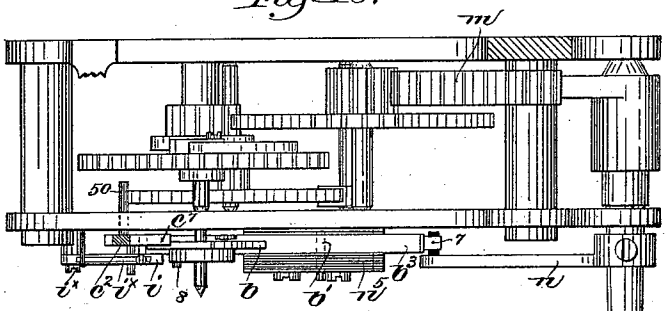


Fig. 13.

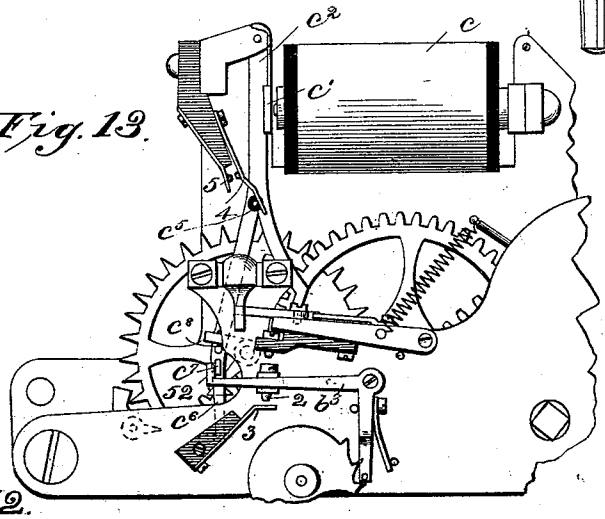


Fig. 11.

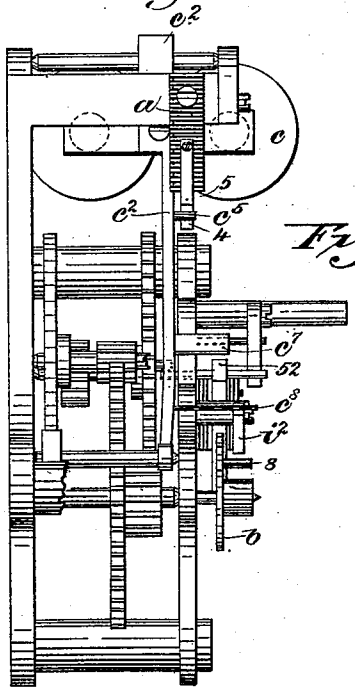
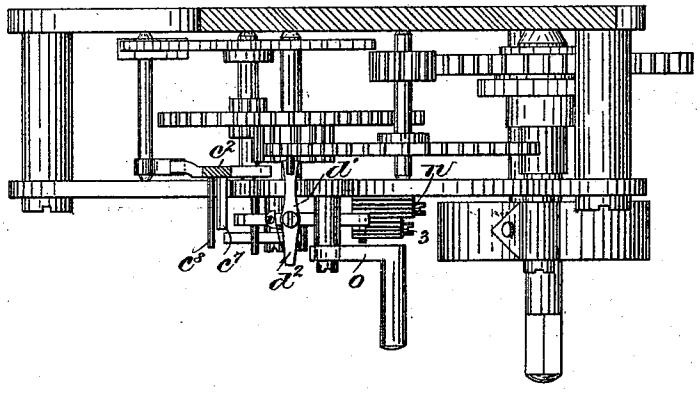


Fig. 12.



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UNITED STATES PATENT OFFICE.

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SUCCESSIVE NON-INTERFERENCE SIGNAL-BOX.

SPECIFICATION forming part of Letters Patent No. 553,840, dated February 4, 1896.

Application filed May 3, 1890. Renewed June 29, 1891. Serial No. 397,906. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK W. COLE, of Newton, county of Middlesex, State of Massachusetts, have invented an Improvement in Successive Non-Interference Signal-Boxes, of which the following description, in connection with the accompanying drawings, is a specification, like letters and numerals on the drawings representing like parts.

This invention has for its object to construct a successive non-interference signal-box, yet by the elimination of some features a plain non-interference signal-box of novel construction is produced.

The box herein represented as containing the features of my invention will continue to operate, when once started, or will not become permanently stopped until it has transmitted a correct signal, although it may be temporarily stopped. The stopping device or locking-lever which permanently or temporarily stops the train, as the case may be, is primarily under the control of the non-interference magnet, its temporary operation being controlled by said non-interference magnet, yet its permanent operation is controlled by the conjoint action of the non-interference magnet and the train in running. When a box has been pulled, thereby setting the signal, if it is ascertained before sending the first impulse that the signaling-circuit has been closed for a longer time than the longest closure in any signal it is evident that no signal is being transmitted from another box, and hence the line is clear.

In signal-boxes of the so-called "open-wheel" variety the closures are all of the same duration, or nearly so, being quite short, while in signal-boxes of the so-called "closed-wheel" variety some closures are of longer duration than the others. For instance, if but a single round is transmitted the longest closure will be between the groups of impulses; but if several rounds are transmitted the longest closure is usually between successive rounds.

To ascertain the condition of the circuit prior to transmitting the first impulse I provide suitable means, herein denominated a "retarded operative device," which consists of a signal-wheel moved by the train and caused to transmit its first impulse after the said train has run a longer time than the longest closure in any signal. Means are also provided for controlling the transmission of the signal, which is herein denominated a "determining device," and consists of the non-interference magnet, its armature, and a controlling-lever—such, for instance, as a shunt-lever.

The determining device, operated by the signaling-circuit, is designed to act during the lapse of time between the starting of the box and the transmission of the first impulse to prevent an interfering-signal being sent, or, if the box be designed as a successive box, said lever may act during such lapse of time to retain the set signal, which is thereafter released. A stopping device or locking-lever also serves as the releasing-lever, and is herein shown as one which is adapted to be moved into two distinct positions, one to release the train and the other to bring the signaling mechanism into signaling condition, as by moving the controlling-lever or shunt-lever, to thereby open the shunt-switch for the signal-contacts or signal-wheel. The first step or movement of said lever by which the train is released is herein represented as controlled by a pull or manually through the intervention of an electromagnet, and thereafter the second step or movement of said lever is controlled by the train in running. The time consumed in moving the releasing-lever from its position, whereby it releases the train, into its position whereby the controlling-lever acts to open the shunt-switch, or otherwise bring the box into signaling condition, is longer than the longest closure in any signal, and during this time the said controlling-lever is free to act to prevent an interfering-signal being sent.

The signal-wheel herein shown contains but a single round, and hence is adapted to be moved several revolutions, and means are provided for giving the control of the line to said signal-wheel only at the commencement of a round.

Means are provided for holding the controlling-lever when the circuit is open at the home

box—*i. e.*, the box from which the signal is being sent—and for releasing it when the circuit is closed at the home box.

Figure 1 shows in front elevation a signal-transmitting apparatus embodying this invention, parts of the frame and driving-wheel being broken off to save space on the drawings; Fig. 2, a horizontal section of the signal-transmitting apparatus shown in Fig. 1, taken on the dotted line *x x;* Figs. 3, 4, and 5, details to be referred to; Figs. 6 and 7, modified constructions to be referred to; Fig. 8, a detail of some of the parts shown in Fig. 7 to be referred to; Fig. 9, an end view of the transmitting device shown in Fig. 6; Fig. 10, a plan view of the device shown in Fig. 6, the non-interference magnet being omitted; Fig. 11, an end view of the signal-transmitter shown in Fig. 7; Fig. 12, a plan view of the signal-transmitter shown in Fig. 7, the non-interference magnet being omitted; and Fig. 13, a detail to be referred to.

The main framework *a* is of suitable construction to support the operating parts.

The signaling-train shown in Fig. 1 comprises a motor mechanism normally wound, and a signal-wheel driven by it, said motor mechanism being common in signal-boxes and need not be herein described.

The particular form of signal-transmitter herein shown, and which in this instance I prefer to employ, consists of a wheel *b*, having teeth arranged on it, as desired, for the box-number or other signal, and a bell-crank lever pivoted at b', one arm, as b^2, of said lever engaging the periphery of the signal-wheel *b*, and the other arm, as b^3, of said lever carrying a contact-point 2 which co-operates with a contact-pen 3, making and breaking contact with said pen as the lever is turned on its pivot by the signal-wheel. This bell-crank lever constitutes the signaling-key, and of course may be constructed in many different ways, and the signal-wheel is of the so-called "open-wheel" variety.

The stopping device or locking-lever for the normally-wound motor is represented at c^6, being formed integral with or secured to a bar c^2, and having on its end a tooth 50, which engages a tooth 51 on the pallet-shaft of the signaling-train. This stopping device or locking-lever c^6 is also employed as the releasing-lever for the train.

The non-interference electromagnet *c* is designed to be connected or included in the signaling-circuit, its armature c' being attached to the aforesaid bar c^2, which is pivoted at c^3 to the framework, and which is provided with a suitable retractile spring c^4.

The non-interference magnet *c* is normally shunted out, the shunt-switch provided for the purpose being herein shown as a contact-point 6, fixed to or carried by an arm a^3, pivoted at a^4, said contact-point 6 being duly insulated from said arm, and another contact-point 7 fixed to or carried by the arm b^3 of the signal-key, said contacts 6 7 when in engagement closing a shunt around the non-interference magnet, and when separated opening said shunt, thereby including said magnet in the signaling-circuit. A spring a^6, connecting the arm a^3 with a fixed stud, is employed to lift the said arm a^3, and a pin a^7 on one of the wheels of the train is employed to depress the said arm a^3 against the tension of the spring a^6. To effect engagement between the arm a^3 and pin a^7, I have pivoted at *d* on said arm a bell-crank lever, (see Fig. 4,) one arm of which, as d', projects at an angle with relation to the arm a^3 and is pressed upon by the pin a^7, the other arm, as d^2, of said lever extending substantially parallel with said arm a^3 and forming an extension thereof. The bell-crank lever d' d^2 turns on an axis at right angles to the axis of the arm a^3.

An actuating-lever *e* is pivoted at e' to the main framework, (see Fig. 3,) it having a downwardly-extending projection e^2, which, when the lever *e* is turned down on its pivot, strikes the arm d^2 of the bell-crank lever d' d^2 and moves the arm d' from beneath the pin a^7 against the tension of the spring 40. This actuating-lever *e* constitutes in this instance the signaling-lever, because it is the device which a person operates to cause the box to transmit its signal, and the bell-crank lever d' d^2 constitutes a let-off. As soon as the signaling-lever has been moved and the bell-crank lever d' d^2 or let-off moved from beneath the pin a^7, the arm a^3 will be lifted by means of the spring a^6 and the contact-pens 6 7 separated, thereby including the non-interference magnet in the signaling-circuit. As soon as the non-interference magnet is included in the circuit, its armature will be attracted or moved toward its poles and the lever c^6 moved to release the train.

When the operated or depressed signaling-lever *e* returns to its normal position, the let-off or bell-crank lever d' d^2 will be turned by the spring 40 into its extreme left-hand position, as indicated by dotted lines, Fig. 4, if not obstructed.

An arm c^{20} is connected to or formed integral with the armature-carrying lever c^2, the lower end of which when the armature is attracted bears against the left-hand side of the arm d', (see Figs. 3 and 4,) or in close proximity thereto, so that said bell-crank lever can turn toward the left only while the armature is retracted. It will thus be seen that this arm c^{20} acts when attracted to hold the let-off or bell-crank lever d' d^2 against the tension of the spring 40, so that it will lie in the path of movement of the pin a^7, to be thereby engaged and moved at the completion of a revolution of the wheel, but if at the completion of said revolution the armature is retracted, then the let-off d' d^2 will not be engaged, and hence the wheel will continue another revolution, and so on until at the particular time the wheel completes its revolution the armature is to be found attracted. When the pin a^7 engages the bell-

crank lever $d' d^2$ it depresses the arm a^3, closing the shunt-switch 6 7 for the non-interference magnet, and the armature of said magnet being at once retracted the lever c^6 will engage and permanently stop the train.

For purposes to be hereinafter described, it is necessary to depress the signaling-key so that it will occupy a position below its proper operating position, and to accomplish this result I have located the arm a^3 above the arm b^3 of the signal-key and have placed the contact 7 on said arm b^3, so that when the arm a^3 is depressed by means of the pin a^7 on one of the wheels of the train the arm b^3 of the signal-key will also be depressed. When the signaling-lever is operated and the non-interference magnet c included in the signaling-circuit, the arm b^3 of the signal-key will be lifted by suitable means, herein shown as a spring which bears against the arm b^2.

A controlling-lever is provided for the signal-transmitter, which controls the transmission of the signal, it being herein shown as a lever adapted to control the operation of a shunt-switch, which comprises two contact-pens 4 5 arranged on a block a' of insulating material. When these contact-pens 4 5 are closed a shunt is formed for the signal-transmitter, and when opened the signal-transmitter is included in the signaling-circuit. This shunt-switch 4 5, which thus forms a disabling device for the circuit-contacts, may be made in many different ways to serve when closed as a means for preventing the effective transmission of the signal, and when opened to place the box in signaling condition; so I do not desire to limit myself to the particular way shown.

It is herein designed that the shunt-switch 4 5 shall be controlled by the armature of the non-interference magnet, and in this instance of my invention, in order to carry out this result, I have arranged on the armature-carrying lever or bar c^2 a pin c^5, which, when the armature is attracted, engages one of the members, as 4, of said shunt-switch 4 5, opening it, and when the armature is retracted disengages said member 4, permitting it to close. It is furthermore herein designed that the shunt-switch 4 5 shall be controlled by the train in running, so that it may be opened to bring the box into signaling condition at a certain time—as, for instance, at the beginning of a round, and then only after a certain length of time has elapsed, during which the circuit must be continuously closed, thereby preventing the operation of the signaling-circuit by means of the signal-key during such length of time.

The non-interference magnet, its armature, and the controlling-lever governed by it constitute a determining device, because when a box is operated in usual manner it will determine whether or not the signal will be transmitted. A projection c^7 is arranged on said armature-carrying bar c^2, and just above it another projection c^8 is located, the purposes of which will be hereinafter explained.

When the box is operated or pulled the non-interference magnet is included in the signaling-circuit, and the signal-key raised into operative position, and presuming the line to be clear the magnet c will at once attract its armature c', causing the releasing-lever c^6 to disengage the pallet, so that the train may start up. The armature-carrying bar is not, however, moved its entire distance, as the projection c^8 thereon strikes a dog i loosely arranged on a shaft $i^\times$. This dog i has an arm i^2, (see Fig. 5,) with a beveled end, and on one of the wheels of the train—as n, for instance—a pin 8 is secured, which pin as the wheel revolves strikes the beveled end i^2 of the dog and moves it on its pivot $i^\times$ against the tension of a spring i sufficiently to disengage it from the pin c^8. As soon as the said pin c^8 is released by the raising of the dog, the lever c^6 will be again moved toward the poles of the non-interference magnet until the projection c^7 strikes the upwardly-projecting end 52 of the signal-key. The signal-wheel b, slowly revolving during all this time, soon arrives in position for its first tooth to engage and move the signal-key to close the contacts 2 3, the interval of time, however, consumed between the time that the pin 8 has lifted the dog and disengaged it from the pin c^8 and the time that the first tooth of the signal-wheel moves the signal-key to break the circuit being a little longer than the time consumed by the longest closure of the circuit during the transmission of any signal. When the signal-key is moved by the first tooth of the signal-wheel the arm b^3 is depressed, first closing the contacts 2 3, then releasing the projection c^7, and the armature-carrying bar will then be farther and completely moved by the magnet c. During this last movement of the armature-carrying lever the shunt-switch 4 5 will be opened, and the signaling-circuit will be then under the entire control of the signal-transmitter to be operated for its first time when the arm b^2 falls into the notch next the first tooth. This signal-wheel b hence waits a longer time than the longest closure in any signal after it has been started before it operates the circuit for its first time, and I therefore denominate it a "retarded operative device." As herein shown, the second and remaining times that the arm b^3 is lifted to open the circuit after being depressed by the teeth of the signal-wheel the projection 52 at its outer end will pass by the opposite side of the projection c^7, so as to hold the said armature-carrying bar in attracted position whenever the arm b^3 is in its elevated position, as represented in Fig. 13, or whenever the circuit is open at the home box. This feature is desirable, for it holds the armature against the poles of the magnet at the time that the line is open at the home box and the magnet has no attractive force.

Thus it will be seen that if the line is clear

the train will be released, and after a predetermined length of time the mechanism will be brought into signaling condition, as by opening the shunt-switch 4 5, these results being effected by the lever c^6, which is moved two distinct steps, one of which is controlled manually, and the other by the train in running. The train will continue to run, the arm b^3 vibrate to correspond with the makes and breaks, and the successive rounds be transmitted until the pin a^7 makes one revolution, when it strikes the arm d' of the bell-crank lever d' d^2, depresses the arm a^3 until it closes the contacts 6 7, thereby shunting out the non-interference magnet, and depresses the arm b^3, so that its upwardly-projecting outer end 52 releases the projection c^7, and there being then no other force to hold the armature-carrying bar against the poles of the non-interference magnet it will be retracted by means of the retractile spring c^4, and permanently stop the train. As soon as the arm c^2 is retracted, the dog i returns to its normal position by means of the spring i' bearing on it. If, however, when the signaling-lever is operated and the arm a^3 thereby released, opening the shunt of the non-interference magnet, or otherwise including it in the line or rendering it operative, the line should be found open at some point, the armature c' will not be attracted, and hence the signaling-train will not be released by the lever c^6; but it will be seen that when the arm a^3 is once released by the signaling-lever it cannot resume its normal position until restored by the pin a^7, and hence not until the train has operated, and it will also be seen that when the arm a^3 is released the arm b^3 will immediately resume its elevated position and cannot again resume its normal position until depressed by the arm a^3, except when moved by the teeth of the signal-wheel. When the condition of the signaling-circuit has been restored, the armature c' will be at once moved toward the poles of the magnet until the pin c^8 strikes the end of the arm i, and is there held, and such movement is sufficient for the locking or releasing lever c^6 to release the train. The train will then start up; but if the signaling-circuit is again immediately interrupted at a remote point, the armature c' being at once retracted, the lever c^6 will again engage with and hold the train temporarily in suspension until the circuit has been again restored.

If a signal is being transmitted from another box, the home box when once started will operate in the manner just described, the armature vibrating to correspond with the successive impulses from the remote box, and during such operation the circuit-wheel of the home box may be driven one or more rounds or fractions thereof, as the train is repeatedly started and stopped. In such an event as this—viz., when a signal is being transmitted from a remote box and the home box has been started—the circuit-wheel b will be moved forward little by little until the pin 8 moves far enough to engage and move the arm i^2 of the dog, allowing the armature-carrying lever c^2 to move when attracted, so that the pin c^8 on said lever will come under the arm i of the dog, said lever being prevented from farther movement toward the poles of the magnet by the projection c^7 bearing against the end 52 of the signal-key. The lever c^2 will be held in this position by the attractive force of the magnet until released by the first tooth of the signal-wheel, which tooth arrives in position to accomplish such result after a predetermined length of time. If the circuit is opened at a remote point during this interval of time, the armature c' will be retracted, and the dog i, which is resting on the pin c^8, will fall or be released as the pin c^8 is withdrawn from beneath it. The dog i will then have resumed its normal position. When the circuit has been again closed, the armature cannot approach the poles of the magnet as on the previous closure, because the pin c^8 will strike against the end of the dog i just as when the box was first started. This dog, when so restored to its normal position, will prevent a sufficient movement of the armature-carrying lever to permit the pin c^5 to open the shunt 4 5 and include the wheel in circuit, but the position of said dog does not prevent the train from operating either intermittingly or continuously.

The pin 8 is so arranged as to move the dog i into its abnormal position once just before the commencement of a round, to thereby bring the apparatus into signaling condition, but if the parts are so positioned at such time as not to properly co-operate therewith or hold it in such abnormal position, or if the dog is not continuously held for a definite length of time, then the dog will prevent the apparatus from getting into signaling condition until the arrival of the pin 8 on the next revolution of the wheel carrying it. It will thus be seen that by the employment of a retarded operative device there is a short interval of time at the commencement of a round, when if the line is clear the signal-key can be included or rendered operative, but if during such interval of time the circuit is opened at a remote point the determining device will operate to prevent the home signal interfering. It will be further seen that when the home signal is being transmitted, if the line is opened at any point during any of the closures of the home box, the armature of the non-interference magnet will be at once retracted, as there is no other means for holding said armature in its attracted position at such time except the attractive force of the magnet.

When the armature is retracted by a break in the circuit at a remote point occurring during the actual transmission of the home signal, it will move far enough for the locking-lever c^6 to engage and hold the train in sus-

pension, and will so hold it until such time as the circuit is restored or closed, and when such retraction takes place the dog *i* will return to its normal position, so that when the circuit has been restored or again closed and the armature attracted the train will start up; but the home signal, however, will not be transmitted until the pin 8 has again engaged and moved the dog *i*. Hence each time the home box attempts to send its signal it will be at the commencement of a round, and if not interrupted will complete such round, but if interrupted will immediately withdraw and wait until the line is restored for a longer time than the longest closure of any signal. Such interruption, however, will rarely occur if on starting a box it is determined that the line is clear for a longer time than the longest closure in any signal, and such result is accomplished by the retarded operative device and the determining device.

It will also be seen from the foregoing that the pin c^8 is stopped by the arm *i*, if a box in the line is transmitting a signal and the home box is pulled, at all times except when said arm *i* is lifted by the pin 8, and at such time said pin c^8 will pass beneath the arm *i*, but the projection c^7 will strike the end 52 of the signal-key b^3. It will be further seen from the foregoing that the arm *i* must be lifted out of the path of the pin c^8, and then held in such elevated position by said pin c^8 a longer interval of time than the longest closure in any signal for the first tooth of the signal-wheel to depress the arm b^3, and allow the projection c^7 to pass by it, and thereby open the shunt-switch 4 5 for the signal-wheel.

Referring to Fig. 6, a motor is shown which is wound up by means of a sector *m* or equivalent winding-arm. The signal-key in this instance consists of a vibrating bar b^3 pivoted at b' and carrying a contact 2 and a cooperating contact 3, which is arranged beneath the contact 2 and secured to a block n^5. To insure good operation of this signal-key, I have arranged on it a roller n^6, which is acted on by the teeth of the signal-wheel *b*. The means shown in this figure for including the non-interference magnet *c* consists of two contacts 6 7, held against each other to normally form a closed shunt around the said magnet by means of the sector or winding-arm *n* and separated when said arm is removed, so that whenever the transmitter is wound by the sector the non-interference magnet will be included in the line. The armature c' of the non-interference magnet is carried by an armature-carrying lever c^2, which has on it a pin c^5, which co-operates with contacts 4 5, which normally when in contact with each other form a closed shunt for the signal-key. The armature-carrying lever c^2 has at its lower end a pin, as 50, which engages one or another tooth of the escape-wheel, acting when the armature is retracted to hold the train either at rest or in suspension, according to the position of the sector. A dog *i* is in this instance shown as a single bar or arm pivoted at $i^\times$ to the frame. This dog is held down by means of a spring i' and is lifted at determinate times by means of a pin 8, shown in this instance as on the circuit-wheel. The armature-carrying lever c^2 has a projection c^7, which is at times engaged by the projection 52 of the signal-key, so as to hold the said armature-carrying lever in position with the armature against the pole of the non-interference magnet while the signaling-key is in proper position and there is no attractive force in the magnet. The armature-carrying lever has also a pin c^8, which when moved strikes a shoulder on the dog. The operation of this transmitter is so near like that shown in Fig. 1 that no further description seems necessary.

Referring to Fig. 7, a normally-wound motor is shown. A signaling-key $b^3 b^2$ is pivoted at b', it having at its outer end a projection 52, which co-operates with a projection c^7 of the armature-carrying lever c^2 of the non-interference magnet *c*. The armature-carrying lever c^2 has also a projection c^5, which co-operates with two contact-pens 4 5, which form a shunt for the signal-key. The armature-carrying lever also has a projection 50, which engages with the pallet of the motor mechanism. A contact 2 is carried by the signal-key, which makes contact with a pen 3 to make and break the circuit. A contact-pen *m* is located next the contact-pen 3, which, when the signaling-key has been moved beyond the distance which it will be moved by the teeth of the signal-wheel *b*, will make contact with said pen 3. A bar $d'\ d^2$ is pivoted at d^3 on the arm b^3 of the signal-key, said bar when in one position (see Fig. 8) being engaged by a pin a^7 on one of the moving parts of the train, the direction of movement of said pin being such as to depress the signal-key sufficiently to close the contacts m^3 and shunt the non-interference magnet. The bar $d'\ d^2$ is moved on its pivot by the signaling-lever *o*. The dog *i* is pivoted at $i^\times$, the end of which is in position to be struck by means of a pin c^8 on the armature-carrying lever, and said dog is further acted on by a pin 8 on the signal-wheel *b*, so as to be moved at determinate times only. The operation of this transmitter is substantially the same as that shown in Fig. 1, so a detailed description of this operation is deemed unnecessary.

I do not desire to limit my invention to the employment of all the parts shown herein, as some of them may be eliminated, and yet a box capable of accomplishing new and useful results may be made; also, I do not desire to limit my invention to the specific construction of parts shown, as it is obvious from the few illustrations herein that many modifications may be made, operated in substantially the same manner and accomplishing substantially the same results, which may quite widely differ in construction, yet come within

the spirit and scope of this invention. Further, I desire it to be understood that in lieu of the dog *i* and means shown for moving it a definite length of time before the beginning of a round, and the arm b^3 and means shown for moving it at the beginning of a round, any other equivalent forms of controlling devices for the shunt or other controlling lever may be employed which operate one in advance of the other, so that the shunt or other controlling lever will be held in a given position a longer time than the longest closure in any signal just prior to opening the shunt-switch or otherwise giving the control of the line to the home box or just prior to the transmission of the first impulse.

I claim—

1. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, a locking-lever, as c^6, for the train controlled by said armature, and a vibrating arm, as b^3, independent of the armature for holding said locking-lever in a fixed position, the vibration of said arm being caused by the train when running, substantially as described.

2. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, combined with a locking-lever, as c^6, for the train controlled by said armature, a vibrating arm, as at b^3, that enters the path of movement of the locking-lever on each successive vibration, and means for vibrating said arm to correspond with the makes and breaks of the signal-wheel, substantially as described.

3. In a signal-box, a signaling-train, and circuit-controller, a non-interference magnet and its armature, a locking-lever, as c^6, for the train controlled by said armature, and a vibrating arm, as b^3, for said locking-lever, the vibratory movement of which is caused by the signal-wheel, substantially as described.

4. In a signal-box, a train, a circuit-controller, a locking-lever for the train, a non-interference magnet and its armature for moving the said locking-lever to release the train, and a vibrating arm controlled by the train for holding the locking-lever in its unlocked position when the non-interference magnet is demagnetized, substantially as described.

5. In a signal-box, a train, a non-interference magnet, and its armature, combined with an arm, as b^3, circuit-contact 2 carried by it which co-operates with circuit-contact 3, a controlling-lever governed by said armature with which said arm b^3 co-operates in controlling the transmission of the signal, and means for vibrating said arm to correspond with the box-number, substantially as described.

6. In a signal-box, a signaling-train, a non-interference magnet, and its armature, a controlling-lever which controls the transmission of the signal held by the armature when the signaling-circuit is closed at the home box, and an independent holder which holds said controlling-lever when the signaling-circuit is open at the home box, combined with a locking-lever, as c^6, which is operated to lock and release the signaling-train by the armature of the non-interference magnet, substantially as described.

7. In a signal-box, a signaling-train, a locking-lever for it, a non-interference magnet, and its armature controlling said locking-lever, combined with a shunt-switch for the said non-interference magnet, and a signaling-lever for controlling the said shunt-switch, substantially as described.

8. In a signal-box, a circuit-controller, a non-interference magnet, a shunt-switch for said magnet, and a shunt-switch for the circuit-controller, the latter controlled by the armature of the non-interference magnet, combined with a locking-lever for the signaling-train operated by said armature, substantially as described.

9. In a signal-box, a signaling-train, a circuit-controller and non-interference magnet and its armature, combined with a shunt-switch for the circuit-controller, and a locking-lever for the train, both of which are operated by the non-interference magnet, substantially as described.

10. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, combined with a shunt-switch for said non-interference magnet, and a signaling-lever for controlling the said shunt-switch, a locking-lever controlled by said armature for locking the train when the shunt-switch is closed, substantially as described.

11. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, combined with a shunt-switch for said non-interference magnet, and a locking device controlled by the armature of said magnet for locking the train when the said shunt-switch is closed, substantially as described.

12. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, combined with a shunt-switch for said magnet, a releasing-lever for the train controlled by the armature of said magnet for releasing the train when said shunt-switch is open, substantially as described.

13. In a signal-box, a signaling-train, a non-interference magnet and its armature, combined with a locking-lever, as c^6 for the train moved by said armature and held in one or another position by the arm b^3, and a signal-wheel *b* for moving said arm b^3, substantially as described.

14. In a signal-box, a circuit-controller, a signaling-train, a locking-lever for it, a non-interference magnet and its armature, controlling said locking-lever, combined with two separate controlling devices for said locking-lever, one of which operates a definite length of time in advance of the other, substantially as described.

15. In a signal-box, a circuit-controller, a signaling-train and locking-lever for it, a non-interference magnet and its armature controlling said locking-lever, a shunt-switch for the circuit-controller operated by said locking-lever, combined with a dog controlling the position of said locking-lever, and an operating device for said dog, substantially as described.

16. In a signal-box, a circuit-controller and signaling-train, a locking-lever for it, a non-interference magnet and its armature controlling the said locking-lever, a shunt-switch for the circuit-controller open just before the said locking-lever completes its movement in one direction, combined with a dog which normally lies in the path of movement of said locking-lever when the latter is moved by the non-interference magnet to open the said shunt-switch, and means for moving the said dog at regular intervals during the progress of said train, substantially as described.

17. In a signal-box, a circuit-controller, and signaling-train, a locking-lever for it, a non-interference magnet and its armature controlling the said locking-lever, a shunt-switch for the circuit-controller open just before the said locking-lever completes its movement in one direction, combined with a dog which normally lies in the path of movement of said locking-lever when the latter is moved by the non-interference magnet to open the said shunt-switch, and means for moving the said dog at regular intervals during the progress of said train, and a vibrating arm which cooperates with said locking-lever to hold it in one or another fixed position, substantially as described.

18. In a signal-box, a circuit-controller, a signaling-train, a shunt-switch for the circuit-controller, a shunt-lever therefor, an electromagnet and its armature for said shunt-lever, combined with a shunt-switch for said electromagnet, and a pin on one of the wheels of the train for closing said last-named shunt-switch at the completion of a signal, substantially as described.

19. In a signal-box, a circuit-controller, a signaling-train, a shunt-switch for the circuit-controller, and shunt-lever therefor, an electromagnet and its armature for said shunt-lever, combined with a shunt-switch for said electromagnet under the control of the aforesaid armature, substantially as described.

20. In a signal-box, a circuit-controller for the signaling-circuit, and a shunt-switch for the said circuit-controller, combined with a lever for said shunt-switch, an electromagnet and its armature for controlling the movement of said lever, and a dog for the shunt-lever which permits free movement thereof in one direction at all times but prevents movement thereof in the opposite direction, and means for moving said dog at regular intervals during the progress of the train, to allow the shunt-lever free movement in said opposite direction, substantially as described.

21. In a signal-box, a circuit-controller, a signaling-train, a shunt-switch for the circuit-controller, a lever for said shunt-switch, and an electromagnet and its armature for said lever, combined with a shunt-switch for said electromagnet, and a signaling-lever controlling the operation of said last-named shunt-switch, substantially as described.

22. In a signal-box, signaling mechanism, a non-interference magnet and its armature, a shunt-switch for said magnet, a let-off loosely mounted on the operating member of said shunt-switch, a restoring-arm for said let-off controlled by the armature of said magnet, said restoring-arm determining the position of said let-off, a pin on one of the moving parts of the train which engages with the said let-off, to close the shunt-switch if the said part is in a certain position, and a signaling-lever for moving said part in a direction to disengage it from the said pin, substantially as described.

23. In a signal-box, signaling mechanism, a non-interference magnet and its armature, and a signal-controlling lever which when in its normal position permits the transmission of the signal and when in its abnormal position prevents the transmission of the signal, combined with an arm repeatedly vibrated by the signaling mechanism during the transmission of the signal, which engages and locks the signal-controlling lever in its abnormal position, substantially as described.

24. In a signal-box, a signaling-train, a circuit-controller, a shunt-switch for it, a non-interference magnet and its armature, combined with an arm repeatedly vibrated by the signaling-train adapted to engage and hold said shunt-switch closed, substantially as described.

25. In a signal-box, signaling mechanism, a non-interference magnet and its armature, and a signal-controlling lever governed by said non-interference magnet, combined with an arm repeatedly vibrated by the signaling mechanism adapted to hold said signal-controlling lever away from the influence of said magnet, substantially as described.

26. In a signal-box, a signaling-train, a non-interference magnet and its armature, a let-off for the signaling-train, and means for moving it, combined with the restoring-arm c^{20}, and the pin a^7 on one of the wheels of the train for returning said let-off to its normal position, substantially as described.

27. In a signal-box, a signaling-train, a non-interference magnet and its armature, the arm a^3, and let-off carried by it, combined with a restorer for said let-off operated by the armature of the non-interference magnet, a shunt for said magnet, and shunt-switch, one of the members of which is moved by said arm a^3, substantially as described.

28. In a signal-box, a signaling-train, a non-interference magnet and its armature, combined with an arm a^3, a let-off interposed between said arm and the signaling-train, a re-

storer controlled by the armature for moving the let-off into position to be engaged by the train, substantially as described.

29. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet, and its armature, combined with a locking-lever for the train, a retaining device, as 52, for it, means for moving said retaining device corresponding with the impulses of the box-number, and a pin on one of the moving parts of the train for moving the retaining device to release the locking-lever at the completion of a signal, substantially as described.

30. In a signal-box, a signaling-train, a circuit-controller, a non-interference magnet and its armature, combined with a shunt-switch for the said magnet, the movable member of which is controlled by the train, and a lever controlled by the armature for controlling the engagement of the said movable member with the train, substantially as described.

31. In a successive non-interference signal-box, signaling mechanism, a non-interference magnet and its armature, a box-number circuit-controller, a shunt-circuit changer therefor, a shunt-lever controlled by said armature, combined with two independent members, as *i* and 52, controlling the movement of said shunt-lever in one direction, one of which is moved in advance of the other, substantially as described.

32. In a successive non-interference signal-box, signaling mechanism, a non-interference magnet and its armature, a box-number circuit-controller, a shunt-switch therefor, the shunt-lever of which is controlled by the armature of said magnet, combined with two members, as *i*, and 52, controlling the movement of said shunt-switch lever in a direction to open the shunt, one of which is moved a definite length of time in advance of the other and equal to a longer time than the longest closure in any signal, substantially as described.

33. In a successive non-interference signal-box, signaling mechanism, a controlling-lever therefor, a non-interference magnet and its armature governing the movement of said controlling-lever, combined with two separate controlling devices, as *i* and 52, for said controlling-lever, one of which operates a definite length of time in advance of the other, substantially as described.

34. In a successive non-interference signal-box, signaling mechanism, a controlling-lever therefor, a non-interference magnet and its armature governing the movement of said controlling-lever, combined with two separate controlling devices as *i* and 52 for said controlling-lever, one of which operates a definite length of time before the beginning of a round, and the other of which operates at the beginning of a round, substantially as described.

35. In a successive non-interference signal-box, a signaling-train, a circuit-controller, a non-interference magnet, and its armature, combined with a controlling-lever that controls the transmission of the signal governed by the armature of the non-interference magnet, and a vibrating member, as 52, which obstructs the path of movement of the controlling-lever as it is moved by the attracting-armature for a definite length of time just prior to the beginning of a round, substantially as described.

36. In a non-interference signal-box, a motor, means for operating it, a retarded operative device moved by the train for a time longer than the longest closure in any signal before bringing the apparatus into signaling condition, and a determining device acting during said lapse of time to prevent an interfering-signal being sent, substantially as described.

37. In an electric signaling apparatus, the combination with a signal-wheel, and contacts therefor, and a disabling device which normally holds the contacts in disabled condition, of an actuating-train for said wheel, a releasing-lever for the train adapted to be moved two steps, one manually controlled to release the train, and the other controlled by the train in running to operate the disabling device and thereby enable the signaling-contacts to operate the signaling-circuit, substantially as described.

38. In an electric signaling apparatus, the combination with a signal-wheel, and contacts therefor, of an actuating-train for said wheel, a releasing-lever for the train adapted to be moved two steps, one manually controlled to release the train, and the other controlled by the train in running to open a shunt for the signaling-contacts, and thereby include them in the signaling-circuit, substantially as described.

39. In an electric signaling apparatus, the combination with a signal-wheel, and contacts therefor, and a disabling device which normally holds the contacts in disabled condition, of an actuating-train for said wheel, a releasing-lever for said train, and mechanism controlled by the signaling-train for operating said disabling device to bring the apparatus into signaling condition, substantially as described.

40. In a non-interference signal-box, a motor, means for operating it, a retarded operative device moved by the train to operate the circuit for its first time after said train has run a longer time than the longest closure in any signal, a determining device comprising a non-interference magnet, its armature and a controlling-lever governed by it which acts during such lapse of time to prevent an interfering-signal being sent, and a normally-closed shunt-switch for the said non-interference magnet adapted to be opened upon the operation of said motor, substantially as described.

41. In a non-interference signal-box, which is normally shunted out of circuit, a motor,

means for operating it, a retarded operative device consisting of a signal-wheel moved by the train to operate the circuit for its first time after the said train has been run a longer time than the longest closure in any signal and before the apparatus has been brought into signaling condition, a determining device comprising a non-interference magnet, its armature, a controlling-lever governed by it, which acts during such lapse of time to prevent an interfering-signal being sent, and means for opening the shunt around the magnet at or before the beginning of said lapse of time, that it may control the transmission of the signal, substantially as described.

42. In a non-interference signal-box, a motor, means for operating it, a retarded operative device consisting of a box-number circuit-controller moved by the train to operate the circuit for its first time after said train has run a longer time than the longest closure in any signal, a shunt-switch for the non-interference magnet, and another shunt-switch for the box-number circuit-controller, and means for opening the first-named shunt at or before the beginning of such lapse of time, and means for opening the last-named shunt at the end of such lapse of time, thereby bringing the apparatus into signaling condition at the end of such lapse of time, substantially as described.

43. In a non-interference signal-box, a motor, means for operating it, a retarded operative device moved by the train to operate the circuit for its first time after said train has run a longer time than the longest closure in any signal, a determining device comprising a non-interference magnet, its armature, and a controlling-lever governed by it which acts during such lapse of time to prevent an interfering-signal being sent, and a normally-closed shunt-switch for the said non-interference magnet adapted to be opened upon the operation of said motor, and a locking-lever for the train also governed by said armature, substantially as described.

44. In a non-interference signal-box, a motor, means for operating it, a retarded operative device consisting of a box-number circuit-controller moved by the train to operate the circuit for its first time after said train has run a longer time than the longest closure in any signal, a shunt-switch for the non-interference magnet, and another shunt-switch for the box-number circuit-controller, and means for opening the first-named shunt-switch at or before the beginning of such lapse of time, and means for opening the last-named shunt-switch at the end of such lapse of time, thereby bringing the apparatus into signaling condition at the end of such lapse of time, and a locking-lever for the train also governed by said armature, substantially as described.

45. In a non-interference signal-box, a motor, means for operating it, a retarded operative device consisting of a signal-wheel moved by the train to operate the circuit for its first time after the train has run a longer time than the longest closure in any signal, a non-interference magnet, its armature, and a normally-closed shunt-switch for the box-number circuit-controller controlled by the train in running, which shunt-switch is opened at the end of such lapse of time, substantially as described.

46. In a non-interference signal-box, a train, a circuit-controller for the signaling-circuit operated by it, a non-interference magnet and its armature, combined with a normally-closed shunt-switch for the said circuit-controller controlled by both the train and the armature, substantially as described.

47. In a non-interference signal-box, a train, a circuit-controller for the signaling-circuit operated by it, a non-interference magnet and its armature, combined with a shunt-switch for said circuit-controller controlled by the train in running, which is opened at the beginning of a round, and a shunt-switch for the said magnet, the closing of which is controlled by the magnet, and means independent of the action of the magnet for opening said last-named shunt-switch, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERICK W. COLE.

Witnesses:
BERNICE J. NOYES,
EMMA J. BENNETT.